ENVIRONMENTAL AND SOCIAL IMPACT STUDY

Empresa Pública de Águas EPAL - E.P.

LUANDA DRINKING WATER SUPPLY – SYSTEM 5

– QUILONGA GRANDE

September 2014

Table 1 – Register of editions / revisions of the present Report

Date	Page	Ed/Rev	Observations / Alterations

Luanda, 15 September2014

Created by:

Approved:

(Ecovisão Angola)

(Empresa Pública de Águas de Luanda, EPAL - EP)

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EXECUTIVE SUMMARY

Implementing projects, irrespective of their features and duration, is liable to introduce changes in the environment where they are implemented, causing impacts on different scales.

Environmental changes exist in Nature, and the repercussion of these depends on the regenerative capacity of the environment where they are implemented. However, when this involves anthropogenic changes, the receptive environments do not always present this adaptive capacity. This in turn creates environmental impacts depending heavily on the typology, duration, nature and surroundings. The correct assessment of environmental impacts, regarding biophysical and socio-economic issues, is of paramount relevance.

Questions related to environmental impacts – in particular to preventing and mitigating them – are dealt with by the Impact Assessment process, which strives to respond effectively to these aspects, with the aim of valuing the project in all of its dimension. This is in order to meet all of the requirements set out in the Environmental Licence, contributing overall to reaching sustainable and integrated development in the various components.

The coincides with the construction of the System 5 Luanda Drinking Water Supply project to part of Luanda, with this system also known as Quilonga Grande. This project integrates capturing water in the River Kwanza, pumping and transfer to the Water Treatment Plant (WTP), and transporting it through pipelines to 7 Distribution Centres, It furthermore includes a Water Treatment Plant of the Process (WTP) and a sludge treatment station. The aim of this Environment Impact Study Report is to obtain an environmental licence that covers all of the activities in the area being studied.

The company promoting the project, Empresa Pública de Águas de Luanda, EPAL – E.P., hereinafter named the Tenderer, contacted Ecovisão Angola to create this report, and below you will find the Registration of Ecovisão Angola at the Ministry of the Environment, granting it the authority to create this report.

Registo n.º 14
Fls 01
Livro n.º A-1

República de Angola
Ministério do Ambiente

CERTIFICADO

a) Gabinete Jurídico

Nos termos do Decreto n.º 59/07, de 13 de Julho, tendo sido cumpridas todas as formalidades previstas nos artigos 29º, 30º e 31º do referido diploma, e não havendo impedimento legal, é emitido o presente Certificado de Registo a favor de:

b) Eco Visão

Emitido em	Válido até
20/02/2014	20/02/2016

Assinatura

Director do Gabinete Jurídico

a) Direcção, Gabinete, Departamento ou Instituto
b) Consultor, Sociedade de Consultoria ou Consórcio

Figure 1 – Certificate of Ecovisão's Registration, at the Ministry of the Environment

Using a technical analysis of a project concerning the environment, it is intended to gauge the main impacts caused by executing the various phases it comprises, giving rise to this report being drawn up and that together with the Non-Technical Summary fulfil the provisions regarding the appraisal of the environmental project, namely the Environment Impact Assessment.

I. INTRODUCTION

The constant change on a global level of the planet's balances – with results such as the depletion of the ozone layer, the increased of the so-called "greenhouse effect", the loss of biodiversity, soil erosion, the exhaustion of natural resources and the change in the vision of the Earth as a living being – has increasingly been giving a planetary dimension to environmental questions. The interrelationship between these environmental issues makes resolving them ever more complex, with this situation already having been reported in 1972 at the Stockholm Conference, the First World Conference on Man and the Environment.

The experience accumulated in recent years both on an international and national level has produced a new global consciousness regarding the environmental implications of human development, translated by society's greater sense of responsibility as a whole, faced with the aforementioned implications.

Society has started to organise itself, and to demand that more effective efforts become evident on the part of world leaders in order to change the scenario of bleak predictions that has been coming to light. A new model of sustainable development is also starting to become common, whereby public and private actions and policies have to be implemented, along with investments in scientific and technological research and the adoption of new technological methods that take preserving the environment into account.

In this sense, in environmental terms companies have in recent years been attempting to comply with and implement the procedures and terms required in legislation, from the outset taking on the creation of Environmental Impact Studies and Environmental Audits. This is a role relevant for establishing sustainable development policies that aim to integrate the various components of management, with a view to sustainable development.

The assessment of environmental impact is a preventive environmental management system, and consists of the identification and prior, qualitative and quantitative analysis of the beneficial and harmful effects of a proposed activity.

The Environmental Impact Study Report involves a document of a technical nature, which is not only informative but also conclusive, containing a synthesis of the principles issues relating to the impacts on the environment where the project is being implemented, and the inherent recommendations for implementing the measures for minimising negative impacts, and for promoting positive impacts. This document is drawn up in technical language, and will be appraised by the competent bodies regarding Environmental Impact Assessment.

This in fact involves a procedure of greater relevance, since its creation (including technical and non-technical reports) will make it possible to obtain relevant elements and information relating to environmental impacts in the environment in which the project is included, allowing the reference situation of the relevant environmental, socio-economic and biophysical descriptors to be characterised in order to evaluate the changes caused by the project and even prevent this developing during the exploration phase, which will be prolonged over time and will have a more marked duration than the construction phase.

Its principal aim is to analyse and assess possible significant environmental, social and economic impacts resulting either directly or indirectly from the project – whether of a positive or negative nature – so as to determine the measures required for avoiding, minimising and compensating the negative effects generated, and even to boost the positive ones. More important in the Environmental Impact Study than identifying negative impacts is determining the mitigation measures for reducing their significance, when these are negative, so that these are reduced to values deemed acceptable and in line with the execution of the project.

The study will not focus solely on assessing impacts and preventing them, and it must define means for propagating the implementation of key measures that aim for compliance with current legislation, and minimising inconvenience for the surrounding population.

The Environmental Impact Study is an essential tool regarding decision taking in relation to implementing this project and defining the strategies inherent to it. The present report thus also includes a raft of measures and recommendations proposed for reducing the effect of the impacts of a negative nature, and boosting the effect of positive ones.

This report was created based on field work conducted in the area of the project by a multi-disciplinary team, with a view to gathering information, and with the findings being collected by means of photography verifying the observations this report contains, and in the form of a paper register.

I.1 LEGAL AND NORMATIVE FRAMEWORK

I.1.1. Angolan legal framework

In terms of Angolan legislation, the first law that focused on environmental issues was the Framework Law on the Environment, Law no. 5/98, which defines that in order to maintain propitious environment guaranteeing the population's quality of life, the least environmental impact of the actions required for developing the country is necessary. This is by means correctly organising the territory and the application of suitable techniques and technologies.

In accordance with article 15, the implementation of infrastructures in national space that – due to their dimension, nature or location – cause significant negative impact on the natural or social environment, is conditioned to an Environmental and Social Assessment process in which its social, environmental and economic viability are determined, as well as the methods for neutralising or minimising their effects.

Pursuant to the provisions of no. 1 of Article 4 of the Decree on Environmental Impact (Decree no. 51/04 of 23 June):

"The licensing of agricultural, forestry, industrial, commercial, housing, tourist processes, or those involving infrastructure, which – by their nature, dimension or location – have implications for the balance and environmental and social harmony, are subject to a prior process of Environmental Impact Assessment that entails the creation of an Environmental Impact Study (EIS) to be submitted for approval to the government body responsible for the environment".

In accordance with the provisions in **point 6**. *Infrastructure projects*, **paragraph g)** *urban development projects* of the Appendix of the aforementioned Decree, lack Environmental Impact Assessment as is the case with the Luanda Drinking Water Supply, System 5 – Quilonga Grande.

The Environmental Impact Study is to focus on various phases of the project: construction, exploration and situation in the absence of the project. The closing phase of the exploration has not been no considered, due to the time-related supply. The environmental impact study deriving from the various phases of the project will make it possible to gauge the strong and weak points regarding the execution of the project, with particular relevance in the environmental descriptors Water Resources, Ecological Factors, Socio-Economics and Waste, the allocation of which by the project presents greater impact.

The phase exploring the Supply System will be extended further in terms of time, with the impacts deriving from the activity being sized starting from when the exploration commences. The construction phase is defined in time as descriptive, in the chapter Description of the Project.

The Environmental Impact Assessment process, and in particular the documents that make up the Non-Technical Summary, will be duly appraised either by the government body formally designated for that purpose, or the National Directorate for the Prevention and Assessment of Environmental Impact (DNPAIA) of the Ministry of the Environment.

Public participation and consultation with interested parties is an integral part of the Environmental Impact Study (EIS). This point assumes particular importance in the Environmental Impact Assessment institutional procedure, as defined in **Article 10**, Public Consultations, of Decree 51/04. The aim in this phase is to listen to the different parties involved in the project, not neglecting the interested parties, thus providing them the opportunity to contribute to formulating broader decisions. These include actions that relating to them, promoting dialogue and consensus in performing the administrative role associated with the Environmental Impact Assessment, and consequently Environmental Licensing of the Supply System.

In the process of creating this ESIS, the following legal acts and regulations in force were take into consideration, insofar as these apply to the activities of the project:

- Basic Law on the Environment (Law no. 5/98);
- Rules and Procedures for Environmental Impact Assessment (EIA) (Decree no. 51/04 of 23 June 2004);
- Environmental Licensing (Decree no. 59/2007, of 13 July);
- Terms of Reference for Creating Environmental Impacts Studies (Executive Decree no. 92/12, of 01/03/2012).

- Approves the regulation of Public Consultations for Projects Subject to Environmental Impact Assessment (Executive Decree no. 87/12, of 24 February 2012);
- Fees to be paid for the Environmental License (Joint Executive Decree no. 130/09, of 26 November (Substitutes the Table attached to the Joint Executive Decree no. 96/09, of 6 October);
- National Environmental Management Programme (PNGA);
- Environmental Audits (Decree no. 1/10 (13/01/2010))
- Regulation on the Responsibility for Environmental Damage (Presidential Decree no. 194/11 (07/07/2011))
- Regulation for the Prevention and Monitoring of Pollution in National Waters (Presidential Decree no. 141/12, of 7 July 2011)
- Biological Law on Water Resources (Law no. 6-A/04 of 8 October);
- Regulation on the General Usage of Water Resources (Presidential Decree 82/14, of 21 April);
- Water Law (Law no. 6.02);
- Water Quality (Presidential Decree 26/11, of 6 October);
- Soil Law (Law no. 9/04 of 9 November);
- Law on Territorial Planning and Town Planning (Law 3.04 of 25 June);
- General Regulation on Territorial, Urban and Rural Plans (REPTUR) (Decree 2/06, of 23 January);
- Regulation on managing Waste (Presidential Decree 190.12, of 24 August);
- Strategic Plan for Managing Urban Waste – PESGRU (Presidential Decree 196/12, of 30 August);
- Legal Framework for Managing Construction and Demolition Waste (Executive Decree 17/13, of 22 January);
- Guidelines for Creating Provincial Plans for Managing Urban Waste (Executive Decree 234/13, of 18 July).

I.1.2. International requirements and project review in accordance with them

Because the project has lending and insurance requirements from sources outside of Angola, and in particular insurance through the Multilateral Investment Guarantee Agency (MIGA), an

Environmental and Social Assessment (ESIS) conforming to international (World Bank, WB) standards is additionally required. The contract for undertaking the ESIS was awarded to Artelia and the study was conducted between July and October 2014.

For this WB-compliant ESIS, the social and socio-economic impacts of the Quilonga Project are assessed according to the criteria of the environmental and social safeguard standards of the World Bank and the relevant IFC Environmental and Social Performance Standards and Guidelines. This ESIS is also compliant with the Multilateral Investment Guarantee Agency (MIGA) Environmental and Social Due Diligence Process.

I.1.2.1. World Bank Equator Principles

The World Bank Equator Principles (EP) provide guidance to financial institutions for managing environmental and social risk in project financing. The principles are voluntary but are legally binding once a financial institution joins (and are then known as an Equator Principles Financial Institution (EPFI). The Equator Principles (III) were updated in June 2013, reinforcing the ten guiding principles, which are as follows:

- Principle 1: Review and Categorisation

When a Project is proposed for financing, it is the role of the Equator Principles Financial Institution (EPFI) to categorise it based on the magnitude of its potential environmental and social risks and impacts. Using categorisation, the EPFI's environmental and social due diligence is commensurate with the nature, scale and stage of the Project, and with the level of environmental and social risks and impacts.

The categories are:

Category A – Projects with potential significant adverse environmental and social risks and/or impacts that are diverse, irreversible or unprecedented;

Category B – Projects with potential limited adverse environmental and social risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures; and

Category C – Projects with minimal or no adverse environmental and social risks and/or impacts.

This Project would be characterized as Category B. Potable water abstraction and distribution from the Kwanza River exist already, and this type of project is well known in Angola. The new infrastructure required is site-specific and readily addressed through mitigation measures.

However, it is the responsibility of the EPFI to determine categorisiation, and our characterization does not limit nor necessarily affect, EPFI categorisiation.

- Principle 2: Environmental and Social Assessment

For all Category A and Category B Projects, the EPFI will require the client to conduct an Assessment process to address, to the EPFI's satisfaction, the relevant environmental and social risks and impacts of the proposed Project.

It is considered that this ESIS Report adequately assesses the relevant environmental and social risks and impacts of the proposed Project.

The Assessment Documentation presented proposes measures to minimise, mitigate, and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the proposed Project, presented as a formal Environmental and Social Impact Assessment (ESIS).

For this Project, combined Scope 1 and Scope 2 Emissions are expected to be less than 100,000 tonnes of CO2 equivalent annually (see GHG Study, Appendix 1).

- Principle 3: Applicable Environmental and Social Standards

The Assessment process should address compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues. It is considered that this Assessment process is compliant with relevant host country laws, regulations and permits that pertain to environmental and social issues.

For Projects located in Non-Designated Countries such as Angola, the EPFI will also require that the Assessment process evaluates compliance with IFC Performance Standards on Environmental and Social Sustainability and the World Bank Group Environmental, Health and Safety Guidelines. This process has been conducted and is reported in the Section I.1.2.2 below.

- Principle 4: Environmental and Social Management System and Equator Principles

For all Category A and Category B Projects, the EPFI will require the client to develop or maintain an Environmental and Social Management System (ESMS). In this Report there is a recommended approach for establishing a Project-wide Environmental and Social Management System (ESMS) to cover the Operational Phase of the Quilonga Grande Project (Section VIII).

Additionally the EPFI will require an Environmental and Social Management Plan (ESMP) to be prepared by the client to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards. An ESMP has been prepared for this Project, and is appended to this Report (Section VII).

- Principle 5: Stakeholder Engagement

For all Category A and Category B Projects, the EPFI will require the client to demonstrate effective Stakeholder Engagement as an ongoing process in a structured and culturally appropriate manner with Affected Communities.

It is considered that a stakeholder engagement with communities potentially affected by the Project has been appropriately undertaken and is reported in the ESIS. This has been conducted in a manner culturally and legally appropriate with respect to Angolan standards.

For Projects with potentially significant adverse impacts on Affected Communities, the client will conduct an Informed Consultation and Participation process.

Identification of Affected Communities and an assessment of impact on them by the Project has been undertaken (see Section III.11.5). Conditional on detailed design elements of the Project (including the exact location of pipeline route, and detailed construction requirements for the WTW and abstraction plant including access roads) Affected Communities are not likely to suffer significant adverse impacts, if recommended mitigations are followed. Nevertheless, it is proposed, and as required by the Angolan process, that a Public Consultation will be conducted by the Angolan Ministry of Environment on submission of this ESIS Report.

This ESIS Report has also considered vulnerable segments of project-affected communities, gender issues, and indigenous peoples.

- Principle 6: Grievance Mechanism

For all Category A and, as appropriate, Category B Projects, the EPFI will require the client, as part of the ESMS, to establish a grievance mechanism designed to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance.

It is been included in the draft ESMS presented in Section VIII the recommendation to establish a grievance mechanism.

- Principle 7: Independent Review

Not relevant to this Report.

- Principle 8: Covenants

Not relevant to this Report.

- Principle 9: Independent Monitoring and Reporting

To assess Project compliance with the Equator Principles and ensure ongoing monitoring and reporting after Financial Close and over the life of the loan, the EPFI will, for all Category A and, as appropriate, Category B Projects, require the appointment of an Independent Environmental and Social Consultant, or require that the client retain qualified and experienced external experts to verify its monitoring information which would be shared with the EPFI.

A recommended Monitoring Plan is included in this ESIS Report, which should form part of the recommended ESMS. Verification of monitoring should be undertaken by the EPFI or by EPAL-EP using qualified and experienced external experts.

- Principle 10: Reporting and Transparency

For all Category A and, as appropriate, Category B Projects:

- ✓ • The client will ensure that, at a minimum, a summary of the ESIS is accessible and available online.
- ✓ • The client will publicly report GHG emission levels (combined Scope 1 and Scope 2 Emissions) during the operational phase for Projects emitting over 100,000 tonnes of CO2 equivalent annually.

It is recommended that a summary of the ESIS is reported online. There are also recommendations for GHG reporting (Appendix 1).

- Summary

The relevant World Bank Equator Principles have been adequately addressed bythis Reportand the recommendations for ESMP and ESMS are implemented.

I.1.2.2. IFC Performance Standards

The eight IFC Performance Standards on Environmental and Social Sustainability were last updated in January 2012.

- **Performance Standard 1**: Assessment and Management of Environmental and Social Risks and Impacts

Objectives

- ✓ To identify and evaluate environmental and social risks and impacts of the project.
- ✓ To adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize and, where residual impacts remain, compensate/offset for risks and impacts to workers, Affected Communities, and the environment.
- ✓ To promote improved environmental and social performance of clients through the effective use of management systems.
- ✓ To ensure that grievances from Affected Communities and external communications from other stakeholders are responded to and managed appropriately.
- ✓ To promote and provide means for adequate engagement with Affected Communities.

Summary of Project Conformance

- ✓ It is considered that this ESIS Report adequately assesses the relevant environmental and social risks and impacts of the proposed Project.
- ✓ A mitigation hierarchy, in respect of workers, Affected Communities, and the environment has been provided.
- ✓ In this Report there is a recommended approach for establishing a Project-wide Environmental and Social Management System (ESMS) to cover the Operational Phase of the Quilonga Grande Project (Section VIII).
- ✓ It is been included in the draft ESMS presented in Section VIII, the recommendation to establish a grievance mechanism.
- ✓ It is considered that stakeholder engagement with communities potentially affected by the Project has been appropriately undertaken. This has been conducted in a manner culturally and legally appropriate with respect to

Angolan standards. Conditional on detailed design elements of the Project (including the exact location of pipeline route, and detailed construction requirements for the WTW and abstraction plant including access roads) Affected Communities are not likely to suffer significant adverse impacts, if recommended mitigations proposed are followed. Nevertheless, it is proposed, and as required by the Angolan planning process, that a Public Consultation will be conducted by the Angolan Ministry of Environment on submission of this ESIS Report. It is also recommended that throughout the project cycle, EPAL-EP communicates iteratively with local communities, on issues of environmental and social concern.

- **Performance Standard 2**: Labor and Working Conditions

Objectives

- ✓ To promote the fair treatment, non-discrimination, and equal opportunity of workers.
- ✓ To establish, maintain, and improve the worker-management relationship.
- ✓ To promote compliance with national employment and labor laws.
- ✓ To protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain.
- ✓ To promote safe and healthy working conditions, and the health of workers.
- ✓ To avoid the use of forced labor.

Summary of Project Conformance

The Social Assessment has assessed PS2 conformance. It is confirmed that the Quilonga Project would meet PS2 objectives for workers employed during Construction and Operation of the facility, in line with Angolan standards for public sector employees.

It is recommended that in the ESMS, labour and working conditions are included, and objectives be subject to monitoring and review.

- **Performance Standard 3**: Resource Efficiency and Pollution Prevention

Objectives

- ✓ To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities.
- ✓ To promote more sustainable use of resources, including energy and water.
- ✓ To reduce project-related GHG emissions

Summary of Project Conformance

The most significant Project issues relating to PS3 emanating from the current ESIS process are:

- ✓ Ensuring water use efficiency through the abstraction, treatment and distribution infrastructure;
- ✓ Determining energy use requirements project for the project and associated GHG emissions; and
- ✓ Protecting the Kwanza River and ground/groundwater from pollution during Construction and Operational phases.

With respect to water use efficiency, and referring to the Section on Water Resources and Hydrology, it is clear that the Project will utilise the most modern and efficient water abstraction, treatment and distribution infrastructure. Issues of water use efficiency are addressed in this ESIS, and are also compared to the Industry Sector Guideline ‘Water and Sanitation’ (IFC, 2007) in the following Section. Recommendations are made for monitoring water usage efficiency in the ESMS framework.

With respect to energy use requirements, and referring to the Energy and GHG emissions Appendix 1, estimated carbon dioxide equivalent (CO2e) emissions for the consumption of electricity were calculated on the assumption of a total treated flow of 518,000 m3 per day, via the operation of two lines of 3 m3/s. Emissions were assessed to be approximately 62,266 tones CO2e per year, with more than 99% resulting from electricity consumption. This suggests the project is likely to exceed the EP threshold of 25,000 tonnes CO2e, for which companies are encouraged to report annually on emissions, and for which the International Finance Corporation (IFC) standards require reporting. Therefore recommendations are made for reporting and monitoring energy use/GHG Emissions for the Project.

With respect to pollution prevention, pollution problems could result from the use of hazardous chemicals during both Construction and Operation; pollution of the Kwanza River during

Construction phase; ground/ground water and air pollution during pipeline trenching Construction Phase; and pollution of surface or ground water during the Operational Phase. Measures for avoiding and dealing with pollution incidents are recommended at the Construction phase through the ESMP and Operation Phase in the ESMS documents in Sections VII and VIII.

- **Performance Standard 4**: Community Health, Safety, and Security

Objectives

- ✓ To anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances.
- ✓ To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities.

Summary of Project Conformance

The Social Assessment has assessed PS4 conformance. It can be confirmed that the Quilonga Project would meet PS4 objectives for anticipating and avoiding adverse impacts and safeguarding communities.

However, it needs to be confirmed as to the exact locations of distribution pipeline and main infrastructure; it is recommended in the ESMP, that the location of communities are avoided and protected; For example, it is understood that the community at Bairo Augusto near to the site of the Water Abstraction plant will not be negatively affected with respect to Community Health, Safety, and Security, but this needs to be confirmed and monitored during Construction and Operationsal Phases through the ESMP and ESMS.

- **Performance Standard 5**: Land Acquisition and Involuntary Resettlement

Objectives

- ✓ To avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs.
- ✓ To avoid forced eviction.

- ✓ To anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost4 and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected.
- ✓ To improve, or restore, the livelihoods and standards of living of displaced persons.
- ✓ To improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites

Summary of Project Conformance

The Social Assessment has assessed PS5 conformance. It can be confirmed that the Quilonga Project would meet PS5 objectives for anticipating and avoiding adverse impacts and safeguarding communities.

It is understood is that there will be no forced evictions and no physically displaced persons as a result of the Project. Therefore, no need to produce a Resettlement Action Plan (RAP) is triggered.

In respect of Land Acquisition it needs to be confirmed as to the exact locations of distribution pipeline and main infrastructure; in addition to ensuring that Communities are not subject to displacement there is a need to establish if there will be 'economic displacement' due to loss of agriculture, fisheries, or other economic activity that would be displaced by the Project. Our understanding is that there is no mechanism for compensation payments in relation to development projects in Angola, but there may be other land/fishing areas that could informally be used in compensation for any subsistence areas affected by the project. This item is included in the recommended ESMP.

- **Performance Standard 6**: Biodiversity Conservation and Sustainable Management of Living Natural Resources

Objectives

- ✓ To protect and conserve biodiversity.
- ✓ To maintain the benefits from ecosystem services.

- ✓ To promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.

Summary of Project Conformance

The ESIS Report has assessed PS6 conformance. It can be confirmed that the Quilonga Project would meet PS6 objectives for conserving biodiversity, maintaining the benefits from ecosystem services, and integrate conservation needs and development priorities.

The nearest 'Critical Habitats'; the Mussolo IBA (located approximately 30km west of the final section of the Project) and National Park of Quiçama (northern boundary located 8km south of the southernmost section of the Project, over the Kwanza River; would be effectively unaffected by the Project.

The main recommended conservation priorities for the project are:

- ✓ Maintaining ecological function and biodiversity of the Kwanza River during both Construction and Operational Phases;
- ✓ Minimising Construction impact on the riparian areas of the north bank of the Kwanza at the site of the Abstraction Plant, and in particular retaining mature baobab trees cultural as well as biodiversity heritage (see also PS8);
- ✓ Minimising distribution pipeline Construction Impacts by avoiding sites of biodiversity value;
- ✓ Compensation loss of flora and fauna due to site clearance by appropriate natural landscaping;
- ✓ Encouraging local conservation initiatives in the Kwanza River.

- **Performance Standard 7**: Indigenous Peoples

Objectives

- ✓ To ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples.
- ✓ To anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts.

- ✓ To promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner.
- ✓ To establish and maintain an ongoing relationship based on Informed Consultation and Participation (ICP) with the Indigenous Peoples affected by a project throughout the project's life-cycle.
- ✓ To ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples when the circumstances described in this Performance Standard are present.
- ✓ To respect and preserve the culture, knowledge, and practices of Indigenous Peoples

Summary of Project Conformance

The Section III.11.5 has assessed PS7 conformance. It can be confirmed the Quilonga Project would meet PS7 objectives, since there are no Project Impacts which affect Indigenous Peoples of Angola.

- **Performance Standard 8**: Cultural Heritage

Objectives

- ✓ To protect cultural heritage from the adverse impacts of project activities and support its preservation.
- ✓ To promote the equitable sharing of benefits from the use of cultural heritage

Summary of Project Conformance

The Section III.12 has assessed PS8 conformance. It can be confirmed the Quilonga Project would meet PS8 objectives, assuming recommendations are implemented.

The main recommended conservation priorities for the project are:

- ✓ In the ESMP, it is recommended that there would be a 'Chance Find' instruction and training procedure if artefacts are discovered during Construction Phase.
- ✓ Identify at the main sites for infrastructure construction any sites or objects of cultural importance and ensure their retention. For example, there is a culturally important baobab tree near the lagoon adjacent to the site for the Water Abstraction Plant.

- **Summary**

The relevant IFC Performance Standards have been adequately addressed by the ESIS, provided that the recommendations for ESMP and ESMS are implemented.

- **IFC Water and Sanitation Industry Sector Guidelines**

The Project has been reviewed in respect of the supporting Industry Sector Guidelines; the one applied here is 'Water and Sanitation' (IFC, 2007).

The following table sets out the Project's compliance in relation to this document.

Guideline	Project Component
Water Withdrawal Recommended measures to prevent, minimize, and control environmental impacts associated with water withdrawal and to protect water quality including:	
• Evaluate potential adverse effects of surface water withdrawal on the downstream withdrawal on the downstream ecosystems and use appropriate environmental flow assessment to determine acceptable withdrawal rates.	Included in ESMP
• Design structures related to surface water withdrawal, including dams and water intake structures, to minimize impacts on aquatic life. For example:	
• Limit maximum through-screen design intake velocity to limit entrainment of aquatic organisms.	Included in ESMP
• Avoid construction of water intake structures in sensitive ecosystems. If there are threatened, endangered, or other protected species within the hydraulic zone of influence of the surface water intake, ensure reduction of impingement and entrainment of fish and shellfish by the installation of technologies such as barrier nets (seasonal or year-round), screens, and aquatic filter barrier systems	The intake site for the Kwanza River is not considered an especially sensitive ecosystem, but protection measures will be taken including the installation of nets/filters to prevent ingress into the intake pipes. Included in ESMP
Water System Leaks and Loss of Pressure Water system leaks can reduce the pressure of the water system compromising its integrity and ability to protect water quality (by allowing contaminated water to leak into the system) and increasing the demands on the source water	Elements included in EMSP • Pipeline and Distribution System constructed to best industry practice standards; • Regular inspection and maintenance programme;

Guideline	Project Component
supply, the quantity of chemicals, and the amount of power used for pumping and treatment. Leaks in the distribution system can result from improper installation or maintenance, inadequate corrosion protection, settlement, stress from traffic and vibrations, frost loads, overloading, and other factors. Recommended measures to prevent and minimize water losses from the water distribution system include: • Ensure construction meets applicable standards and industry practices; • Conduct regular inspection and maintenance; • Implement a leak detection and repair program (including records of past leaks and unaccounted-for water to identify potential problem areas); • Consider replacing mains with a history of leaks of with a greater potential for leaks because of their location, pressure stresses, and other risk factors.	• Leak detection and repair program (including records of past leaks and unaccounted-for water to identify potential problem areas).
Solid Waste Solids removed from wastewater collection and treatment systems may include sludge and solids. Recommended strategies for the management of solid wastes include: • Select appropriate sludge treatment technologies; • Processing, disposal and re-use of wastewater treatment plant residuals should be consistent with applicable national requirements or, in their absence, internationally accepted guidance and standards.	Elements included in EMSP Sludge treatment plant constructed according to Best Industry Practice and disposal according to Best Available Technology required for Angola
Water Distribution The water distribution system is a critical component in delivery of safe potable water. Even if water is effectively treated to remove contaminants and destroy pathogens, waterborne diseases outbreaks can occur because of deficiencies in the water distribution system. Recommended measures to prevent or minimize potential community health risks associated with the water distribution system include: • Construct, operate, and manage the water distribution system in accordance with	Elements included in proposal for the ESMS

Guideline	Project Component

applicable national requirements and internationally accepted standards;
• Construct and maintain the distribution system so that it prevents external contamination from entering the water system by, for example:
  ○ Inspecting storage facilities regularly, and rehabilitate or replace storage facilities when needed. This may include draining and removing sediments, applying rust proofing, and repairing structures:
  ○ Ensuring that all installation, repair, replacement, and rehabilitation work conforms to requirements for sanitary protection and materials quality:
  ○ Testing material, soil, and water quality and implementing best practices to prevent corrosion, such as cathodic protection:
  ○ Preventing cross-connections with sewerage systems:
  ○ Separating water lines and sewer pressure mains):
• Maintain adequate water pressure and flow throughout the system, for example by:
  ○ Implementing a leak detection and repair program:
  ○ Reducing residence time in pipes :
  ○ Maintaining positive residual pressure of at least 20 pounds per square inch
  ○ Monitoring hydraulic parameters, such as inflows, outflows, and water levels in all storage tanks, discharge flows and pressures for pumps, flows and/or pressure for regulating valves, and pressure at critical points, and using system modeling to assess the hydraulic integrity of the system:
• Prevent introduction of contamination from the distribution system itself, for example by:
  ○ Minimizing microbial growth and biofilm development (e.g. by ensuring adequate residual disinfection levels). Collect samples from several locations throughout the distribution system, including the farthest point, and test for	

Guideline	Project Component
both free and combined chlorine residual to ensure that adequate chlorine residual is maintained. • Choosing residual disinfectant (e.g. chlorine or chloramines) to balance control of pathogens and formation of potentially hazardous disinfection byproducts. • Using construction materials that do not contribute to release undesirable metals and other substance or interact with residual disinfectants.	

- **Cumulative Impact Assessment**

This Report undertakes a Cumulative Impact Assessment for each Chapter or each Impact.

The most important Cumulative Impact for this Project is abstraction of water from the Kwanza River, because there are already other abstraction points in this vicinity as well as effluents from industrial users. There may also be other planned abstractions in the future, as well as other proposed activities in the zone, including oil and gas exploration in the Kwanza River basin. Running concurrently with Quilonga Grande Project is the Bita Project, and the impacts of these two projects combined on the Kwanza should be assessed.

It is clear from the Hydrology Section of the ESIS that the proposed water abstraction rates for Quilonga Grande even at the maximum capacity scenario of 9 m3/s is sustainable in context of the present average, minimum and maximum seasonal/daily flows in the Kwanza River. However, natural water availability may alter with climate change impacts, and at present, it has not been possible to assess the cumulative impacts on the Kwanza with respect to other existing, planned or possible abstraction projects.

It is important that the many users of the Kwanza River at the location of the Quilonga project, including local communities; commercial and industrial users; and indeed the beneficiaries of water distribution to Luanda, take a holistic view of the resource of freshwater supplied by the Kwanza in context of the protection of its quality, in order to ensure that the abstraction of water is sustainable over the long term.

The ESMP for this Project recommends that a Cumulative Assessment of total water abstraction requirements and provisions, together with impact on water quality from effluents and other sources is conducted during the first five years of Quilonga/Bita operation.

I.1.2.3. Multilateral Investment Guarantee Agency (MIGA) Performance Standards On Environmental And Social Sustainability

The eight MIGA Performance Standards (Extracted from http://www.miga.org/, September 2014) mirror the eight IFC Performance Standards, each with an explanatory note, as follows:

- **Performance Standard 1**: Assessment and Management of Environmental and Social Risks and Impacts

Underscores the importance of identifying E&S risks and impacts, and managing E&S performance throughout the life of a project.

- **Performance Standard 2**: Labor And Working Conditions

Recognizes that the pursuit of economic growth through employment creation and income generation should be balanced with protection of basic rights for workers.

- **Performance Standard 3**: Resource Efficiency and Pollution Prevention

Recognizes that increased industrial activity and urbanization often generate higher levels of air, water and land pollution and that there are efficiency opportunities.

- **Performance Standard 4**: Community Health, Safety and Security

Recognizes that projects can bring benefits to communities, but can also increase potential exposure to risks and impacts from incidents, structural failures, and hazardous materials.

- **Performance Standard 5**: Land Acquisition and Involuntary Resettlement

Applies to physical or economic displacement resulting from land transactions such as expropriation or negotiated settlements.

- **Performance Standard 6**: Biodiversity Conservation and Sustainable Management of Living Natural Resources

Promotes the protection of biodiversity and the sustainable management and use of natural resources.

- **Performance Standard 7**: Indigenous Peoples

Aims to ensure that the development process fosters full respect for Indigenous Peoples.

- **Performance Standard 8**: Cultural Heritage

Aims to protect cultural heritage from adverse impacts of project activities and support its preservation.

It is considered that for present purposes, since the Project has been reviewed in respect of IFC Performance Standards, that the eight MIGA Performance Standards have by proxy also been included in the project review.

I.2 IDENTIFICATION THE TENDERER

In order to conduct the aforementioned study, the Empresa Pública de Águas de Luanda (Luanda Public Water Company) EPAL-EP. , promoter of the project and hereinafter named solely the **Tenderer**, is in this case represented by the President of the Administration Council and Director General, Mr Líonido Gustavo Ferreira de Ceita, with the following contact details:

Address: Rua Frederich Engels nº3, 1387 Luanda

Telephone: 222 33 50 01/2/5

I.3. IDENTIFICATION OF THE TEAM RESPONSIBLE FOR CREATING THE ESIS

At the request of EPAL-EP., a Ecovisão Angola, Lda., was commissioned to create the Environmental Impact Study of the Luanda Drinking Water Supply project, System 5 – Quilonga Grande.

The field work and elaboration of the technical documents occurred in August 2014, with a multi-disciplinary team presented in table 1 having been responsible for creating the ESIS.

Table 1 – Ecovisão and Artelia Teams

ECOVISÃO		
COORDINATION OF THE ENVIRONMENTAL IMPACT STUDY		
Susana Palminha/Sofia Pinto		
TECHNICAL TEAM		
Sofia Pinto Rita Mena Susana Palminha	Environmental Engineering Environmental Engineering Biophysical Engineering, Territorial Planning and Management	Quality of Air, Waste and Landscape
Pedro Duarte Iracema Luciano	Geologist Biologist	Geology, Soil Usage and Planning, Water Resources and Climate
Miguel Gamboa Américo Reis Rita Mena Susana Palminha	Geographer Geographer Environmental Engineer Biophysical Engineer, Territorial Planning and Management	Socio-Economics
Pedro Martins Luna Fortunato	Biologist Finalist in Environmental Engineering	Ecological Factors
Nuno Cunha Avelino Kalungunlungo	Environment Engineer Environment Technician	Sound Environment
Ricardo Nogueira	Biological Engineer (Environmental Branch)	Sound Environment (Modelling)
Luis Castro	Archaeologist	Heritage
ARTELIA		
COORDINATION OF THE ENVIRONMENTAL IMPACT STUDY		
Dr. Mark McLellan		
TECHNICAL TEAM		
Dr. Mark McLellan	Environmental Specialist	
Manuel Trindade	Specialist in Social Studies and Angolan experienced	
Jérémy Gasc	Specialist in Climate Change and Energy Management	
Armeline Dimier	Specialist in Social Assessment	
Maud Dellong	Project Assistant	

I.4. METHODOLOGY AND GENERAL DESCRIPTION OF THE STRUCTURE

The methodology used in creating the Environmental Impact Study was defined in advance, or rather in the previous Study, to make it possible to identify, characterise and evaluate the ecological, biophysical, socio-economic and cultural aspects existing in the area of the project, the resulting impacts of its execution and the measures for minimising each impact verified.

According to the Basic Law on the Environment, Law no. 5/98 of 19 July, the Environmental Impact Assessment is classified as one of the main instruments for Environmental Management, with its execution being obligatory for actions that have implications for environmental and social balance and harmony, contributing to improving the quality of human life.

The objective of the Environmental Impact Assessment is to correlate the results obtained in this assessment with the defining and substantiating the required measures for prevention and minimisation, with the principle of avoiding passive negative effects being generated by the project itself, or if minimising and/or compensating proves impossible, proposing preventive measures as such.

Also defined within the scope of the study are the guidelines for determining monitoring plans that guarantee the process of observation and gathering data on the environment study, and on the environmental effects of the project both constituent phases, hereafter named Environmental Monitoring Plans. Identified in the Environmental Monitoring Plans are the descriptors that lack this monitoring, the respective environmental parameters to be assessed, target areas for monitoring, the phases of the project to which they apply, periodicity of the monitoring and duration of the campaigns. The Elaboration of Plans makes it possible to evaluate the state of the environment in an systematic and insightful manner, without gaps in information or subjectivity in appraising the development of the environment.

The first phase of creating the ESIS is surveying the field, making it possible to obtain information in order to perform the previous items, on the project area and its surroundings. This enables elements for characterising the Reference Situation and creating the remaining constituent elements of the ESIS, which is of essential importance, since it allows a basis for assessing impacts.

Pursuant to these objectives and in accordance with the stipulations in Decree no. 51/04 of 23 June, the methodology adopted in creating the study took approaching the following aspects into account:

- Description of the project;
- Characterising the reference environmental situation of the project-implantation area, and the surrounding area liable to be affected during the construction and exploration of the supply system;
- Forecast and assessment of the positive and negative environmental impacts liable to be caused during the phases of the project;
- Definition precautionary, minimising and/or compensatory measures for the most significant negative impacts identified, and the measures promoting positive impacts.
- Definition of the specific monitoring plans, when necessary and if applicable;

The work was developed using as a basis various environmental descriptors most suitable for the area where the project is being integrated, based on using specific methodologies for their prompt classification.

I.4.1. Assessment of the impacts

The analysis and assessment of environmental impacts derived from performing a certain project constitute a key step in defining the best alternatives, defining the preventive and minimising measures for the negative impacts and the measures boosting the positive impacts.

The methodology for assessing the environmental impacts should be coherent and comprehensive, so as to sustain the decision-process intrinsic to appraising projects.

The assessment of the environmental impacts determines — whenever possible qualitatively and quantitatively – the most significant effects associated with the different phases of the project, these being the construction phase and the exploration phase. This assessment involved elaborating the various scenarios, considering the environmental trends with the implementation of the Luanda Drinking Water Supply – System 5 – Quilonga Grande, and without its construction.

Identifying the impacts was based on qualitative methods supported by the bibliography, field work, previous experiences and expert opinions, interrelating them with the principle actions of the project and their implementation with a scenario of environmental variables evolving, and consequent alterations and direct allocations produced.

I.4.1.1. Methodology for Assessing Impacts

The qualitative assessment of environmental impacts was based on the characteristics of the impacts (see Table 3), taking the following qualifiers into account: Qualification, Magnitude, Incidence, Probability or Degree of Certainty, Duration, Occurrence or start of the Impact, Spatial Dimension, Reversibility, being the assessment performed by means of a relational matrix for assessing impacts, also known as a cause/effect matrix, in which the principle actions of the project were compared, and the environmental descriptors deemed relevant. Also distinguished in this matrix, based on the impact assessment, are the minimising measures to be implemented in each descriptor.

In order to assess the impacts, their degree of significance was taken into account, both in relation to the environmental factor and to other impacts (cumulative). The significance refers to the importance attributed to a change in the state of the environment, having been assessed on the following scale: Impact of Little Significance, Significant and Very Significant (*see* Table 3).

Table 2 – Synthesis of the methodology for assessing impacts

Nature	Classification
Qualification (reveals whether the impact is positive or negative for the environment)	Positive / Negative
Magnitude (refers to the degree of allocation on a particular factor)	Low / Moderate / High
Incidence (if the impacts results from direct actions of the project or from its effects)	Direct / Indirect
Probability or Degree of Certainty (the degree of probability of the impact occurring is revealed)	Certain / Likely / Unlikely
Duration (refers to the time scale in which a certain impact has an effect)	Temporary / Permanent
Occurrence or Start of the Impact (refers to the time phase in which the impact occurs)	Immediate / Medium Term / Long Term
Spatial Dimension (geographical area of occurrence of the impact)	Local / Regional / National / Cross-border
Reversibility (takes into account the possibility that once the impact has occurred, the system affected can return to its initial state)	Reversible / Irreversible

In an initial phase, the activities will have to be characterised as rigorously as possible, since this is in the basis for the Impact Assessment, with the following methodology being pursued for this purpose (*see* Figure 2).

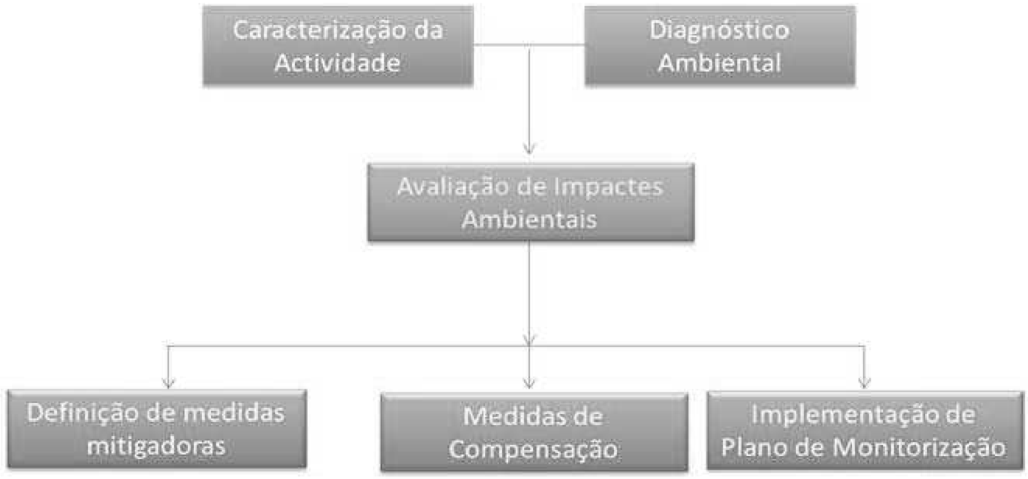

Figure 2 – Working methodology for creating the ESIS

I.4.1.2. Cumulative Impacts

The assessment of the cumulative impacts (CI) of a given project differs essentially from the general assessment of impacts, since the object of assessment becomes the resource in which the potential impacts can be sensed. In this type of project, the assessment of Cumulative Impacts is of greater relevance since in its area of implementation:

– There are already other activities (industrial units such as CIF Cement Factory, Coca-Cola factory, Cuca beer factory, sand and clay extraction units, warehouses, water-bottling units and water abstraction, among others.

– Environmental problems has already been verified (open deposit of resides and effluence, abandonment of aggregate extraction areas without restoring the landscape, among others).

The cumulative impacts are caused by the aggregation of actions taking place in the past, of present actions and even those the predicted future occurrence of which is relevant. However, cumulative impacts are the total impacts – including direct and indirect impacts in a particular resource, ecosystem and human community – of every action, independent of their origin, which is why they lack analysis in terms of resource, the ecosystem or the human community specifically affected.

The following figure presents the approach for assessing impacts, comparing the typical procedures of the ESIS and the cumulative impacts (Source: Partidário & Jesus)

Figure 3 – Schematic representation of the approach for assessing impacts and cumulative impacts (Source: Partidário & Jesus)

Contrary to that which was performed in the traditional impact assessment in which the environmental aspects affected by the project were assessed, the approach conducted in the assessment of cumulative impacts will be based on analysing other projects and actions, passed and foreseeable, that might affect a certain descriptor.

Within this scope, the analysis of cumulative impacts was considered based on the followed:

- ✓ Identifying passive impacts of presenting effects of cumulativity;
- ✓ Defining the time and spatial limits;
- ✓ Identifying other activities or actions of current, future or passed projects that promote the cumulativity of the impacts with the project being analysed;
- ✓ Assessment of the meaning of the cumulative impacts;
- ✓ Identifying the most important cause-effect relationships, between the resources, human activities and the human communities;
- ✓ Determining the magnitude and significance of the CIs;
- ✓ Modifying or adding alternatives in order to avoid, minimise or mitigate significant CIs;
- ✓ Monitoring the CIs from the alternatives selected and adapting their management.

With a view to classifying the cumulative impacts, according to the categories listed above, use was made of the expert opinions of the technicians involved in the study by considering the foreseeable thresholds of sensitivity, probability and scales of occurrence, making it possible to gauge the significance of the impacts for the different environmental variables.

It is furthermore relevant to refer to the assessment having been developed taking their occurrence phase into account, with it thus being organised in two phases (construction phase and exploration phase) in accordance with the abovementioned.

I.4.2. Structure of the ESIS

The Environmental Impact Study is divided into an Environmental Impact Study Report (henceforth solely named the Report) and a Non-Technical Summary (NTS).

The **Report**, of which this document forms a part, includes an integrated analysis of the various components studied, summarising all of the relevant information in order to support decision-making by the component bodies. This document is created using technical and scientific language.

The purpose of the **Non-Technical Summary** is to summarise the content of the study report in non-technical language, thus facilitating consultation and the general public's understanding. According to point 2 of article 10 of Decree no. 51/04, "the public consultation starts with prior disclosure of a non-technical summary of the Environmental Impact Study containing the most important effects that the project might generate in the environment, namely the use of natural resources, the emission of pollutants, the creation of disruptions (light intensity and temperature, noises and odours) or the elimination of waste; identifying the preventive measures for assessing and lessoning the effects on the environment, as well as the project's impacts on the socio-economic environment".

Law no. 5/98 of 19 June, referring to the Basic Law on the Environment, expresses in Article in 5 its objectives and measures concerning the guarantee of less environmental impact of the actions necessary in developing the country through planning the territory correctly, applying suitable techniques and technologies, and pursuant to the quality of the urban environment, where it refers in Article 16 (Environment Impact Assessment) that the Environmental Impact Study is a document fundamental for conducting EIA processes.

Based on the abovementioned Decree, the ESIS is the document of the Tenderer's responsibilities within the scope of the EIA procedure, which contains a summary description of the project, the identification and assessment of probable positive and negative impacts that performing the project might have on the environment.

According to the document referred to above, the creation of the Environmental Impact Study (ESIS) performs a synthesis of the various technical dossiers created from various angles, with the ESIS being required to present the following minimum content:

- ✓ Description of the project;
- ✓ The Environmental Impact Study Report;
- ✓ All of the project's technological alternatives, and those concerning location, comparing them with a hypothesis of not executing the project;
- ✓ Identifying and assessing the Environmental Impact generated in the project's exploration and closure phases;
- ✓ Defining the limits of the geographical area to be affected directly or indirectly by the impacts, named for each of the project's areas of influence, in all instances considering the populations, other living beings and drainage basin where it is located;
- ✓ Considering the governmental plans and programmes proposed, and under implementation in the project's area of influence, and their compatibility;
- ✓ Other elements deemed pertinent due to the project's compatibilities and characteristics.

With regard to the technical content of the ESIS, the following activities should principally be developed:

a) Environmental diagnostic of the project's area of influence, and a description and analysis of the environmental resources and their interactions, as they exist, so as to characterise the environmental situation in the areas before implementing the project;

b) Analysis of the project's environmental impacts and their alternatives by identifying, predicting the magnitude and interpreting the importance of the probably relevant impacts;

c) Definition of the mitigating measures for the negative impacts;

d) Elaboration of the guidance and monitoring programme for the positive and negative impacts, indicating the factors and parameters to be considered.

II. CHARACTERISATION OF THE PROJECT

This chapter aims to provide a summarised description of the project Luanda Drinking Water System 5 – Quilonga Grande, since it has the elements of the initial consultation as its basis (Preliminary Draft, 2013). The project is still subject to minor adaptation, such as location changes (availability issues with the sites, for instance), or technical adaptations (for the same reasons), although the broad outline of the project will be retained overall.

II.1 OBJECTIVES AND BACKGROUND OF THE PROJECT

The three existing water-supply systems in the Angolan capital Luanda (System I, II and III), (see Figure 4) are proving insufficient for supplying the growing population with drinking water.

Consequently, the Drinking Water Supply project known as System 5 – Quilonga Grande, the subject of the present study, aims to reinforce the provision of drinking water to the eastern part of the province, by implementing an abstraction plant and treatment plant with a maximum capacity of 9 m^3/s ($6m^3/s$ in the initial phase), and the respective pumping network and connection to the different distribution centres.

The water treatment is to use the latest technologies, and will guarantee the standards for drinking water defined by the World Health Organisation (WHO).

The current production of drinking water to the Province of Luanda of 5.8 m^3/s should reach 25 m^3/s thanks to the System 5 - QUILONGA GRANDE and the System IV – BITA (the latter is still to be elaborated).

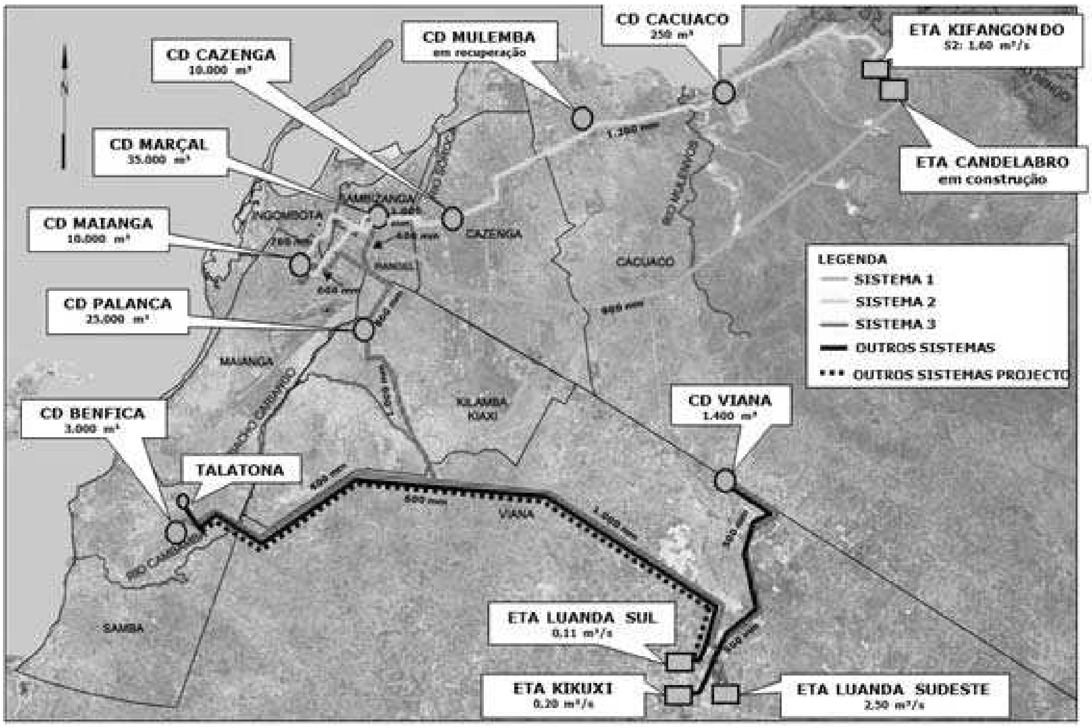

Figure 4 - Representation of Luanda's existing Water Supply system (Source: http://www.epal.gv.ao/pt)

In give an order of magnitude to the importance of the project, taking into account an equivalent daily consumption of 100 litres per person (domestic consumption and industrial needs), by 2017 the System 5 – Quilonga Grande Project will be able to make drinking water available to a population equivalent to 5 million inhabitants.

II.2 LOCATION OF THE PROJECT AND DESCRIPTION OF THE SURROUNDINGS

The project is located in the province of Luanda, with infrastructures to be implanted in the municipalities of Icolo e Bengo, Viana e Cacuaco; see Figure 5.

The water abstracted from the River Kwanza will be normalised in a treatment plant and conveyed through a powerful abduction network of more than 1000 km to 7 distribution centres (DC), consisting of tanks and pumping stations to the installations constructed. Other networks, known as "secondary" networks, will divide off from these centres, capable of transporting drinking water to homes and collectives or industrial installations.

The dimensions of the Quilonga Grande project, as well as the short period of time foreseen for achieving it, have led the company EPAL-EP. to divide the project into 10 Plots. The geographical distribution of the plots of which the project comprises is presented in Figure 6.

Table 3 – Geographical distribution of the project's plots

Plots	Province	Municipality	District
Plot 1- Water abstraction and WTP	Luanda	Icolo e Bengo	River Kwanza
Plot 2 - Network for transporting drinking water to the distribution centres		Cacuaco, Viana Icolo e Bengo	miscellaneous
Plot 3 – Cacuaco DC 2		Cacuaco	Cacuaco 2 District
Plot 4 - Zango DC 5		Viana	Zango District
Plot 5 - new airport DC		Icolo e Bengo	District Km 30
Plot 6 –Km30 DC		Viana	n/a.
Plot 7 –Capalanga DC		Viana	Capalanga District
Plot 8 –Quilonga Grande DC		Icolo e Bengo	Bom Jesus District
Plot 9 –PIV DC		Viana	Special Economic Zone District
Plot 10 – Sludge Treatment Plant		Icolo e Bengo	n/a

Legend:
DC – Distribution Centre
WTP – Water Treatment Plant
n/a – Information not available

The main accesses to the plot areas are made by highways, respectively:

- Express Way;
- Zango/Calumbo highway;
- Catete highway;
- Bom Jesus highway;
- Secondary dirt tracks;

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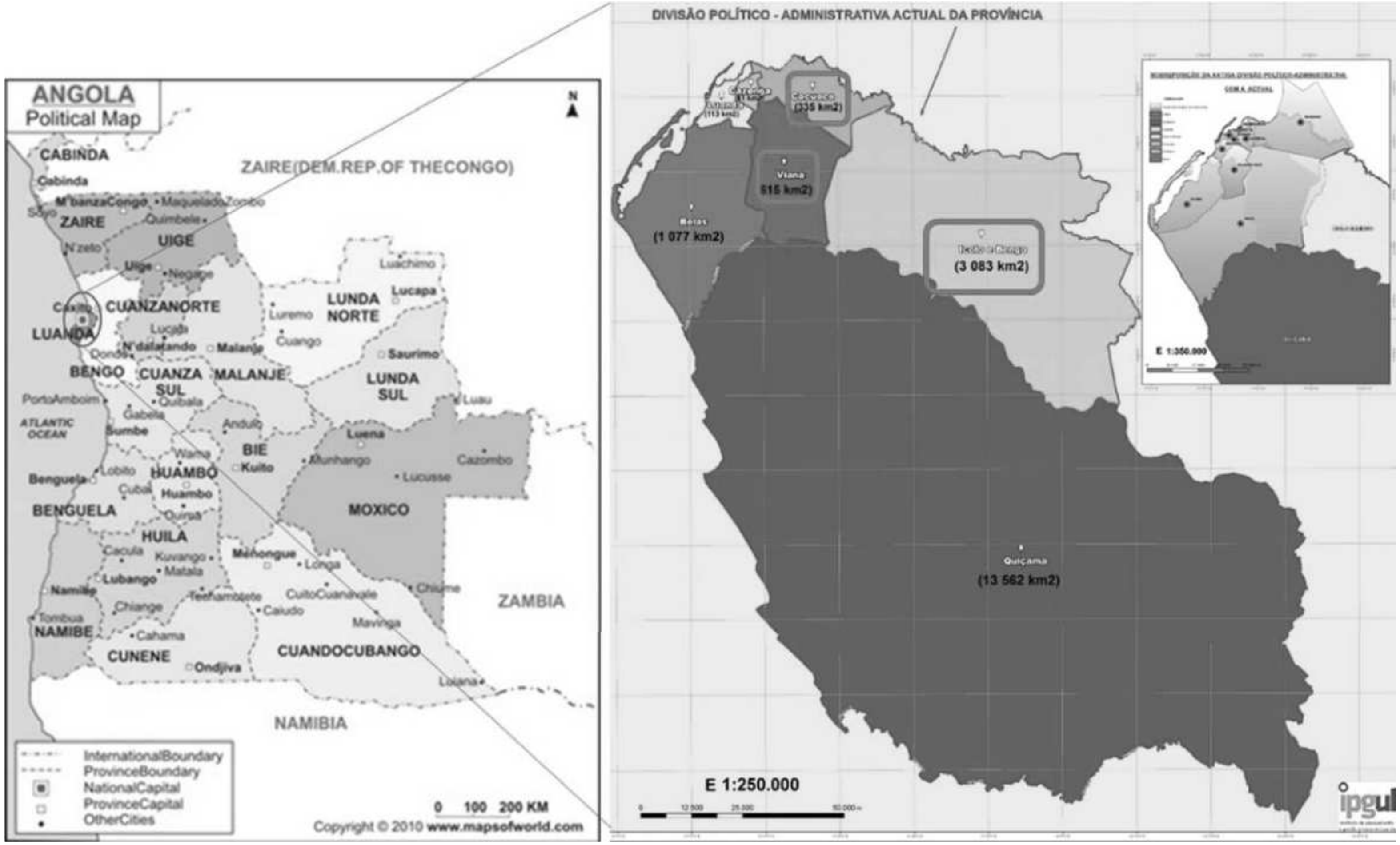


Figure 5 – Administrative location of the project at province and municipality level (Source: Municipality Atlas of Angola)

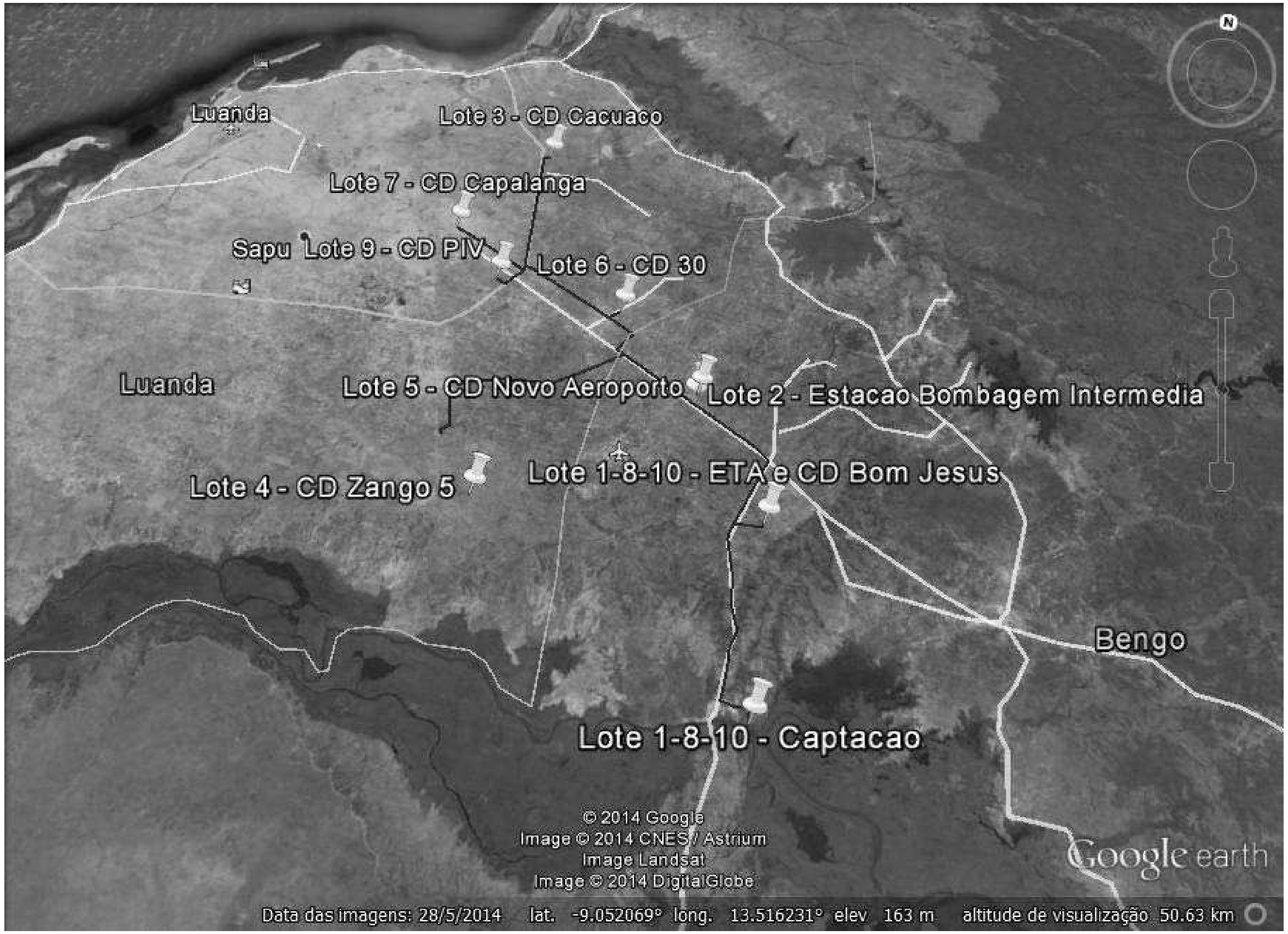


Figure 6 – Location of the project in satellite image (Source: Google Earth, 2014)

To better situate the area of the project implementation in context, presented below is a brief description of the implantation sites and their surroundings.

Table 4 – Brief description of the area of 10 plots and their surroundings (Source: Google Earth images, 2013 and 2014 and field survey)

Plot	Characterisation of the area and its surroundings
Plot 1 – Water abstraction	The abstraction site is located on the right bank of the River Kwanza. Upstream there are various industrial units such as a Coca-Cola factory, the Cuca beer factory as well as various water-bottling units. NNW of the abstraction site is the town of Bom Jesus, and NNE is the Augusto district. Access is made by the Bom Jesus road and then by dirt track.
Plot 1- WTP **Plot 8 –Quilonga Grande DC** **Plot 10 – Sludge treatment plant**	Access to the site is made by dirt track, after exiting the Bom Jesus road. The area only presents tree and bush vegetation, as do its surroundings.
Plot 2 - Network for transporting drinking water to the distribution centres	The pipe network largely follows the roadways in parallel outlines. The section connecting the abstraction to the WTP continues on land not occupied by humans that connects the Coca-Cola factory to the Cuca beer factory, and from there it follows up to the Bom Jesus road. It continues to the WTP following the Bom Jesus road. The section connecting the WTP to Plot 5 (new airport) follows the outline of the Bom Jesus road and the Catete road, toward Luanda. The connection to plot 6 and to lot 4 is made from the Catete road by dirt tracks or by land unoccupied by any housing or industry. The sections connecting plot 9 (PIV) and plot 3 (Cacuaco) are made in part parallel to the Express Way, and the reminder by secondary road. The connection to plot 7 (Capalanga) is made through the interior of a densely populated area.
Plot 3 –Cacuaco DC	Area without any housing or industrial occupation, the presence of a number of baobab trees and power poles is recorded.
Plot 4 - Zango 5 DC	Area without any housing or industrial occupation, although its surroundings are densely populated and with intense commercial activity at the site access.
Plot 5 - new airport DC	Area without any housing or industrial occupation. There are in its surroundings various industrial units, warehouses and railway lines.

Plot	Characterisation of the area and its surroundings
Plot 6 –Km30 DC	Access is made by dirt track up the Catete road, along which various industries are located. There is one dwelling in the area, and its surroundings are occupied by housing.
Plot 7 –Capalanga DC	Built area involving a football field, and its surroundings are occupied by housing, commercial sites and a hotel.
Plot 9 –PIV DC	Area without any housing or other type of usage, which is inserted in an industry and warehouse area. The DC will be constructed within the area of the DC industrial estate.

II.3 DESCRIPTION OF THE PROJECT

The project System 5 – Quilonga Grande under study is composed of 10 construction plots consisting of, respectively:

Plot 1 – Abstraction Units, Raw Water Pumping Stations, Pumping Station, Conveyance to Treatment System, Raw Water Treatment Plant (WTP), Auxiliary buildings and installations of the Distribution System;

Plot 2 – Treated-water pipes making the connecting between the WTP and the various distribution centres (DC);

Plots 3, 4, 5, 6, 7 and 9 – Distribution centres named Cacuaco, Zango, New Airport, Km30, Capalanga and PIV;

Plot 8 – Treated water reservoir situated at the end of the WTP, as well as a corresponding pumping station and an elevated reservoir, for supplying the Bom Jesus Zone;

Plot 10 – Final Treatment Plant of the Sludge produced during the treatment in the WTP (sludge originating from decanting and cleaning the filters). This treatment is installed in the WTP site.

II.3.1 Predicted activities

Plot 1

Water Abstraction

All of the raw water to be treated in the WTP will be captured in the River Kwanza, as referred to previously, and for this purpose a canal will be constructed next to the riverbanks. The canal provides for variations in the river's minimum and maximum water level, conveying the raw water through a sorting system, first coarse (30 mm), then fine (2 mm), the role of which is to remove waste (branches, etc.) transported by the river. This cleaning grills are equipped with automatic skimmers, which lift the waste up to a conveyor belt that transports them to evacuation recipients. The recipients are then sent to the final destination, by lorry.

A set of 6 vertical line-shaft pumps, with a unit flow rate of 1 m^3/second, and a TDH (Total Dynamic Head) of more than 100 m (the exact value will be determined depending on the definitive location of the works) guarantees the pumping of a total flow of 6m^3/second to the treatment station.

The pumps' electrical energy is supplied by an underground electrical line of 11 KV from the treatment station and 5 generators, with unit power of 2500 KVA installed as backup.

The pumps' motors are installed in a dry atmosphere, in a location equipped with a crane in order to facilitate maintenance. Cement partitions isolate each pump, preventing the mutual influences of the pumping, retention and blocking valves are installed upstream and downstream from the pumps, which unload into a common nucleus for the supply consisting of 2 channelling lines, which corresponds to two projected processing lines, as described below.

An important anti-water hammer device completes the apparatus, which will be equipped with suitable measuring devices (electromagnetic flow measurers).

The cleaning grills, the pumping building, the electrical sites (Medium Voltage, Low voltage, control room) the transformer and electrogenic group sites, the outside installations (circulation routes, walls, etc.) and the annex buildings (offices, security cabin) make up a architectural whole of refined quality, given its locations on the banks of the river Kwanza and in an area in full development.

The supply to the treatment station: consists of two steel pipes with a diameter of 1,200 mm, and a thickness of 8/8 inches. These two lines correspond to the 2 treatment lines of 3m^3/second constructed in the treatment station. The steel, chosen due to its resistance and the possibilities for adapting it to the site, is coated inside and outside in accordance with the standard in force (standard AWWA-C-210). The anchorage blocks guarantee resistance to the pressures exerted in the work equipped with discharges in the low points and suction cups in the higher points along the channelling. The hydropneumatic reservoirs serving the anti-water hammer devices, connected in the pipes and mentioned above, contain air supplied by a compressor and water, and may be equipped with butyl membranes, if avoiding the dissolution of air in the water is desired.

The length of the supply channels is currently 11km, after modifying the treatment centre implementation site. The longest distance (3.5 km to the origin) may justify the installation of an intermediary pumping station.

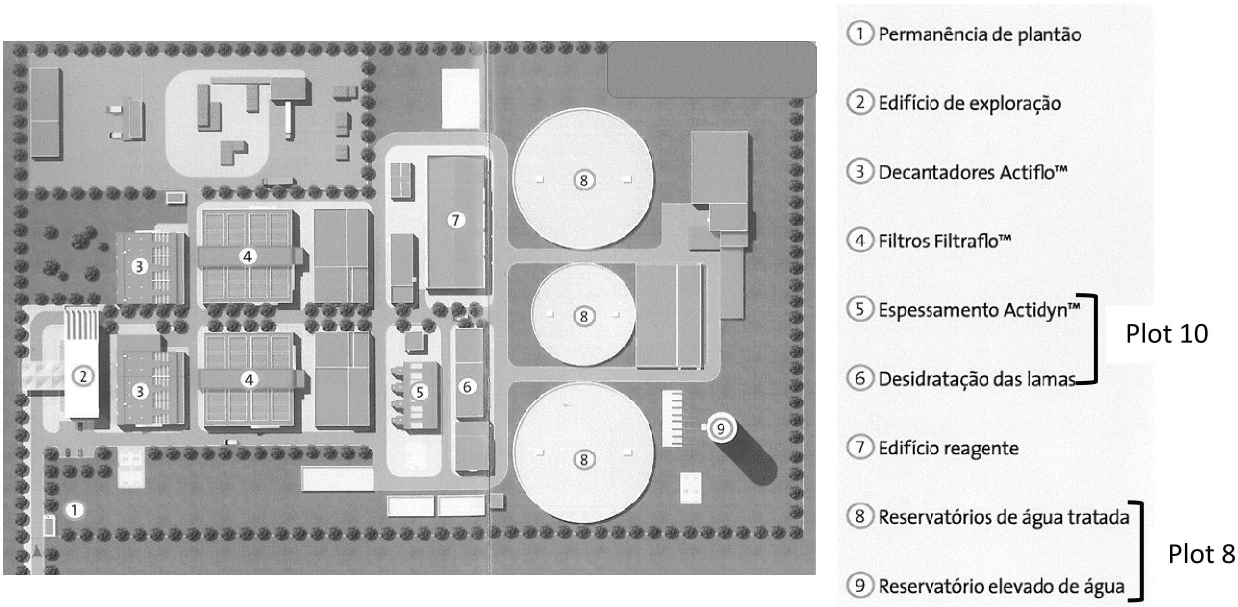


Figure 7 – View of Plot 1 (WTP) plot 10 (Sludge treatment plant) and plot 8 (DC Quilonga Grande) (Source: Epalanga Consortium, 2012)

Water Treatment Plant (WTP)

As indicated above, the station comprises two rigorously identical treatment lines with a flow of 3 m^3/second, for a total treatment of 6 m^3/second, or 518,000m^3/day. It is anticipated subsequently to add a new line of 3 m^3/second, which will increase the treated flow of the Quilonga Grande project to 9 m^3/second.

The treatment is of the classic type: decanting, filtration and disinfection. What makes it original are the modern technologies patented and implemented by the Epalanga Consortium. The Actiflo or Actidyn type equipment is compact equipment, particularly well adapted to variations in loads and flow rates.

The main parameters for analysing the water to be treated, as well as the treatment objectives to be reached in order to respect the potability standards of the WHO, are summarised in the table below:

Table 5 – Values of the parameters for raw and treated water considered for dimensioning

	Raw water	Treated water
Physicochemical parameters		
Cor (mg/l Pt-Co)	39	15
Turbidity (NTU)	43	5
pH	6.12	6.5-8.5
Aluminium (mg/l Al)	0.6	0.2
Ammonium (mg/l NH_4-N)	1.6	0.39
Iron (mg/l Fe)	1.1	0.3
Nitrates (mg/l NO_3)	---	50
Sulphates (mg/l SO_4)		250
Bacteriological parameters		
Total germs /ml	9400	0
Total coliforms /100 ml	540000	0
Faecal coliforms /100 ml	43000	0
Faecal streptococci /100 ml	93000	0

The characteristics of raw water from the river Kwanza are well known, on account of the results of analyses from the Kikuxi station in the period 2006-2010, supplied by the EPAL-EP. These results classify the quality of the water into "minimum", "medium", "maximum" and "extreme", in accordance with the seasons of the year or the climatology. It was the "extreme" quality characteristics that were retained for dimensioning the works.

The analysis of the results of the raw water defined the treatment procedures that will allow the desired objectives to be reached. Water treatment is a series of complex operations, with some interacting with others. Presented below is a brief description of the main principles of the treatment:

The first stage is to eliminate the iron, which is oxidised in an insoluble manner ($Fe(OH)_3$) in order to change its oxidisation potential. The oxidant used is chlorine, thus pre-chlorination will be performed at the top of the station.

There then follows the clarification stage for removing the turbidity and the colour. This operation is performed in a lamellar decanter, with plates arranged in the form of nests inclined to 60°, the purpose of which is to increase the decantation surface. This decanter, crossed by a ascending flow, is preceded by coagulation and flocculation vats. In these vats, the suspended materials charged with negative-charge electricity are agglomerated by adding positively charged salt (aluminium sulphate), and deposited by injecting micro sand intended to considerably increase the speed of decantation. Lastly, polymers are added to the reaction as catalysts. Actiflo is the work that combines the abovementioned vats to the decanter.

The materials decanted (known as sludge) are scraped from the bottom of the decanter and sent through the pump and hydrocyclones, which separate them from the micro sand, so that they are largely recovered. The sludge is then directed to the Actidyn thickeners, while the fluctuating waters are sent to the top of the Actiflo, after passing through UV-ray treatment, top prevent bacteriological pollution being sent back to the top.

The finer materials that cannot be decanted are then reduced in the **sand filters** in high velocity flow (for this reason, they are called "TGV filters"). A sand filter consists of a structure of slabs lined with fin tubes that allow the filter to be cleaned periodically against the air and water current, topped by a fine layer of gravel and sand with a thickness in the order of 1.20 m high.

This layer of sand is a true biological environment in which bacteria develop that eliminate the polluting materials present in the water.

The water from cleaning the filters (also known as "sludge") are also sent to the Actidyn technology. The thick and homogenised sludge is then ready for the final treatment, the object of Plot 10.

The final stage is eliminating bacteriological pollution by **disinfection** with chlorine gas. Each treatment line of 3 m^3/second (*see* Figure 7 and Figure 8) includes:

- 3 parallel Actiflo decanters, with a unit volume of 535 m^3;
- A battery of 8 sand filters, with a unit surface of 104 m^2;
- 2 Actidyn, with a unit volume of 60 m^3, one for decanting sludge, and the other for the sludge from cleaning the filters;
- 2 treatments with UV rays;

Lastly, a pumping station equipped with 6 unit flow pumps of 1m^3/second releases the treated water through the large-diameter channels (object of Plot 2) to the distribution centres, object of plots 3, 4, 5, 6, 7, 9, and from 3 final storage tanks, object of Plot 8.

Other treatments

Elimination of aluminium: aluminium precipitates at a pH between 6 and 6.5 and as coagulation can reduce the pH below 6, it is necessary to increase the value, which can be obtained by adding lime milk. The lime milk is then injected at the two of the Actiflo decanters;

Neutralisation: the water from the Kwanza is known as aggressive (low level of bicarbonates), with it being necessary to neutralise them to protect the pipes from corrosion. This operation is performed by injecting lime water into the reservoirs of treated water (after filtration). The lime water is prepared from the lime milk.

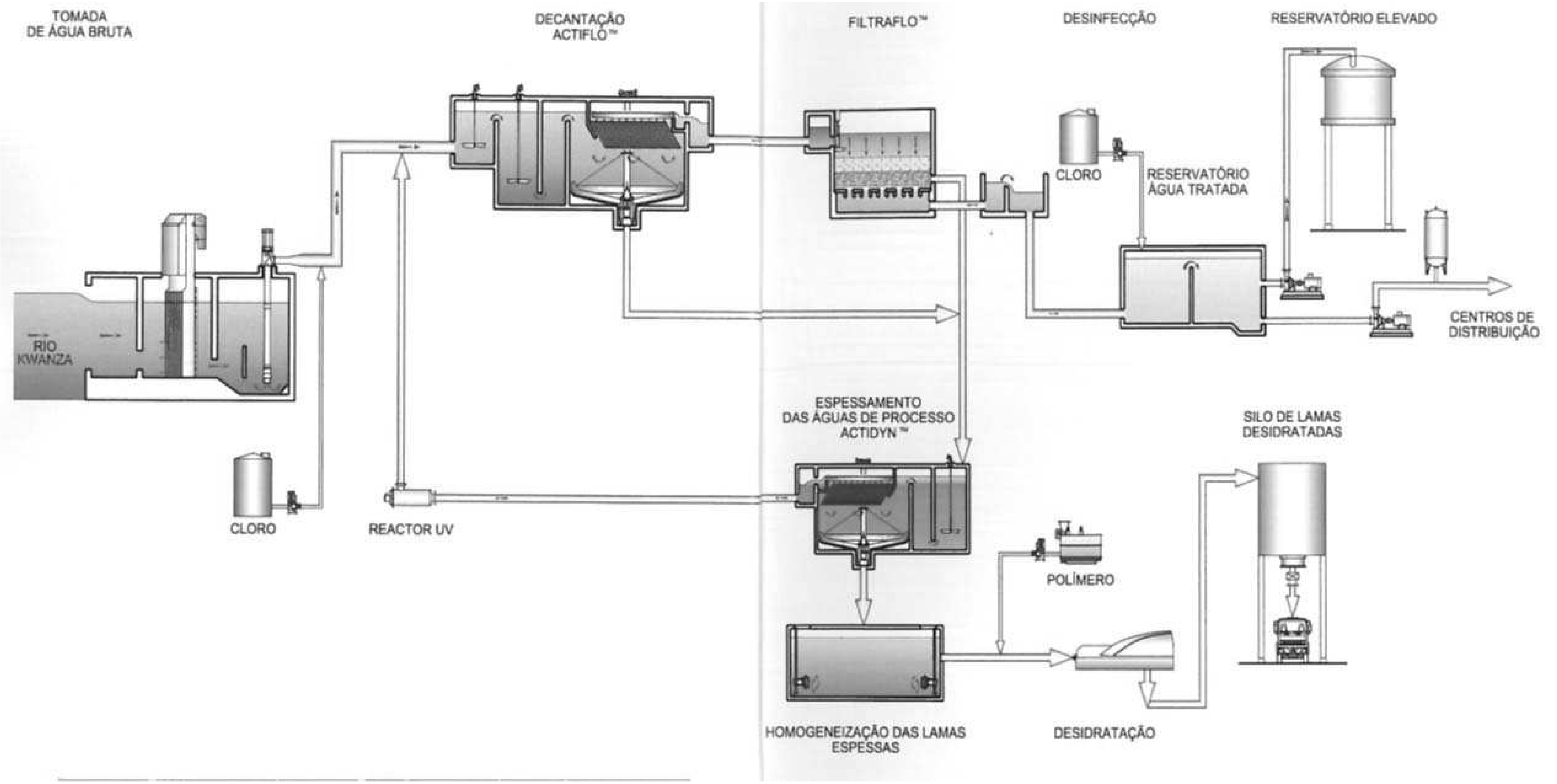
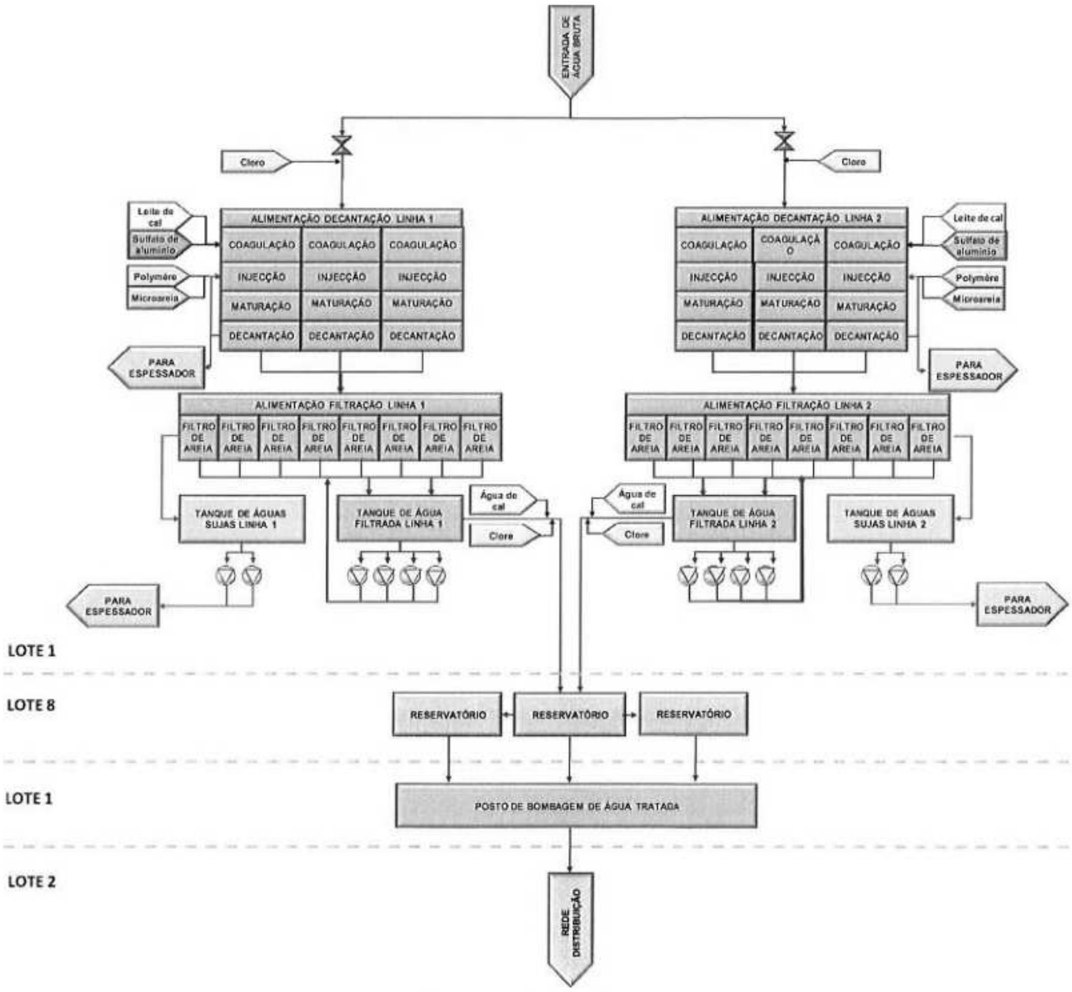


Figure 8 – Overview of the WTP and Sludge Treatment Plant treatment (Source: Epalanga Consortium, 2012)



Esquema da linha água

Figure 9 – Overview of the water treatment system (Source: Preliminary draft, 2013)

The physiochemical and microbiological treatment of raw water will be performed from the dosage of chemical products. The project thus anticipates the construction of various buildings for storing, preparing and dosing chemical products:

- Chemical-product storage areal
- Chlorination building;
- Reagent building;
- Lime-saturators building;
- Area for conditioning and dosing chemical products;

The project envisages two distinct treatment processes, are referred to above, (see Figure 10) which on one hand reduce the volume of sludge o be evacuated by dehydrating them, and on the other hand assess the overflow waters, sending them for recirculation in the WTP to be re-used on agricultural irrigation systems.

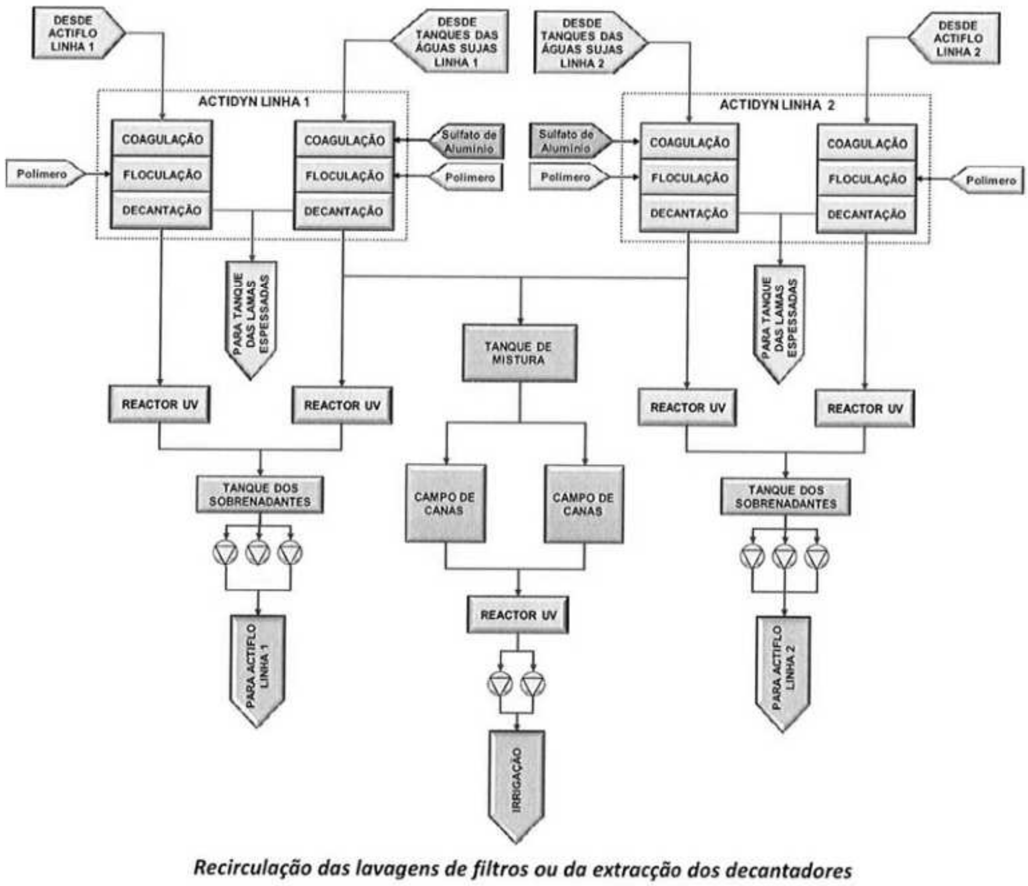


Figure 10 - Overview of the dirty-water treatment system of the WTP process (adapted from Preliminary Draft, 2013)

The dirty process water originating from the drinking-water production plant (WTP) consists of:

- ✓ Thick sludge originating from the WTP thickeners (Actiflo Decantation);

The sludge produced by the WTP is transferred to the sludge treatment installations.

- ✓ Overflow water from various hydraulic structures;

The overflow water originating from the sludge thickening from the ACTIFLO™ decanters are pumped to an ACTIDYN™ decanter thickener and recycled at the start of the treatment, after disinfection by UV rays.

The totality of the water from the FILTRAFLO™ filters is stored in a tank, pumped to the ACTIDYN™ decanter and finally sent for tertiary treatment in Plot 10.

The tertiary treatment consists of filtration on a reed bed and disinfection by UV rays, for possible re-use in an agricultural irrigation network. This final step of a possible connection to an irrigation network is outside the scope of the project under study.

However, the treatment of sludge will be specified in greater detail in the point referring to Plot 10.

Plot 2

Water transmission network

Plot 2 presents a set of drinking-water pipes from the WTP to the distribution centres,

The transmission network can be divided into 8 main sections, with each section having a different diameter. Each section will be limited by the distribution centres and, in certain cases, by derivations. The following table presents a summary of the extension to be executed by diameter, in each section.

Table 6 – Extensions by diameter and material of the water transmission network between Distribution Centres (Preliminary Draft, 2013 Descriptive Document Q2)

Section	DN (mm)	Material	Extension (m)
Abstraction - WTP – Derivation 1	2 x 1200	STEEL	2 x 10075
Derivation 1 – Derivation 2	1200	STEEL	5115
Derivation 2 - DC KM 30	500	FFD	600
Derivation 2 – DC Airport	600	FFD	6160
Derivation 1 – DC Zango	1200	STEEL	23830
DC Zango - DC PIV	800	FFD	14280
DC PIV - DC Capalanga	800	FFD	6680

Section	DN (mm)	Material	Extension (m)
DC Capalanga - DC Cacuaco	2 x 400	FFD	2 x 11120

The values of the material quantities are provided here subject to reservations, since the outlines are still subject to alterations.

The channellings are equipped with blocking valves useful at the sections for the maintenance operations, draining the bottom and suction cups at high points, and – given their size – each of these devices are placed in reinforced concrete and equipped with inspection boxes.

The stagnation of the channellings will be tested before putting them into service, in accordance with the standards in force, as well as being cleaned and disinfected before being activated.

Plot 3 to 9

<u>Distribution Centres</u>

The project envisages 7 distribution centres, with each of these being consisting of a chlorination section, reservoir, water tower, administrative building, pumping building and chlorine store. The residual water from the installation will be sent to a sceptic tank. The main characteristics of each one of the centres are presented in Tabla 8.

Table 7 – General characteristics of the Distribution Centres (Source: EPAL-EP topographical survey, 11.08.2014 and Preliminary Draft)

Distribution centre	Quilonga Grande	Km 30	New airport	Zango 5	PIV	Capalanga	Cacuaco
	Plot 8	Plot 6	Plot 5	Plot 4	Plot 9	Plot 7	Plot 3
Capacity (m^3)	50000	20000	40000	20000	50000	10000	35000
Area occupied (m^2)	87500	21980	35500	62100	26000	10175	47500
Radius of influence (ha)	N/A	6.624	9.103	3.894	7.518	5.215	5.281
Elevation/quote (m)	161	150.5	156	150	141.5	135	125
Reservoir height (m)	35	46.5	40	39	51	25	55

Legend:
N/A – Information not available

Plot 10

Sludge treatment

Plot 10 relates to the final treatment of the sludge (*see* Figure 11) produced during the water-treatment process, and is integrated at the area regarding the WTP of the Quilonga Grande, It will comprise an ultraviolet (UV) treatment, a dehydration building, a neutralisation tank, cane fields and a sludge storage area.

The thick-sludge treatment process is performed in the dehydration building that is integrated into the continuation of the sludge-thickening process. The dehydrated sludge is subsequently stored, and then sent elsewhere by lorry. The final destination of the sludge is not defined, and is outside the scope of the project.

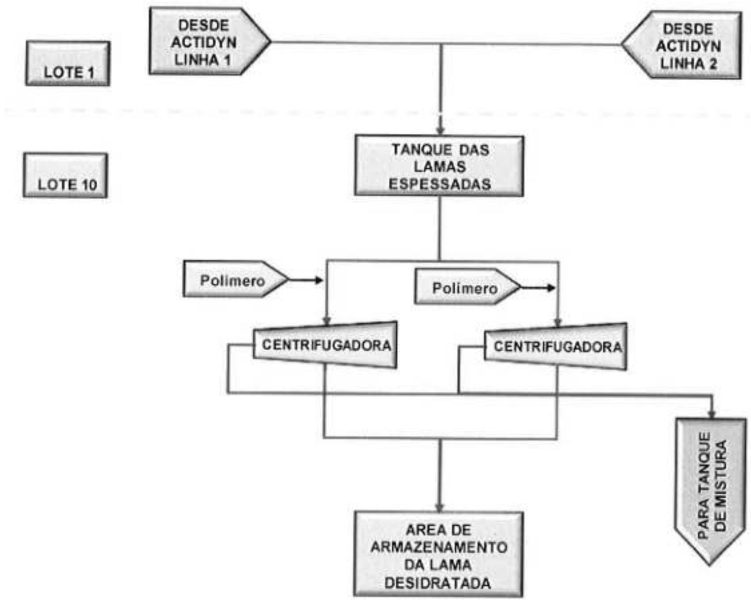


Figure 11 - Overview of sludge treatment process (Source: Preliminary Draft - Q10, 2013)

The thickened sludge from plot 1 is transferred through pumping to a 1500 m^3 homogenisation tank, also known as a thickened sludge tank, which is equipped with submersible agitators. From this step, the sludge continues to the mechanical dehydration facility consisting of two centrifuges.

The dehydrated sludge is sent to screw pumps for storage, being injected with a polymer in order to facilitate this transfer. The storage area is 480 m^3.

The overflow water is sent to a neutralisation tank and from this, a part of the flow goes to a filtration phase on a reed bed and then, disinfection by UV. The excess if sent by natural means (see Figure 12).

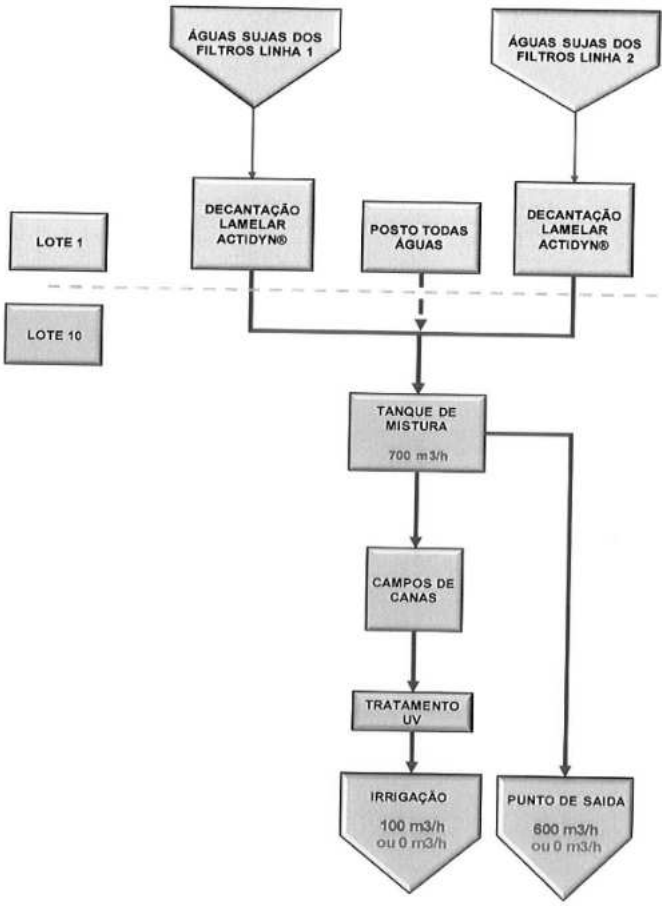


Figure 12 – Overview of the overflow-water treatment process (Source: Preliminary Project Q10, 2013)

The overflow is sent to a 195 m^3 neutralisation tank equipped with submersible agitators.

A part of this neutralised overflow is conveyed to tertiary treatment for disinfection and re-usage in agricultural irrigation networks. The neutralised excess is released into the rainwater network, and can also be disposed of into the environment.

The tertiary treatment consists of the following stages:

- Filtration on 2 reed filter beds (cane fields), with a unit surface of 175 m^2;
- Treatment with UV rays, for eliminating pathogenic germs;
- Pumping for irrigation.

This plot will be equipped with a road scale for weighing lorries transporting sludge.

Auxiliary installations

Monitoring and administration structures

In order to perform exploration and maintenance services to the WTP, a two-storey building of 656 m^2 in total will be built, consisting of reception rooms, two laboratories, bathrooms and male and female changing rooms, circulations, meeting rooms, control, archives, kitchen and canteen.

A three-storey building will be built for management and administration that will be house the reception, IT rooms, archive, offices, meeting room, maintenance room, toilets, secretariat and conference room.

II.2.2. Equipment and Consumptions

The list of equipment to be installed in Plot 1, 8 and 10 can be found **Attached**. For the remaining plots, no information is available at this phase of the project.

The energy and reagent consumptions at the exploration phase of plot 1-WTS was estimated based a treated-water flow of $3m^3/s$ of product for 20 hours a day, 365 days a year, i.e. half of the station's nominal capacity.

Annual electrical energy consumption will be 78,78,.986 kWh/year, 39.5 kWh for the abstraction installation, 37.3 kWh for the treatment, and 1 kWh for preparing the reagents.

The quantities of reagents in commercial products will be 90 tonnes of chlorine, 15 tonnes of polymers, 3,400 tonnes of aluminium sulphate, 246 tonnes of sand and 2,000m^3 of lime milk. The consumptions are differentiated in the following figure.

TRATAMENTO	QUANTIDADE CONSUMIDA	
	kg/d	kg/a
PROCESSO DE TRATAMENTO DE ÁGUA		
PRÉ-CLORAÇÃO (BOMBAGEM DE ÁGUA BRUTA) -GÁS DE CLORO 100%	28	10 249
PRÉ-CLORAÇÃO (ETA)-GÁS DE CLORO 100%	112	40 997
POLIELECTROLITO - ACTIFLO - POLÍMERO EM PÓ 95% DE PUREZA	35	12 946
LEITE DE CAL - ACTIFLO - CAL APAGADA EM PÓ 80% DE PUREZA	2 752	1 004 422
SULFATO DE ALUMÍNIO - ACTIFLO - EM PALHETA 17,5% DE PUREZA	9 210	3 361 738
MICROAREIA	674	245 981
CARBONO ACTIVADO - 100%	-	-
POLIELECTROLITO - SATURADOR - POLÍMERO EM PÓ 95% DE PUREZA	0,8	279
LEITE DE CAL - NEUTRALIZAÇÃO - CAL APAGADA EM PÓ 80% DE PUREZA	2 727	995 355
CLORAÇÃO - DESINFECÇÃO - GÁS DE CLORO 100%	216	78 840
PROCESSO DE TRATAMENTO DAS ÁGUAS SUJAS		
SULFATO DE ALUMÍNIO - ACTYDIN - ÁGUAS SUJAS FILTROS - EM PALHETA 17,5% DE PUREZA	202	73 730
POLIELECTROLITO - ACTYDIN - ÁGUAS SUJAS FILTROS - POLÍMERO EM PÓ 95% DE PUREZA	1,3	466
SULFATO DE ALUMÍNIO - ACTYDIN - ACTIFLO - EM PALHETA 17,5% DE PUREZA	-	-
POLIELECTROLITO - ACTYDIN - ACTIFLO - POLÍMERO EM PÓ 95% DE PUREZA	6,1	2 213

Figure 13 – Consumptions of reagents (Source: Preliminary draft, 2013)

II.2.3. Basic infrastructures

All of the buildings will be equipped with cooling systems, communication system, anti-intrusion systems, and fire-detection systems.

Service water and water for human consumption

Service water will essentially be used for diluting reagents and cleaning the installations. Each building consuming service water is connected by a distribution network. Water for human consumption will be supplied by the Quilonga Grande DC – Plot 8.

Compressed air

The project still envisages the installation of compressed-air production plants for manoeuvring the valves with pneumatic controls, and the station's other consumers of compressed air.

Residual water treatment

Residual water of domestic origin are sent to screening equipment and then transported to a tilting funnel for treatment on a bed of microphytes before being released into the environment.

Energy system

An energy Transformer Station (TS) will be constructed, an electrical substation, able to guarantee the supply of energy for the system to function in normal conditions and in periods of electrical failure. The TS will have an area of 68,4 m^2 that will be connected to another building for installing the generator and diesel storage.

Security equipment

To ensure the technical installations are protected, the projects foresees the provision of $C0_2$, powder and water extinguishers, and equipment for individual protection such as ear protectors, protection masks for handling reagents and gloves.

II.4. Phases of the Project

As mentioned in the previous chapters, the project will consist of two distinct phases known as the **construction phase** and the **exploration phase**.

Since the project is divided into 10 plots with various locations as well as different civil construction works, the actions to be listed in the construction phase will be the main ones to occur in each plot. There will subsequently be a more detailed description of each of the phases and activities involved:

Construction Phase:

In terms of activities, it is predicted that in Plot 1 and 10 in particular, the following be developed:

- ✓ Work-site installation;
- ✓ Ground levelling (excavations, ground movements and, prior demolitions in certain lots);
- ✓ Foundations – Special works;
- ✓ Structural Works (moulded concrete structures, scaffolding and falsework, concrete assembly scaffold, concrete structures and pre-fabricated slabs, etc.)

- ✓ Finishes (waterproofing concrete roofs, metal work and carpentry);
- ✓ Buried networks (drainage, electrics and lighting), circulation routes and access and landscape planning;
- ✓ Installations (electrics, telephony, logistics and water sanitation);
- ✓ Storey construction;
- ✓ Construction of steel piping;
- ✓ Miscellaneous (construction of fencing, wooden-structure covers, block masonry, metal structures and rolling bridges;
- ✓ Cleaning and Disinfections;
- ✓ Dismantling the work site and cleaning the area;
- ✓ (….)

<u>Exploration Phase:</u>

The second and final phase is the exploration (or usage), which will consist of:

- ✓ Operation of the WTP, sludge treatment station, DC and intake conduits;
- ✓ Maintaining all of the infrastructures;

Since the basis for the EIA is the Preliminary Draft, certain aspects such as the workforce numbers required, the duration of the works in each plot and the working hours have not yet been defined.

The Supply System will operate continually, i.e. 24 hours/day, 365 days a year. In the WTP and Sludge Treatment Station, the majority of equipment will operate 20 hours/day.II.4.1 Schedule

The construction phase of the project has a predicted duration of 3 and a half years. Its phasing will make it possible to product 3 m^3/s, or 50% of the total capacity, 10 months before the system's total operation.

Figure 14 presents the schedule for the construction phase, it can be seen that the works with the least duration are the WTP (Plot 1, 8 and 10) and those of the DC New Airport (Plot 5) and DC PIV (Plot 9).

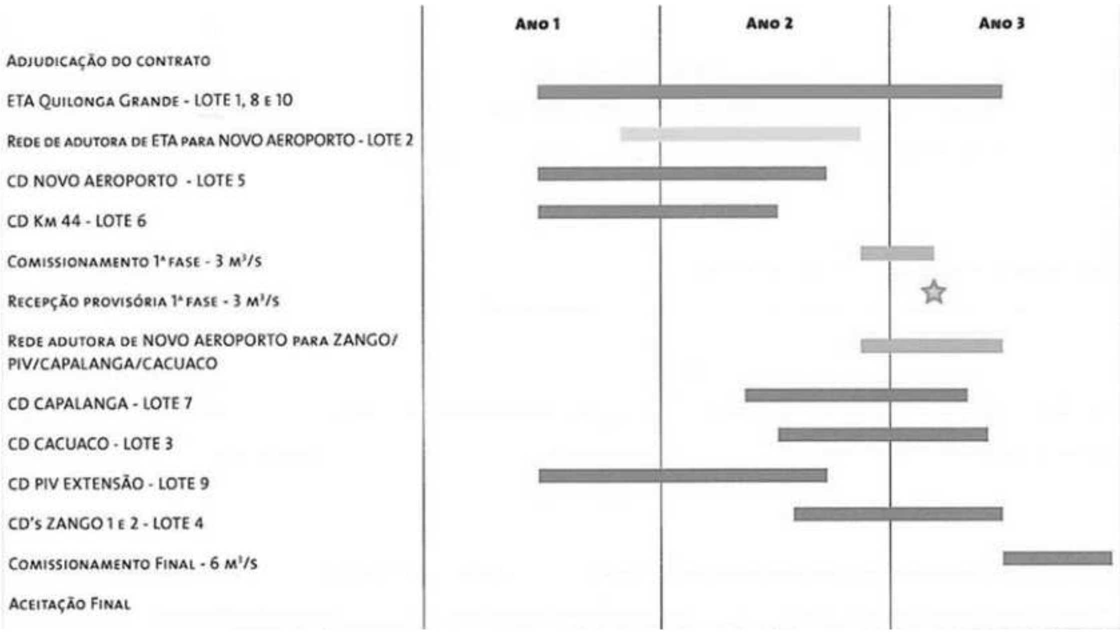


Figure 14 – Schedule for the construction phase of the project

II.5. ASSOCIATED OR COMPLEMENTARY PROJECTS

The project also integrates the electrical supply of the WTP from the electrical pole of the high-voltage electrical Substation "Aeroporto Dr. Agostinho Neto". This connection *(see* Figure 15) will be air type 60kV, consisting of around 56 electrical poles and sized 30 MVA power (adapted from Descriptive Document Q1-Preliminary Project, 2013).

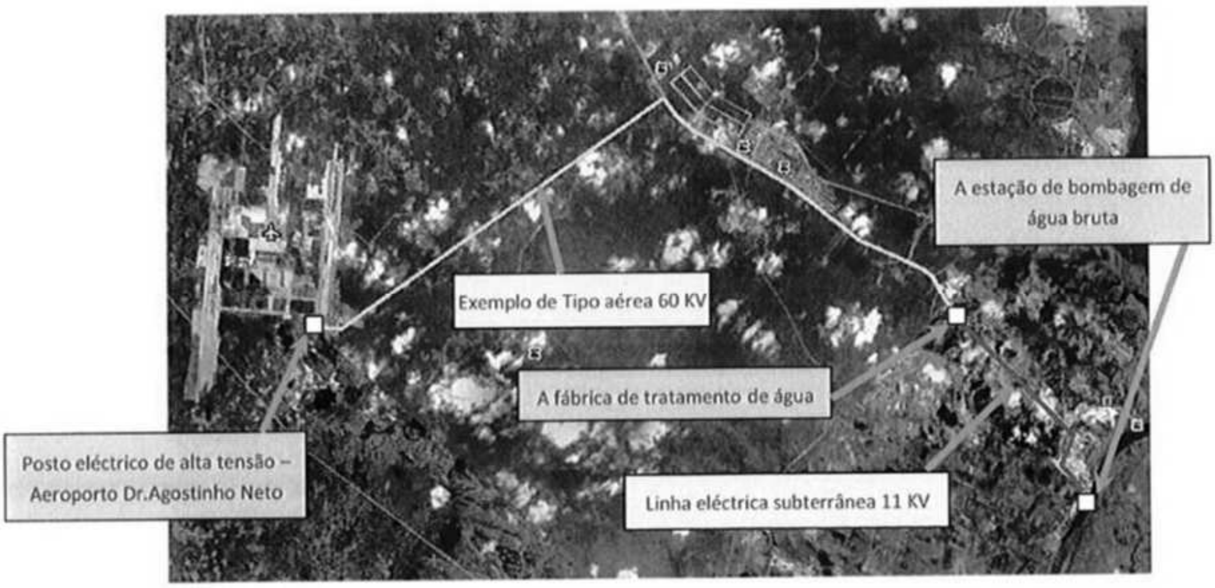


Figure 15 – Location of the WTP electrical supply project

Installed at the entrance of the WTP are an electrical pole of protection/block/transformer type, as well as a 60/11 KV transformer, or 30 MVA power. Auxiliary transformers of 11 KV / 400V are also installed at different points of the station in order to supply the equipment. The Low-Voltage 400V/230V Distribution/230V undulated frames complete the device.

In the raw-water pumping station, 5 generators with a unit power of 2,500 KVA assisting the High Voltage will be installed.

II.6. MATERIALS AND ENERGY USED

Various energy sources and materials will be used during the two phases analysed of the project, in accordance with the specific needs of each of the phases.

Performed below is a synthesis of the main materials and energy sources used during the construction and exploration (see Table 9).

Table 8 – Materials and Energy sources used in the phases of the project

Project phase	Resources
Construction	**Materials**
	Topsoil
	Equipment maintenance materials
	Various construction materials
	Piping in various materials
	Metal structures
	Metal security railings
	Water
	Concrete
	Cement
	Sand and other crushed aggregates
	Various floorings (e.g. asphalt)
	Wood
	Tile and other ceramic elements
	Paper and cardboard
	Various electrical materials
	Geo-synthetic materials
	Metal structures
	Paints and coating materials
	Various plastics
	Plaster
	Iron
	Energy
	Electricity
	Fossil fuels (diesel)
	Gas
Exploration	**Materials**
	Chemical products for WTP and WTSP • Chlorine gas; • Sodium hydroxide; • Fluorosilicic acid; • Cationic polymer; • Aluminium polychloride. • Aluminium sulphate (coagulant)
	Water
	Installation maintenance and conservation materials
	Office materials
	Energy
	Electricity
	Fossil fuels (diesel)

II.7. EFFLUENTS, WASTE, ATMOSPHERIC EMISSIONS AND NOISE

Considering the activity under study and the typology of the project at hand, it is possible to prevent effluents, solid waste, atmospheric emissions and noise being produced, as can be seen in Tabla 10..

Table 9 – Effluents, Waste and Emissions emitted in the construction and exploration phase

Project phase	Effluents, waste and emissions predicted
Construction	**Liquid effluents**
	Residual domestic water
	Equipment-cleaning water (concreting)
	Waste
	Waste from maintaining mobile equipment
	Earth from excavation
	Waste from clearing and scouring
	Waste from construction and demolition
	Lubrication oils and masses
	Paper and cardboard; plastics; paper and cardboard packaging; plastic packaging
	Metallic and non-metallic waste
	Solid domestic waste
	Atmospheric emissions
	Dust originating from demolition works
	Dust and gasses originating from vehicle circulation and equipment operation
	Combustion gasses from generator operation
	Sound emissions
	Emission of noise due to activities of the works (concreting, handling equipment, etc.)
	Emission of noise generated by circulation of vehicles

Exploration	**Effluents**
	Residual domestic water
	Residual water from the process for irrigation (100 m^3/h)*
	Residual water from the process for natural environment disposal (600 m^3/h)*
	Waste
	Solid urban waste
	Paper/cardboard and/or plastic packaging (contaminated or non-contaminated)
	Sludge resulting from Sludge Treatment Station (97 m^3/dte)
	Various contaminated packagings (paints, diluents, oils and detergents, chemical products)
	Waste from equipment maintenance (electro-pumps, etc.)
	Paper and cardboard
	Paper and cardboard
	WEEE - waste electric and electronic equipment
	Inks and toners
	Atmospheric emissions
	Gasses and particles from vehicle circulation and mobile equipment;
	Gasses from combustion, circulation and operation of equipment
	Sound emissions
	Noise emissions generated by vehicle circulation (sludge transportation to elsewhere)
	Noise emission generated by equipment operation (pumps, generators, etc.)

(*) values indicated in the Preliminary Draft

III. Characteristics of the Reference Situation

This chapter characterises the current state of the environment in the study area for the different environments that may be affected by the project. The characteristics of the reference situation were based on evidence collected from field trips and studies, and used available maps of the area and other bibliographic references. This characterisation should make it possible to predict possible future developments in the areas affected by the project and their influence in construction and operation phases.

The documentation used in the preparation of this document include:

- Military maps (IGCA);
- Maps used by the FAO;
- Dynamic Angola Municipalities Atlas;
- Geographical Atlas of Angola;
- Other bibliographic references.

The field studies provided a detailed framework for the descriptors that were analysed, which are shown in Table 11.

Table 10 - Environmental Descriptors analysed in the study

<table>
<tr><th colspan="3">Environmental Descriptors</th></tr>
<tr><th>Physical</th><th>Biological</th><th>Social</th></tr>
<tr><td>Climate</td><td rowspan="4">Ecological Factors</td><td rowspan="2">Socio-Economy</td></tr>
<tr><td>Geology</td></tr>
<tr><td>Water Resources (Water Quality and Pollution Sources)</td><td rowspan="2">Land Use and Planning</td></tr>
<tr><td>Noise</td></tr>
<tr><td>Air Quality</td><td rowspan="3">Landscape</td><td rowspan="3">Regional framework, Heritage</td></tr>
<tr><td>Soil</td></tr>
<tr><td>Waste</td></tr>
</table>

The classification process of the environmental descriptors also included a study and analysis of all information available from official bodies.

The following chapters describe the reference situation for each of the relevant environmental descriptors.

III. 1. CLIMATE

The characterisation of the region's climate has a bearing on this study because of its influence on the hydrologic cycle, and particularly on water availability, flow regimes and soil erosion. The climate also determines the type of vegetation that can be incorporated in the project area to try to minimise negative impacts. This characterisation is in general based on parameters of temperature, rainfall and atmospheric humidity.

Most of Angola is subtropical and has a dry season (Cacimbo) and a rainy season.

According to the Atlas of Angola for secondary schools (2008 edition), Angola is divided into four climate zones: highlands, tropical desert, tropical damp, and tropical dry. The project area is in this last zone.

The dynamic map of Angola divides the territory into seven climate zones: the warm, dry coastal climate (of which the project area is located); the warm semi-arid region; the warm rainy northern plains; the warm rainy sandy North; the cool damp central plains; the cool rainy sandy East; the dry sandy South.

Among other classifications, Figure 16 shows Koppen-Geiger's climate classification for Angola. This particular classification shows that the project area lies in an arid region (warm/steppe).

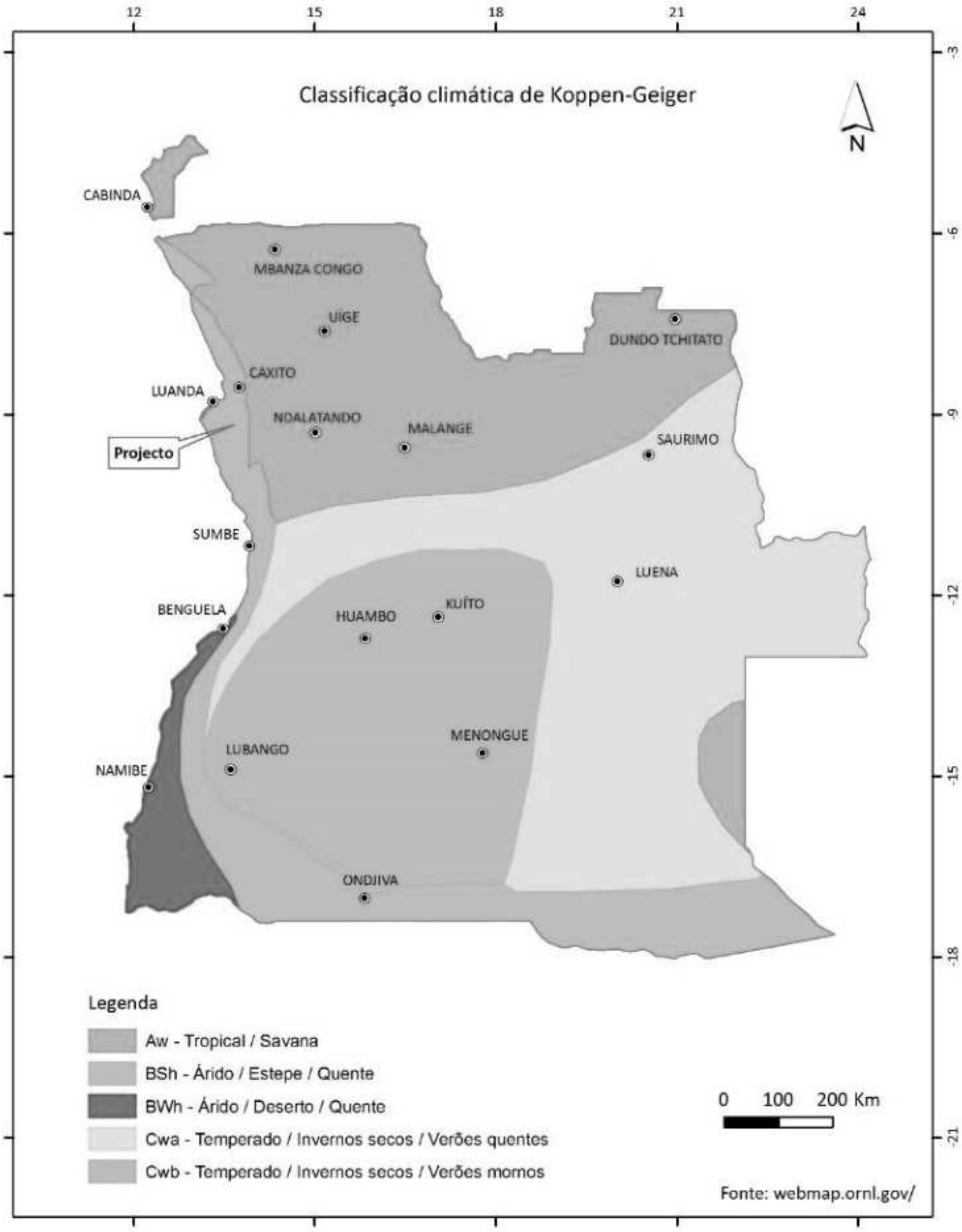


Figure 16 - Koppen-Geiger Climate Classification for Angola

III. 1.1 Temperature

There are significant geographical differences throughout Angola in relation to average annual temperatures, with the lowest temperatures recorded in the region of Huambo and Lubango and the highest temperatures recorded in Luanda and Ndalatando and part of the province of Zaire.

There are also significant seasonal variations in temperature in other regions of Angola. This is not the case in the region for the project, which shows no seasonal fluctuations of over 12ºC.

The lowest temperatures are in July and August (approx. 19 ºC) and the maximum temperatures are between February and April (approx. 31 ºC) (Table 12 and Figure 17).

Table 11 - Minimum, average, and maximum temperatures in the region of Luanda

	Min. air temp (ºC)	Av. air temp (ºC)	Max. air temp (ºC)
JAN	23.8	26.8	29.6
FEB	24.7	27.9	30.9
MAR	24.6	28.1	31.2
APR	24.4	27.5	30.8
MAY	23.6	26.4	29.6
JUN	20.6	23.7	26.7
JUL	19.0	22.3	25.0
AUG	19.1	21.9	25.4
SEP	20.3	23.3	26.3
OCT	22.2	24.4	27.9
NOV	23.4	26.4	29.2
DEC	23.6	26.5	29.2
YEAR	22.4	25.4	28.5
Source: www.inamet.ebonet.net/NormaisClimatologica.htm			

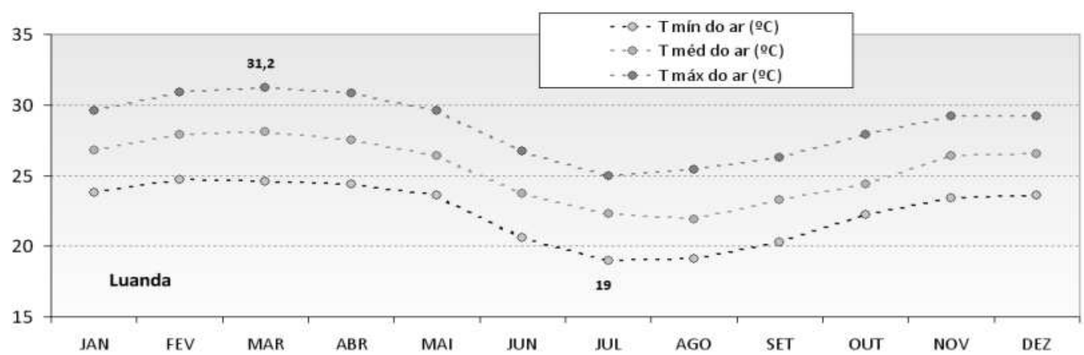


Figure 17 - Graph showing the evolution of minimum, average, and maximum temperatures in the Luanda region

III. 1.2 Rainfall

Rainfall in Angola is influenced by the centre of high pressure in the South Atlantic, by the cold Benguela current, and by its altitude. The average annual rainfall decreases from North to South and increases with altitude and distance from the sea. The most mountainous regions north of Huambo and in northern Angola have higher rainfall, with over 1000 mm annually.

The data available from http://www.inamet.gov.ao/ was used to draw up Figure 18, which highlights the geographical distribution of the monitoring stations network (although with lesser representation in the provinces of Lunda Norte, Kwanza-Norte, Moxico, Cuando-Cubango and Cunene) and the geographical heterogeneity of the amount of rainfall.

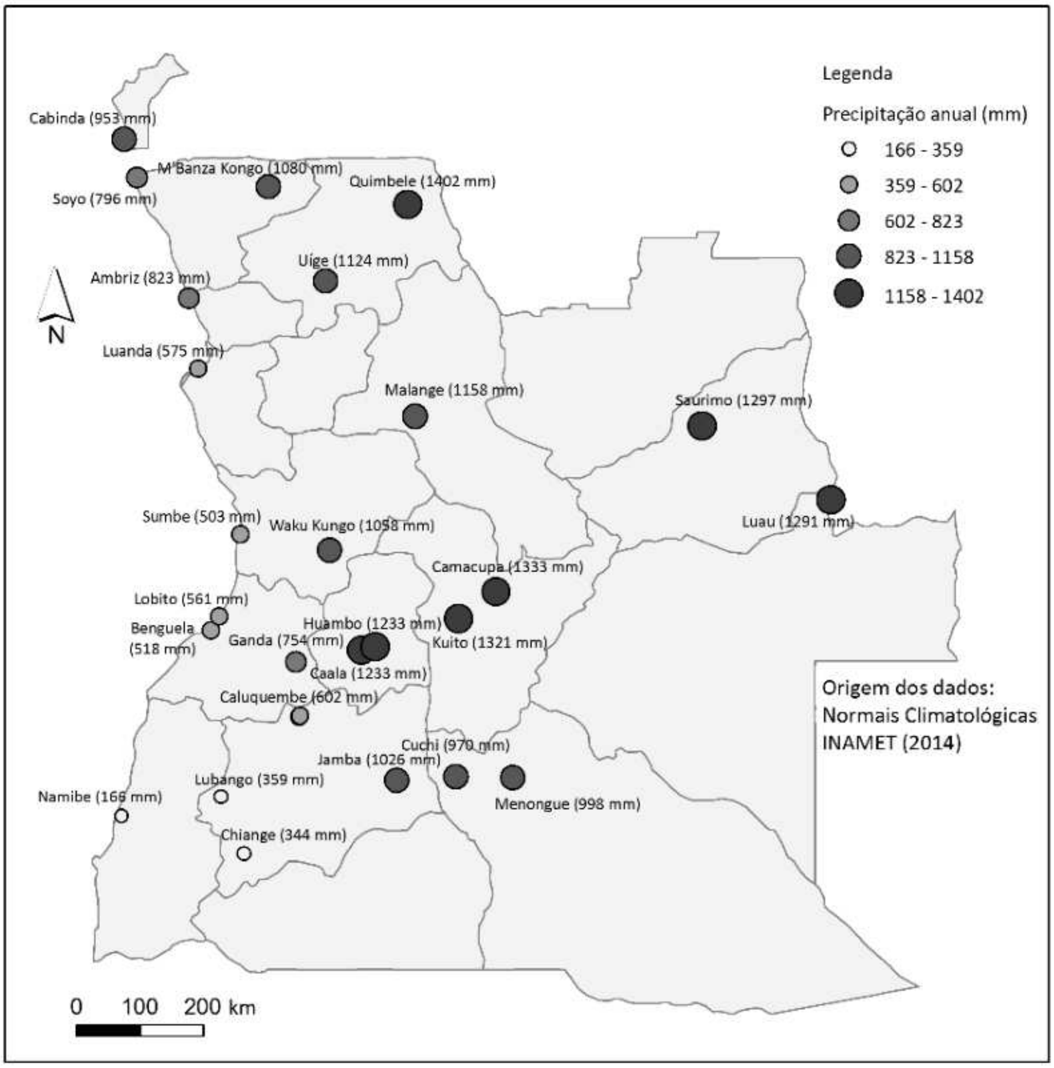


Figure 18 - Average annual rainfall from the 27 monitoring stations in Angola

According to data recently published by UNAMET, in Luanda the average annual rainfall is around 575 mm, and the rainy season is considered as the period between November and April (Table 13).

Table 12 - Monthly rainfall data for Luanda (Climate Normals)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Rainfall (mm)	52.7	53.2	133.3	162.0	24.8	0	0	0	6.0	21.7	69.0	52.7	575.4

Source: http://www.inamet.gov.ao/ (accessed September 2014[1])

However, the Climate Normals for the period between 1931 and 1960 show a lower average of 368 mm (SMN, 1965).

There is considerable inter-annual variability in rainfall with differentials of 780 mm (e.g. in 1916 there was 854mm of rain and in 1914 there was only 73mm). For the data[2] for the period between 1901 and 1952 (52 years of data), the average rainfall was 335mm with a median equivalent to 316mm (Figure 19). Although this data relates to the more distant past, it is compatible with the Climate Normals for the period 1931-1960, and is well below the average value provided by the Angolan National Institute of Meteorology and Geophysics (Table 13).

From an examination of Figure 19 and Figure 20 one can also see that:

- There are several periods of two, three or four years in a row with annual rainfalls of less than the average value of the data series.
- The annual rainfall of the rainiest year was 11 times greater than that of the driest year;
- The least rainy months are in June, July and August (90% seeing less than 1 mm per month);
- 93%[3] of the annual rainfall falls in the six months of the year from November to April.

[1] The time series for the data is not known.
[2] Source: Meteorological and climatological elements - Angola, 1952 (Meteorological Service of Angola, 1953)
[3] Average Value. In these six months, the lowest percentage of annual rainfall is 69% (seen in 1943). In 1924, these same six months saw 100% of the annual rainfall.

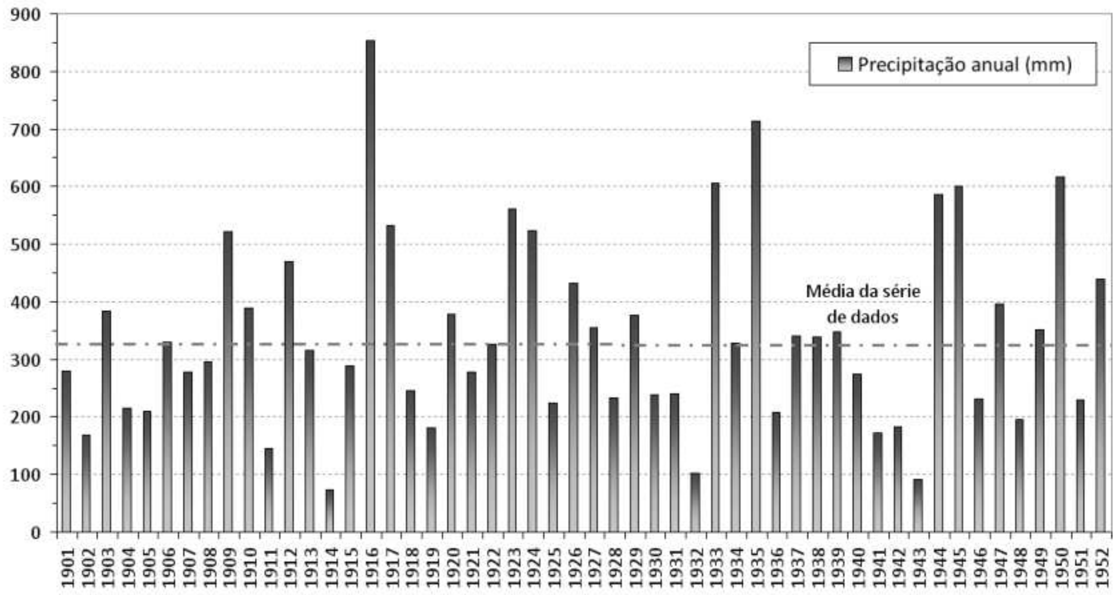


Figure 19 - Evolution of annual rainfall in the period 1901 - 1952 at the "João Capelo Observatory" in Luanda

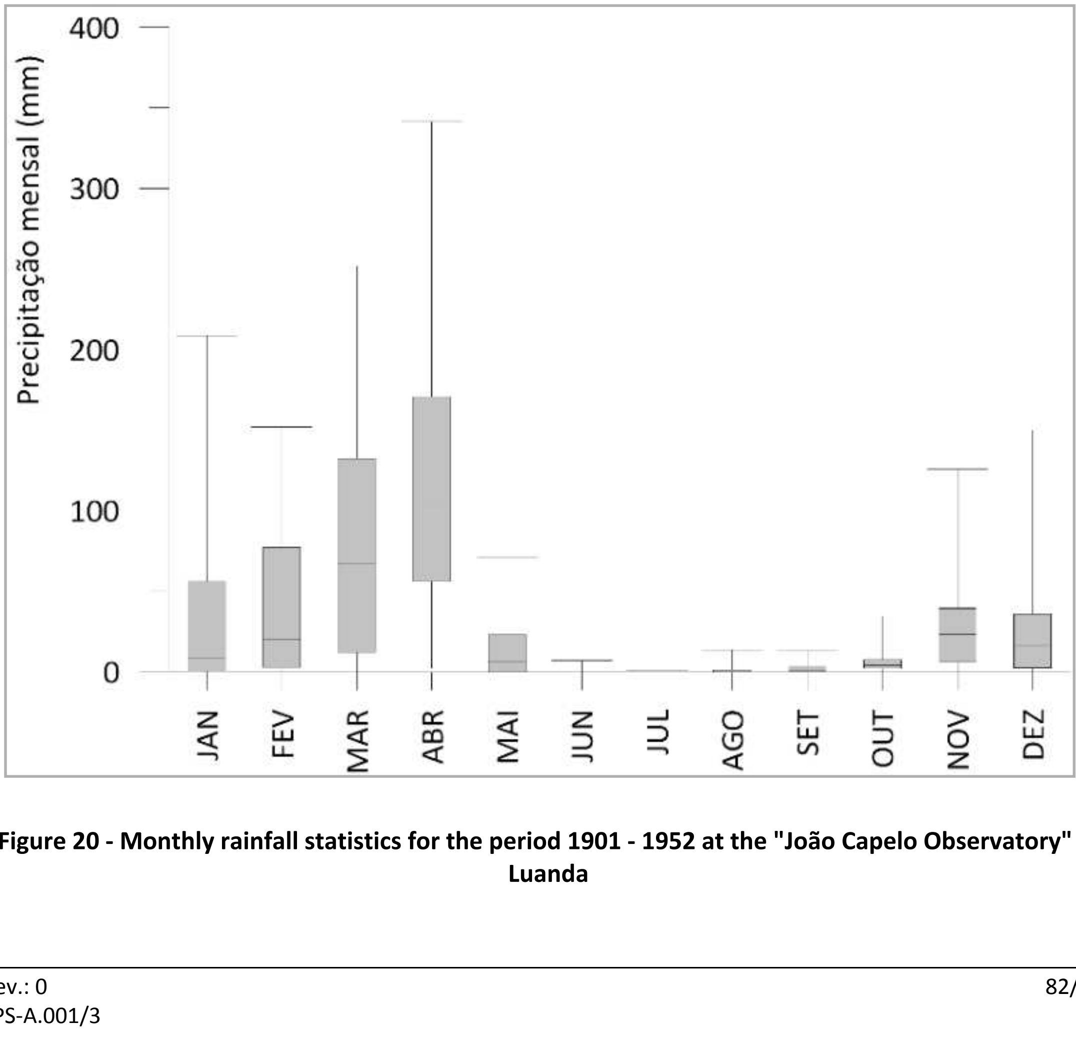


Figure 20 - Monthly rainfall statistics for the period 1901 - 1952 at the "João Capelo Observatory" in Luanda

Records for the years of 1931 and 1960 show that the maximum daily rainfall was 149mm. The maximum daily figures according to month are shown in Table 14.

Table 13 - Maximum daily rainfall in Luanda (Climate Normals for the period 1931-1960)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Maximum daily rainfall (mm)	132.2	82.5	147.7	149.0	58.8	4.8	1.0	5.0	5.4	19.5	62.7	39.7

III. 1.3 Atmospheric humidity

Atmospheric humidity is the amount of water vapour in the atmosphere. It is important to measure it as it affects the air temperature and the speed of evaporation of water from the soil surface. Additionally, the condensation of water vapour into the atmosphere can influence other phenomena such as fog and rain. Relative humidity, together with temperature, solar radiation and wind speed, influence certain important aspects including farming and general well-being.

According to the data provided by the Angolan National Institute of Meteorology and Geophysics (UNAMET), the average atmospheric humidity in Luanda is 78%. There is not a great deal of seasonal variability, with the lowest values seen in the month of February and the highest in the months of April, May, July, August and September (Table 15).

Table 14 - Monthly values showing the relative atmospheric humidity in Luanda

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Relative Humidity (%)	76	74	77	80	80	78	80	81	80	78	77	77

Source: www.inamet.ebonet.net/NormaisClimatologica.htm (accessed 2013)

These values are consistent with the mean values obtained for the thirty years between 1931 and 1960 (Table 16). In Table 16 one can see there are consistently fewer readings taken at 15:00h than those taken at the start of the day (at 9:00h), and than those taken at the end of the day (which are measured at 21:00h) for the maximum daily values.

Table 15 - Climate Normals for relative atmospheric humidity, measured at three different times of day, for the period 1931-1960, at the João Capelo Observatory in Luanda

Relative Humidity (%)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
9:00h	78	76	78	83	82	81	82	84	81	80	81	78
15:00h	74	71	73	77	77	74	77	77	76	75	76	74
21:00h	84	81	82	87	88	86	87	88	88	84	84	84

III. 1.4 Wind patterns

Analysis of wind patterns was based on the climate normals registered at the João Capelo Observatory (Luanda), for the thirty years between1931-1960.

According to these data from the João Capelo Observatory:

- With the exception of the month of July (with SW prevailing winds), the prevailing winds are from the West at all other times (Figure 21);
- The prevalence of these W and SW winds is more marked in the months of October and November.
- Average wind speeds (from those recorded over 1 km/h) do not exceed 22 km/h and three quarters of these are below 12.9 km/h.
- The periods with wind less 1 km/h are most common in the months of July and August, and least common in the months of October and November.

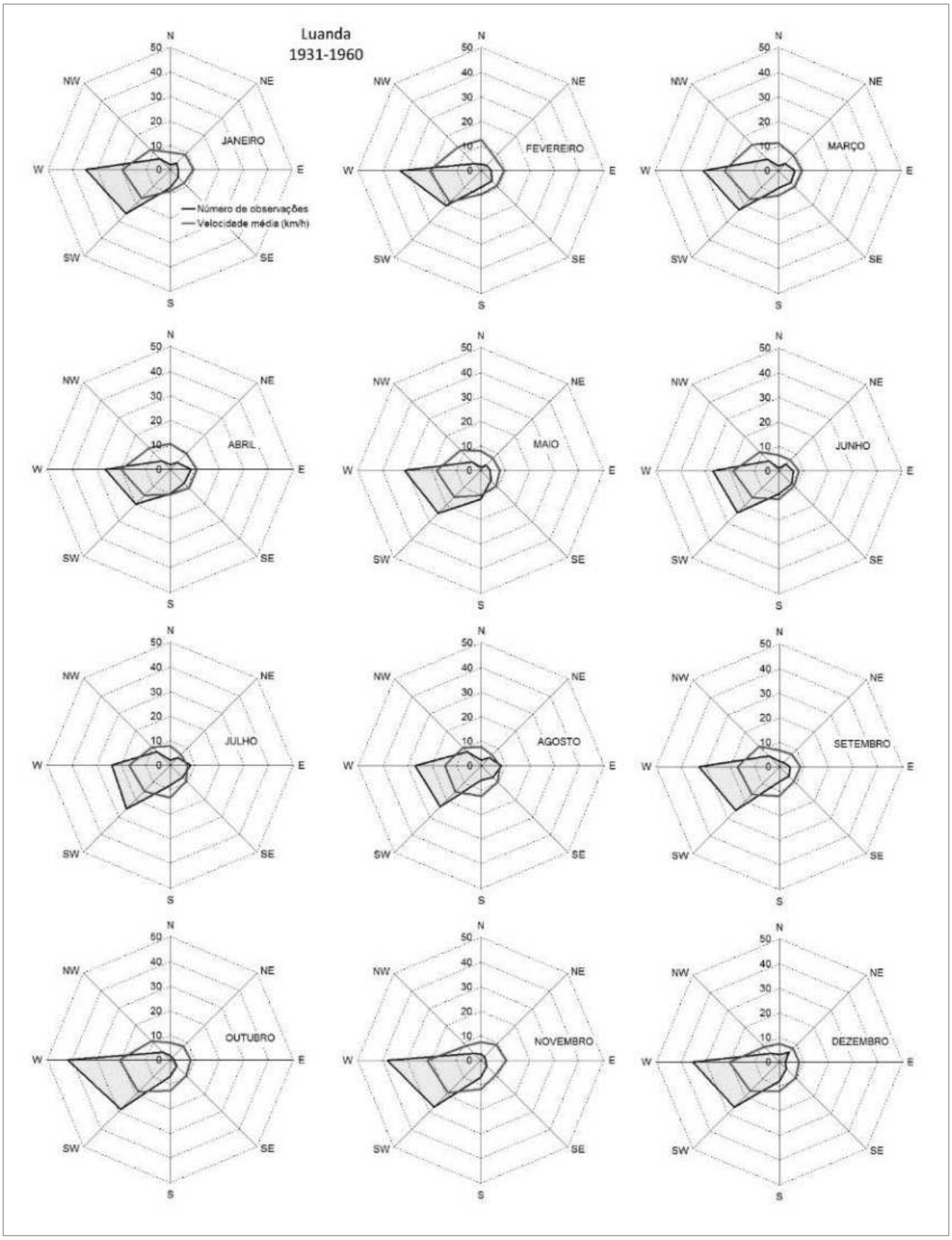


Figure 21 - Monthly variation of wind frequency and speed from eight directions, in the period 1931-1960, recorded at the João Capelo Observatory in Luanda.

III. 1.5. Forecasts in the Absence of the Project

In the absence of the Project "Abastecimento de Água Potável de Luanda - Sistema V - Quilonga Grande" [Drinking Water Supply in Luanda - System 5 - Quilonga Grande] there are likely to be changes in the current climate, given that the economy of the region under analysis (as well as the country as a whole) is growing fast, and this growth will lead to more residential, commercial and industrial construction.

This overall predicted change is, however, in the long-term, and it is not certain, particularly because of so-called global "climate change".

Climate change is related to certain human activities (e.g. emissions of CO_2 and/or CH_4 from industrial plants) and to natural phenomena (e.g. emissions of different gases from active volcanoes). However, this report will only look at human causes, as these are the ones that can be controlled/minimized. It should also be noted that many of the consequences of climate change are not necessarily felt locally, but are more widespread, and changes caused by activities in other parts of the world may have repercussions in this region.

This means that even in the absence of the Project, predictions are that vegetation will continue to be removed and/or burned, industrial plants will continue to emit gases (even though there may be certain improvements as a result of more effective environmental policing by the Angolan authorities), and construction will continue to spread, all of which will increase the barrier effect, in particular with regard to wind and sunshine. These will directly affect the climate at a more local level.

III.2. GEOLOGY

III.2.1 Geomorphological Framework

On the basis of its morphological and structural characteristics, Angola is divided into two parts: east and west. The east is characterised by outcrops and highlands, while the west (which is where the Project is located) is more denuded with high current levels of erosion.

The western part of Angola encompasses the Central Plateau and the steppes, the denuded plains of Maiombe, the plains of Kuanza-Longe , the Zenza-Longe "plateau", the plain of Cuango and lowlands of Cassanje, the coastal plain (which is where the project is located) and the high plains of Namibe.

The coastal plain, which is irregular, was formed on Mesozoic marine deposits from the Perioceanic basin. In general, it is no wider than 15-30 miles. Close to the mouths of the Zaire and Kwanza rivers, the plain widens to between 100 and 130 km, forming the coastal basin of the same name.

At the Kwanza basin, the coastline is dotted with lagoons that fill a variety of tectonic land-level changes. The hills and ridges on the plain were formed in local outcrops of rocks that are resistant to denudation. The arched depressions that can be seen in relief probably correspond to salt dome structures. Along the coast, there is an abrasion of between 20 to 50 m in altitude. Near the mouths of several rivers are beaches, ridges, islands and sandbanks that are several metres high (Araujo & Guimaraes, 1992).

Using a different terminology from that used in the work of Araujo & Guimaraes (1992), Figure 22 shows the geomorphological mapping from the Geographical Atlas of Angola for secondary schools, published in 2008.

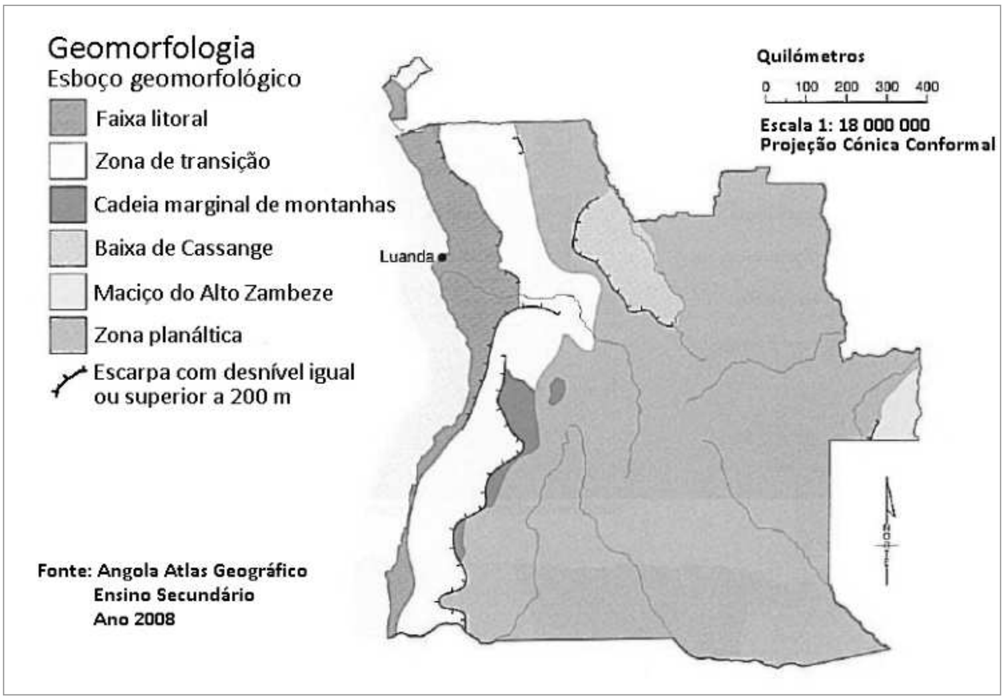


Figure 22 - Geomorphological Mapping of Angola

III. 2.2 Geological Framework

The geology of the region is dominated by Cenozoic sedimentary formations. According to the explanatory notes for the Geological map (scale 1: 1,000,000), organised A. G. de Araujo and Filomena Guimaraes (1992), one can characterise the formations, from oldest to most recent, as follows:

- **Paleogene**

The region of Kwanza is characterised by Palaeocene formation of the Dande River, the Eocene formations of Gratidão and Cunga and the Palaeocene-Eocene formations of the Dande River, Gratidão and Cunga. The Paleogene deposits have been most developed in the area of Kwanza, and have been the subject of a large number of drilling exercises along with a number of other outcrops in the region of the Dande, Cuvo, Kwanza and Cunga rivers.

The formation of the Dande River has the most important outcrops in the eastern part of the region. It is principally marl and sandstone clay that are amassed at the bottom, and phosphatic clay at the top. The western sector of the region has limestone-clay deposits. These are about 600m deep and lie in stratigraphic unconformity on the Teba deposits.

The Gratidão formation is in the eastern and central parts of the area, and also in small spots along the coast in the southern part. It consists of marl, limestone, sandstone and clay. These are up to 500m deep and lie along the formation of the Dande River, there is only unconformity in its contact in the eastern part of the region.

The Cunga formation is particularly well developed in the south of the region. It is composed primarily of marl and clay. It is 500m deep and lies in conformity with the Gratidão formation.

The Dande River, Gratidão and Cunga formations were separated on the coast of the northern part of the area, and were only discovered after drilling. Due to their homogeneous lithology, it had not been possible to differentiate. They consist of marl and limestone and include coprolite and conglomerates. They are between 200 to 300m deep. The age of the Paleogene deposits was defined through the fossils. The rocks of these formations have storage properties and are in an area of oil deposits.

1) Paleogene - Neogene

Undifferentiated Paleogene-Neogene deposits in the Perioceanic basin and continental basins. They are represented in the Perioceanic basin by the Oligocene-Miocene Quifangondo formation; in the Kwanza region by the Eocene-Miocene Malembo formation and by Eocene-Pliocene and Oligocene-Miocene deposits in the Cabinda-Congo region; and by Eocene-Miocene and Eocene-Pliocene deposits in the Namibe region.

In Kwanza the Quifangondo formation is widely developed, forming large areas in its northern, southern and central areas. It is principally composed of sandy-clay rock. Occasionally the centre of these may have calcareous or gypsiferous sediments and intercalated marl and limestone. Its depth varies. In the basins it can reach 3013m deep (Calomboloca 1 drill, northern sector of the zone), ranging in it older elevations and depths between zero and several hundreds of metres. It lies in stratigraphic unconformity on the deposits of the Cunga formation.

2) Neogene

Neogene deposits have only been identified in the Perioceanic Basin area of Kwanza, and consist of the Miocene formations of Bom Jesus, Cacuaco and Luanda.

The Bom Jesus formation is a localised development, filling the Mesozoic basins in the area close to the Cuvo and Kwanza rivers. It consists of marl, clay, and, more rarely, limestone and sandstone. At the base are conglomerations of calcareous sandstones. It is about 120m deep and lies in stratigraphic unconformity on the Quifangondo formation.

The Cacuaco and Luanda formations that are together in this map, are only found along the current coast line in the north-west of Kwanza, with seemingly no other processed sedimentation in other locations. These are made up of clay, marl, some gypsum, limestone and sandstone. Its depth reaches 2000m, and like in stratigraphic unconformity on the Quifangondo formation.

3) Neogene - Quaternary

The Pliocene-Quaternary deposits are represented by the Quelo formation in the region of Kwanza.

This formation is in the northern sector of the zone, and touch the South of Luanda. Its deposits are gentle slopes in the interfluves of the coastal plain, and are made up of clay and reddish sand. There are some laterite layers (0.5-1.0 meters) at the base. Freshwater fossils from the Cenozoic era have been found in the deposits. Its depth ranges from several tens of metres to 150-200 metres. It lies in conformity on the Miocene marine deposits of the Cacuaco and Luanda formations, and is often covered by sediments from marine terraces and other Quaternary deposits.

4) Holocene

The modern deposits include those from beaches and marine terraces of 3 to 6m in depth and alluvium from watercourses. Its age is based on geomorphological data.

The deposits from beaches and marine terraces are generally represented in a narrow (only a few hundred metres) strip along the coast. These deposits are made up of numerous sandbanks (especially around Luanda). They constitute fine pale sand, often rich in magnetite and epidote, sometimes gravel and, less frequently, clay and mud. Its depth is no more than a few dozen metres.

The alluvial deposits are low terraces of up to 3m, riverbeds and marshlands of all more or less relevant watercourses. They are composed of fine and coarse sand, in general with little clay, sometimes with pebbles, chunks or layers of clay between 1.5 to 3.5 m thick. There is gravel at the top. The depth of the deposits ranges from 8 to 20 metres.

Figure 23 shows the stratigraphic column of Cenozoic sedimentary deposits in the Kwanza region, based on two different reference works. The differences observed are not relevant to the present environmental impact study.

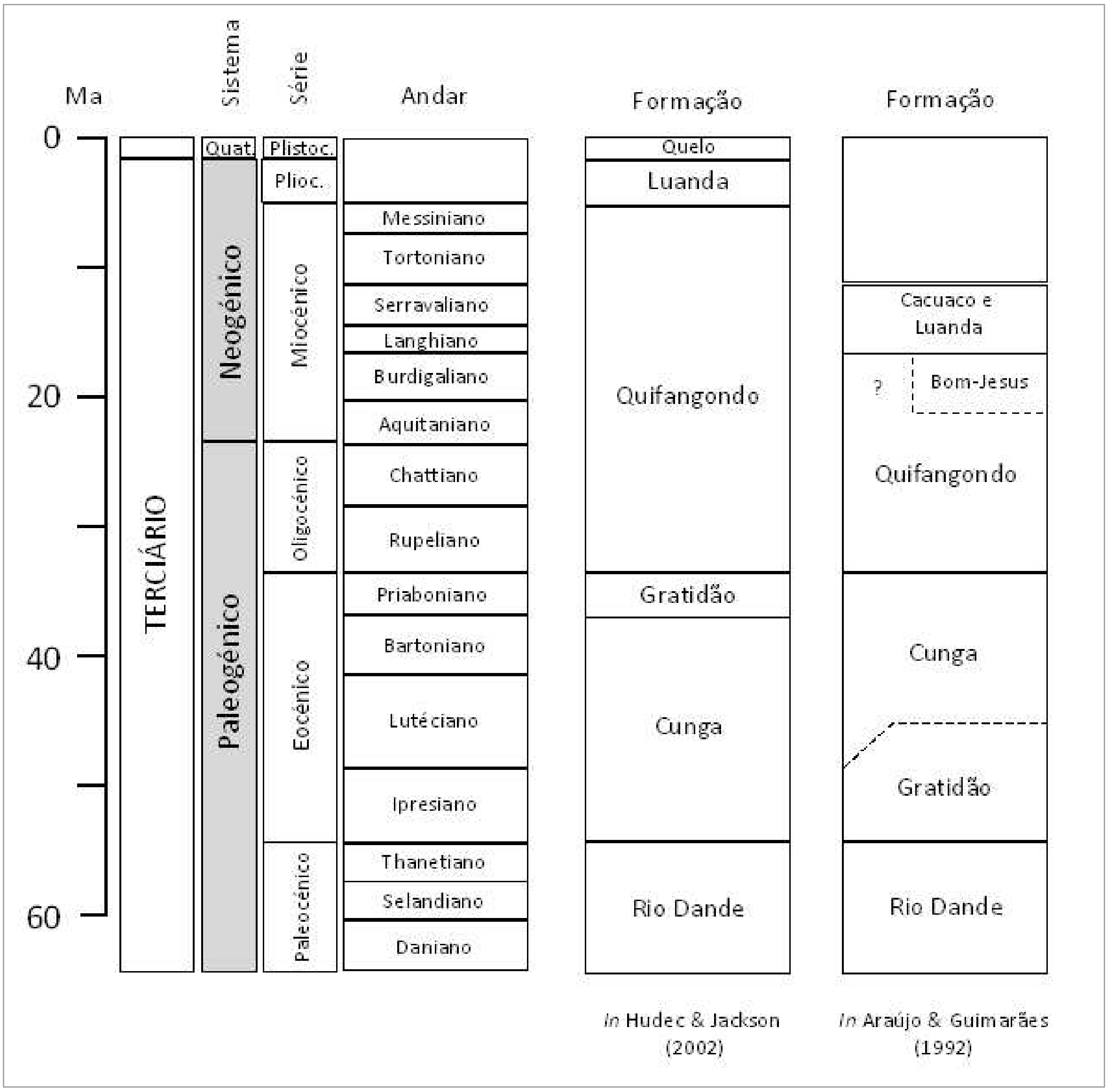


Figure 23 - Stratigraphic Column of Cenozoic deposits in the Kwanza region

The Geological Map of Angola (scale 1:1,000,000) by Heitor de Carvalho (1980) was used for the geological mapping of the region. According to this map, the Project area is located predominantly on Miocene-Oligocene Cenozoic sedimentary formations, formed lithologically by sand, marl, clay, sandstone and conglomerates, as well as more recent formations from the Pliocene-Quaternary era made up of sand, laterite and clay (Figure 24).

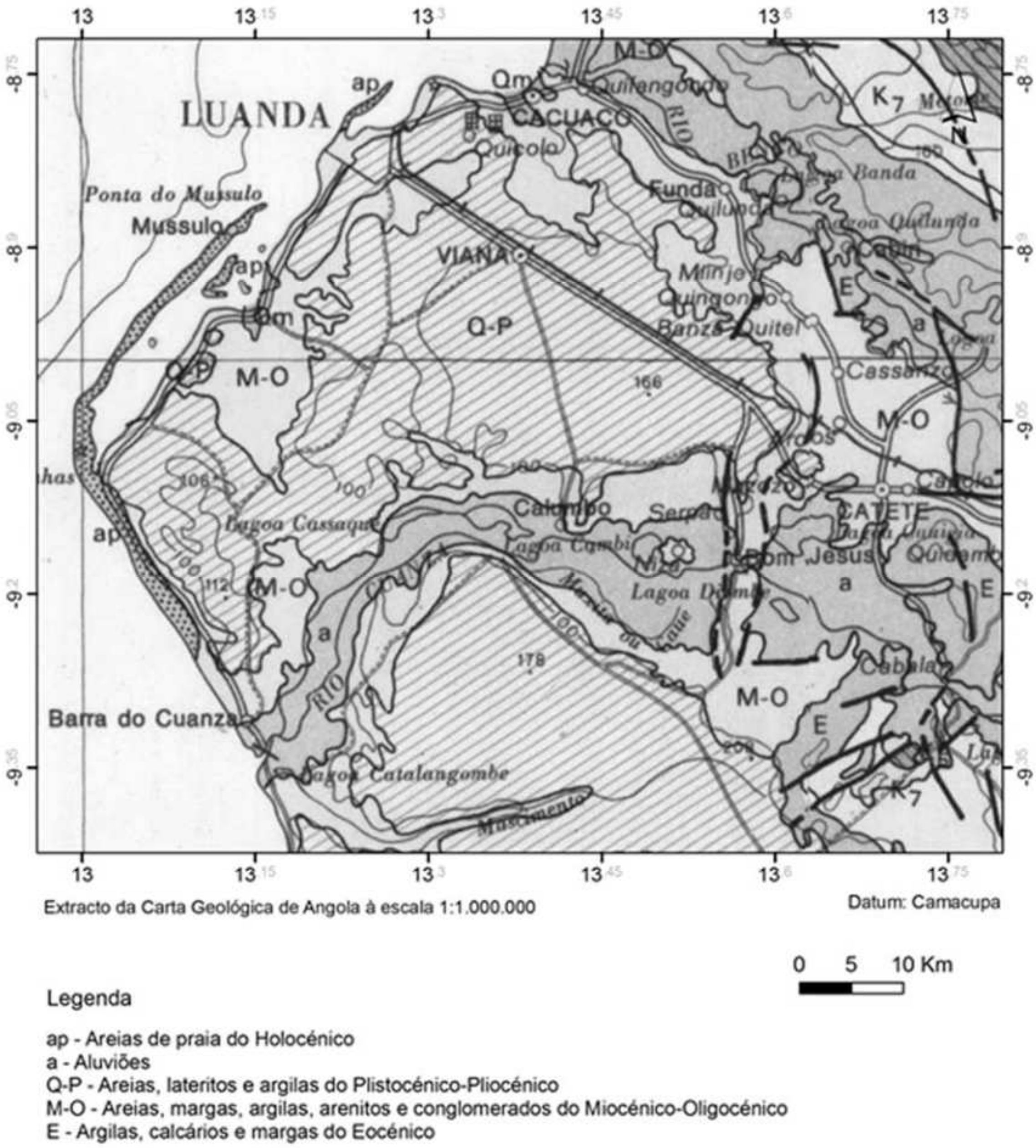


Figure 24 - Regional geological framework of the Project area

Further refinement of the geological characterization of the region was made using the Geological Map of Luanda (scale 1:25000), published by the Department of Geology of the Faculty of Sciences at Agostinho Neto University. The lithological outcrops in the Project area and its surroundings are, from the oldest to the most recent as follows:

- Alternating shaly clay and calcilutite with planktonic foraminifera, in the Quifangondo formation (Miocene epoch);
- Bioclastic calcarenite with lamellibranchia, brisingida, red algae and abundant macroforaminifera and planktonic foraminifera, in the Cacuaco formation (Miocene epoch) [m1c];
- Clay, silt, fine, medium or coarse sand, sometimes alternating with layers of limestone and marine fossils, in the Luanda formation (early-mid Pliocene) [p1];
- Medium-fine red sand (in various tones), which suggest a depositional cycle, in the Quelo formation (Pleistocene epoch) [Q2] (on which a large area of the Project is located);
- Alluvial deposits from thalwegs and terrace and sandy debris (Holocene era) [a3];
- Fine yellow beach sand from coastal stretches and dunes, alluvial and flood plains (Holocene era) [ap];

Also in accordance with the Geological Map of Luanda (scale 1:25000), the sequence of stratigraphic relations is represented in Figure 25.

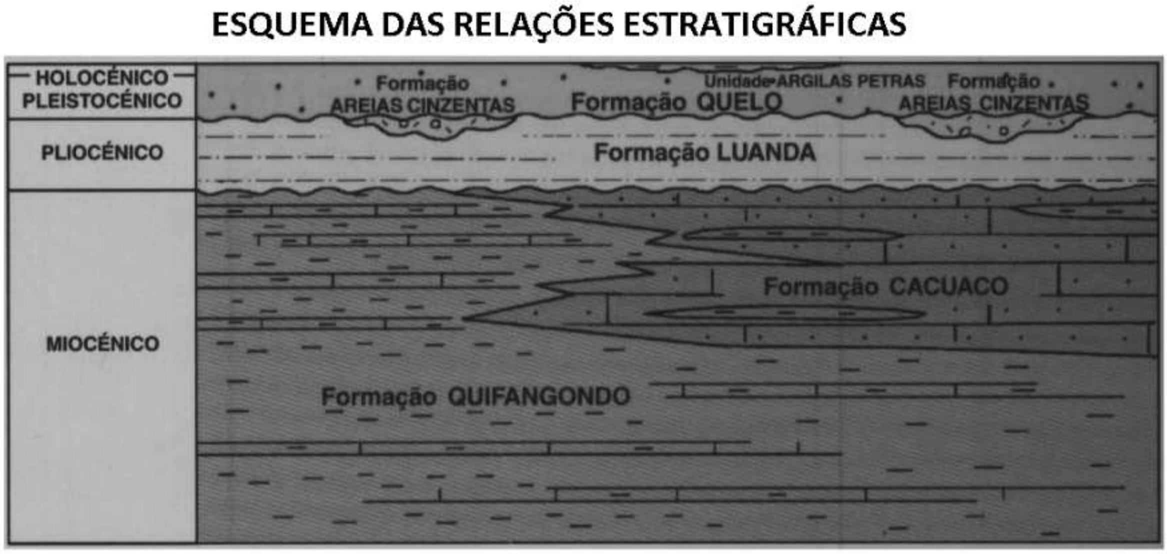


Figure 25 - Stratigraphic Column of tertiary and quaternary formations in the Project area (Source: Geological Map of Luanda (scale 1:25000)

According to the Geotechnical map of the Luanda region - 1st Edition (Horta Da Silva & Gomes Teixeira, no date), the Quelo (or Muceque) formation consists of fine and medium, well calibrated, oceanic sand. Later, in the continental ecosystem, phenomena of revolving and alteration reddened the sands, and developed a clay fraction composed of kaolinite, illite and iron oxides (goethite and haematite); these last being responsible for the formation's dark red colour (Figure 26).

Figure 26 - Outcrop of the Quelo Formation in the Project area (Zango IV)

The Quelo formation is a granulometric composition of a percentage of sandy particles ≥ 75 %, a percentage of silt particles from between 1% and 5% and a percentage of clay particles from between 8% and 20%. The mineralogical composition of the sand and silt particles is identical to that of the base of quartz and feldspar. The depth varies from a few centimetres to 17 metres in the city limits, although according to data provided by Brognon and Verrier (1955), it could be as deep as 50 metres. It dominates the top of the Luanda plateau and as such constitutes the largest part of the city's foundations, covering tertiary formations to a large extent.

The Luanda formation is the most heterogeneous of all the tertiary formations, encompassing clay, silt and sand sediments as well as limestone rocks.

This formation starts with a shaly-clay, composed of brownish or greyish clay and marl, with foraminifera, that represent the lateral equivalent of the platform's facies formed by the limestone of the Cacuaco formation. This shaly-clay then created a coarser sedimentation of silt and sand, interspersed with limestone shell rocks (Brognon, 1955 and Verrier, 1965).

The Cacuaco formation consists of limestone with algae, echinoids and bivalve molluscs and calcarenites rich in seashell remains and foraminifera. The limestone rocks that make up this formation correspond to a platform facies and then become the clay and marl formations that are the basis of the Luanda formation.

The limestone rocks of the Cacuaco formation are also more or less dolomitised and additionally there may be layers or intercalated dolomites. The insoluble residue of these rocks is rich in calcarenites and less frequently in limestone, especially for those that are more dolomitised.

The Quifangondo formation consists of black or mottled Azoic clays, a lot of gypsum and black, greenish-black and brown shaly clay with foraminifera. This formation is topped by clay and silty marl that is rich in foraminifera, and is occasionally interspersed with limestone and lumachelic limestone (Brugnon and Verrier, 1965).

In tectonic terms, there are hardly any failures near the Project area. In accordance with the Geological Map of Angola (scale 1:1,000,000) published by Heitor de Carvalho in 1980, the exceptions are near the road to Bom Jesus, where two possible failures from N-S have been pinpointed.

The region of Luanda has a very low seismic risk (less than 0.2 m/s^2 of seismic acceleration) (WHO, 2010). In Figure 27 one can see clearly that almost the whole of Angola is classified in the lowest zone of seismic risk.

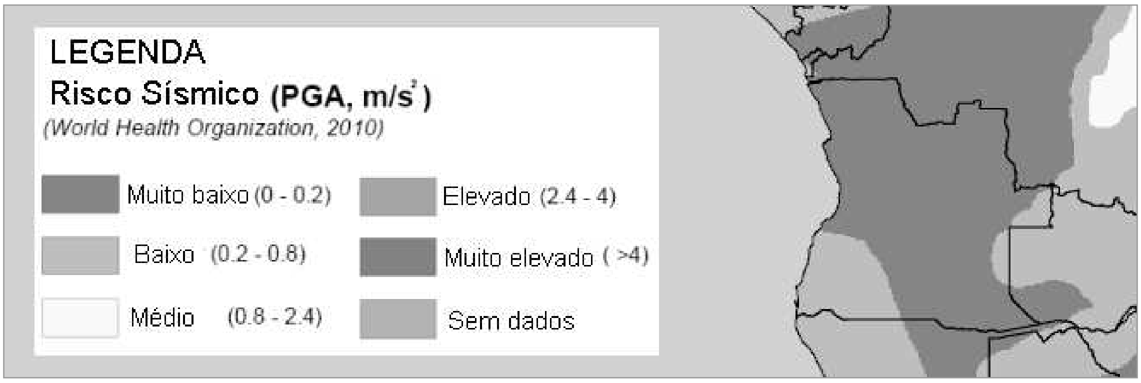


Figure 27 - Extract from the Seismic Hazard Distribution Map of Africa (Source: World Health Organization)

A survey carried out in http://earthquake.usgs.gov/earthquakes/search/ for earthquakes between longitudes 10º and 25º east, latitudes between 3º and 20º south, with magnitudes equal to or greater than 3 for the period between 01-01-2010 and 08-31-2014, gave the results shown in Table 17 with a cartographic representation in Figure 28.

Table 16 - Location of epicentres in Angola and neighbouring countries

Magnitude	Location	Coordinates (WGS84)	Depth	Date of occurrence
4.6	50 km SSE of Zambezi (Zambia)	13.926°S / 23.361°E	10.0 km	21 /04/2014
4.4	Zambia	14.692°S / 23.288°E	10.0 km	28/10/2010
4.2	66 Km SW of Uacu Cungo (Kwanza Sul, Angola)	11.794°S / 14.691°E	15.1 km	19/11/2013
4.2	Democratic Republic of the Congo	9.786°S / 24.995°E	10.0 km	26/12/2010
4.1	Zambia	13.394°S / 24.222°E	10.0 km	29/02/2012
4.0	Namibia	18.375°S / 15.962°E	10.0 km	11/04/2010

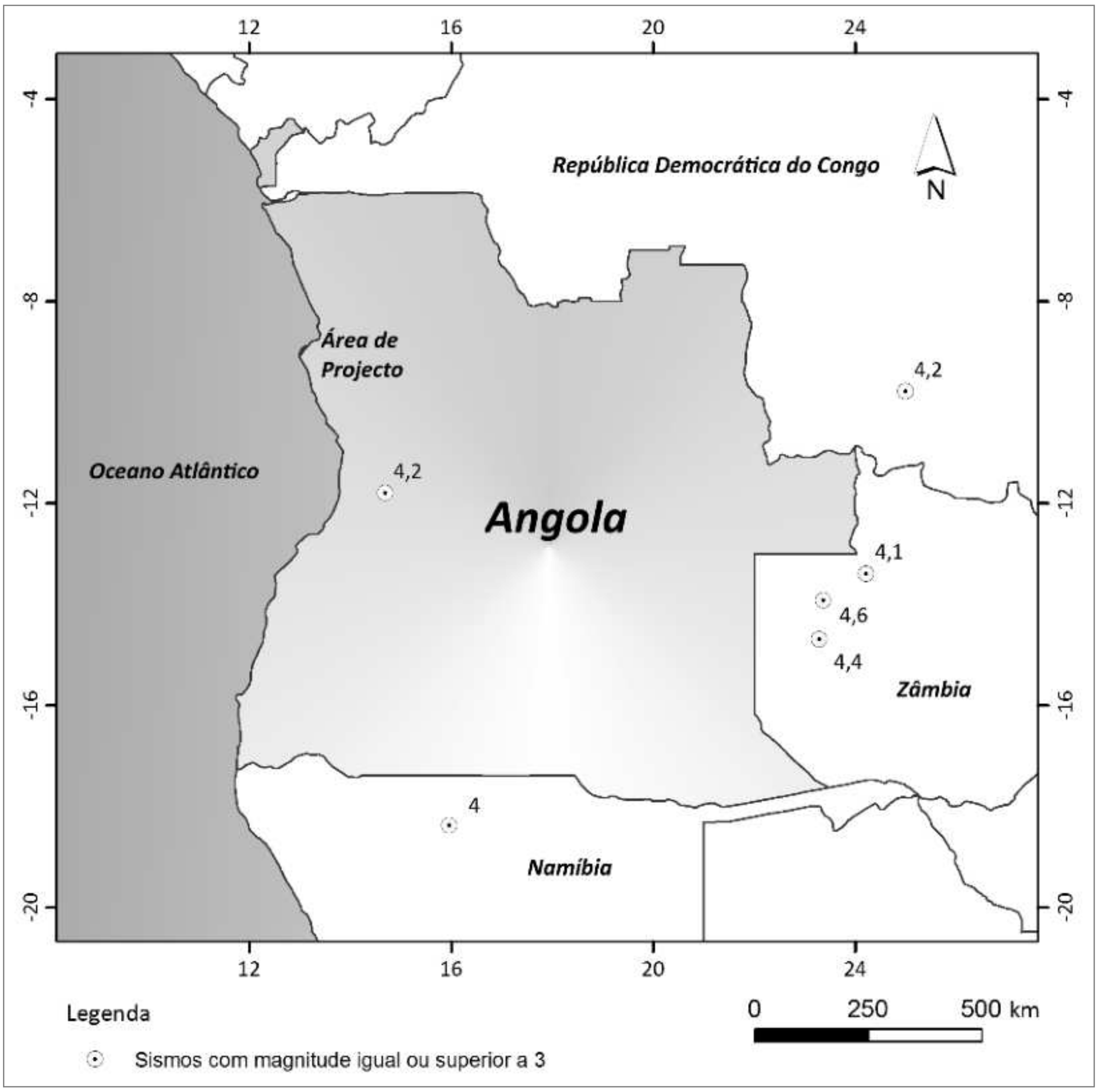


Figure 28 - Location of earthquakes with magnitudes equal to or greater than 3 since January 2010

There is no mention in the literature of any outcrops classified as conserved geological heritage. However, in a recent initiative called "Sete Maravilhas Naturais de Angola" [The Seven Natural Wonders of Angola], three places in the province of Luanda were finalists: Mussulo Island, Miradouro da Lua, and the Quiçama National Park.

The Project area does not interfere with no overlap in any of these places.

For a geological framework from a more local geographic perspective, 33 locations were visited on the field trip between 27 August and 1 September 2014. The main characteristics of these sites are summarised in Table 18. and their geographical location is shown in Figure 29 and in Figure 30.

Table 17 - Location and brief characterisation of sites visited for the Geology descriptor

Reference	Coordinates (WGS84)	Description
Geo01	13.51826 | -8.99474	Sandy Soil, alluvium, beige, little consolidated (Figure 29 and Figure 31).
Geo02	13.49198 | -8.95734	Sandy Soil, alluvium, beige, little consolidated, not well calibrated (Figure 29 and Figure 31).
Geo03	13.43165 | -8.84631	Sandy Soil, alluvium, brownish, little consolidated, not well calibrated (Figure 29 and Figure 31).
Geo04	13.43512 | -9.07918	Sandy Soil, alluvium, reddish, little consolidated. Quelo (or Muceque) formation (Figure 30 and Figure 31).
Geo05	13.39112 | -8.91037	Sandy Soil, alluvium, beige (Figure29 and Figure 31).
Geo06	13.60874 | -9.20300	Alluvium from the Kwanza river (Figure 30 and Figure 31).
Geo07	13.63239 | -9.22397	Alluvium from the Kwanza river. Sub horizontal stratification (Figure 30 and Figure 31).
Geo08	13.56260 | -9.17393	Clayey limestone, sometimes perforated with lithophagous molluscs, outcrop on right bank of the Kwanza river (Figure 30 and Figure 31).
Geo09	13.55420 | -9.17558	Clayey limestone, sometimes perforated with lithophagous molluscs, outcrop on right bank of the Kwanza river (Figure 30 and Figure 32).
Geo10	13.50598 | -9.17782	Quarry working along the right bank of the Kwanza river (Figure 30 and Figure 32).

Reference	Coordinates (WGS84)	Description
Geo11	13.59037 | -9.14036	Conical relief with high symmetry. Unknown Genesis (Figure 30 and Figure 32).
Geo12	13.61515 | -9.11156	Abandoned sand pit Preservation of Baobabs (Figure 30 and Figure 32).
Geo13	13.57946 | -9.17411	Alluvium from the Kwanza river, with strong clay component (Figure 30 and Figure 32).
Geo14	13.57879 | -9.17399	Clay limestone, sometimes perforated with lithophagous molluscs, outcrop on right bank of the Kwanza river (Figure 30 and Figure 32).
Geo15	13.57820 | -9.17378	Whitish Limestone, compact (Figure 30 and Figure 32).
Geo16	13.59391 | -9.14629	Very compact hard limestone, porous and with fossils (Figure 30 and Figure 32).
Geo17	13.59120 | -9.13870	Sandstone, heterogeneously granulometric, with carbonated or conglomeratic levels (Figure 30 and Figure 33).
Geo18	13.57580 | -9.07691	Sandy Soil, alluvium, brownish, little consolidated, not well calibrated (Figure 30 and Figure 33).
Geo19	13.58801 | -9.08244	Level with strong clay component underlying the organic soil (Figure 30 and Figure 33).
Geo20	13.55102 | -9.07904	Sandy Soil, alluvium, beige (Figure 30 and Figure 33).
Geo21	13.55545 | -9.10526	Sandstone formation in abandoned quarry (Figure 30 and Figure 33).
Geo22	13.53876 | -9.11151	Clay pit. Partially active (Figure 30 and Figure 33).
Geo23	13.53545 | -9.13553	Alluvium with heterogeneous granulometric clasts, mostly quartz but also carbonates A strong clay component causes abundant, deep cracks in extraction Some siliceous clasts reach 10 cm in length (Figure 30 and Figure 33).
Geo24	13.50739 | -9.16908	Quarries in operation and vertical slopes of several meters without any protection (Figure 30 and Figure 33).

Reference	Coordinates (WGS84)	Description
Geo25	13.51149 | -9.16553	Abandoned sand pit Preservation of Baobabs (Figure 30 and Figure 34).
Geo26	13.53587 | -9.17920	Deposit of alluvium with clasts predominantly of quartz, very heterogeneous granulometry, and may reach 10 cm in length (Figure 30 and Figure 34).
Geo27	13.55731 | -9.10371	Abandoned sand pit, now transformed into a landfill site for various waste and liquid effluents from neighbouring industries (Figure 30 and Figure 34).
Geo28	13.57264 | -9.13399	Sand pit active at the time of the visit. Stratification NNE, 25ºE. Influence of nearby failures (?) (Figure 30 and Figure 34).
Geo29	13.55205 | -9.02443	Sandy Soil, alluvium, brownish, little consolidated, not well calibrated (Figure 29 and Figure 34).
Geo30	13.48448 | -8.99400	Old sand pit, now abandoned and used as overflow for sludge (Figure 29 and Figure 34).
Geo31	13.41784 | -8.94215	Sandy Soil, alluvium, reddish, little consolidated. Quelo (or Muceque) formation (Figure 29 and Figure 34).
Geo32	13.41815 | -8.96738	Sandy Soil, alluvium, reddish, little consolidated. Quelo (or Muceque) formation (Figure 29).
Geo33	13.43027 | -8.88634	Sandy Soil, beige, with plastic waste incorporated in it (Figure 29).

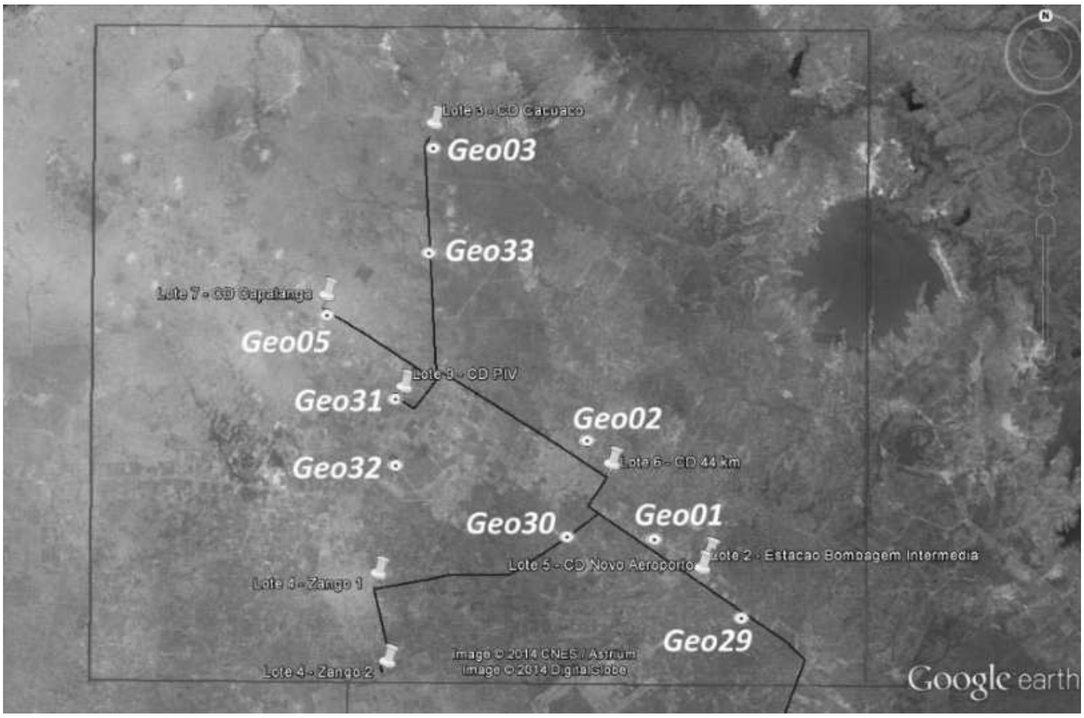


Figure 29 - Geographical location of the places visited for the geological characterization of the local area (Cacuaco, Capalanga, Zango, Viana) [satellite image from GoogleEarth)

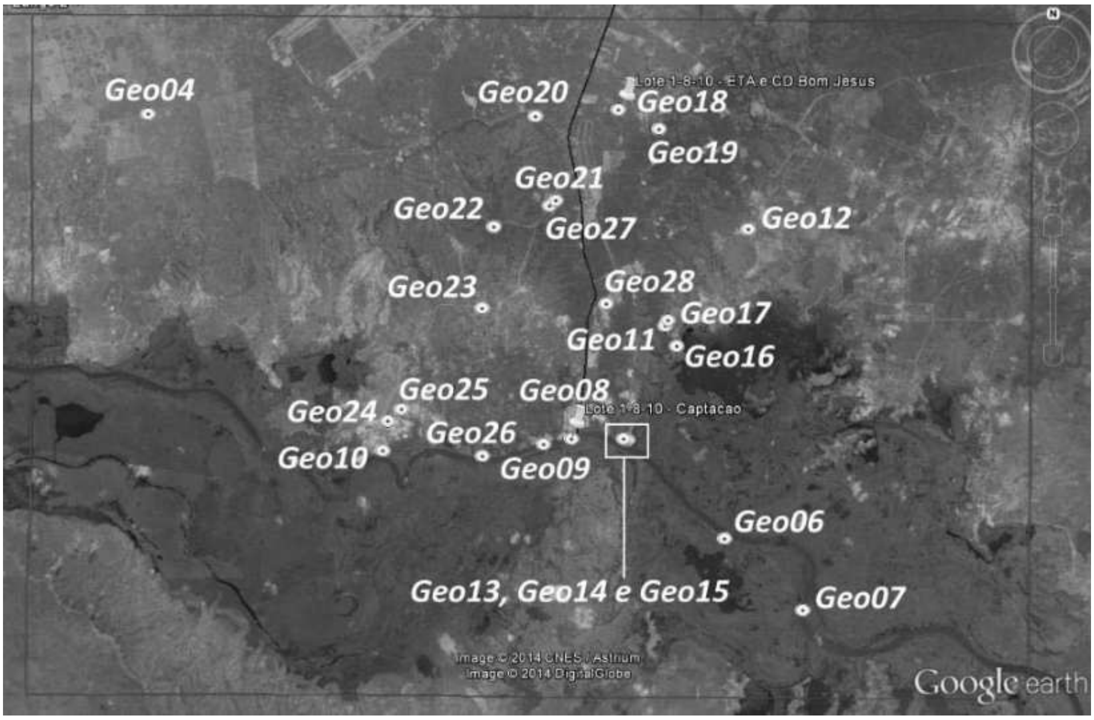


Figure 30 - Geographical location of the places visited for the geological characterization of the local area (Bom Jesus) [satellite image from GoogleEarth)

Figure 31 - Morphological and textural aspects of the outcrops visited (part 1)

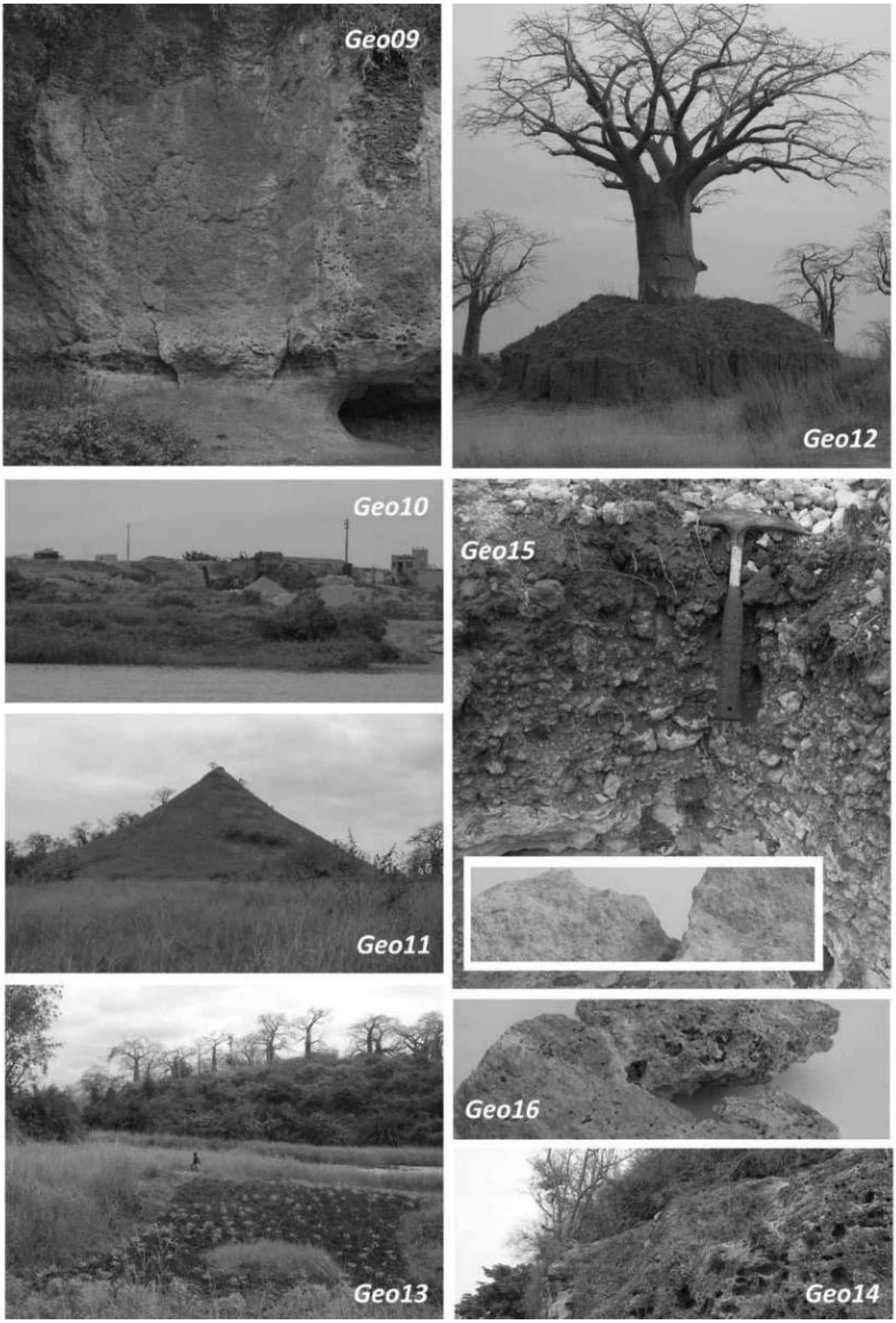


Figure 32 - Morphological and textural aspects of the outcrops visited (part 2)

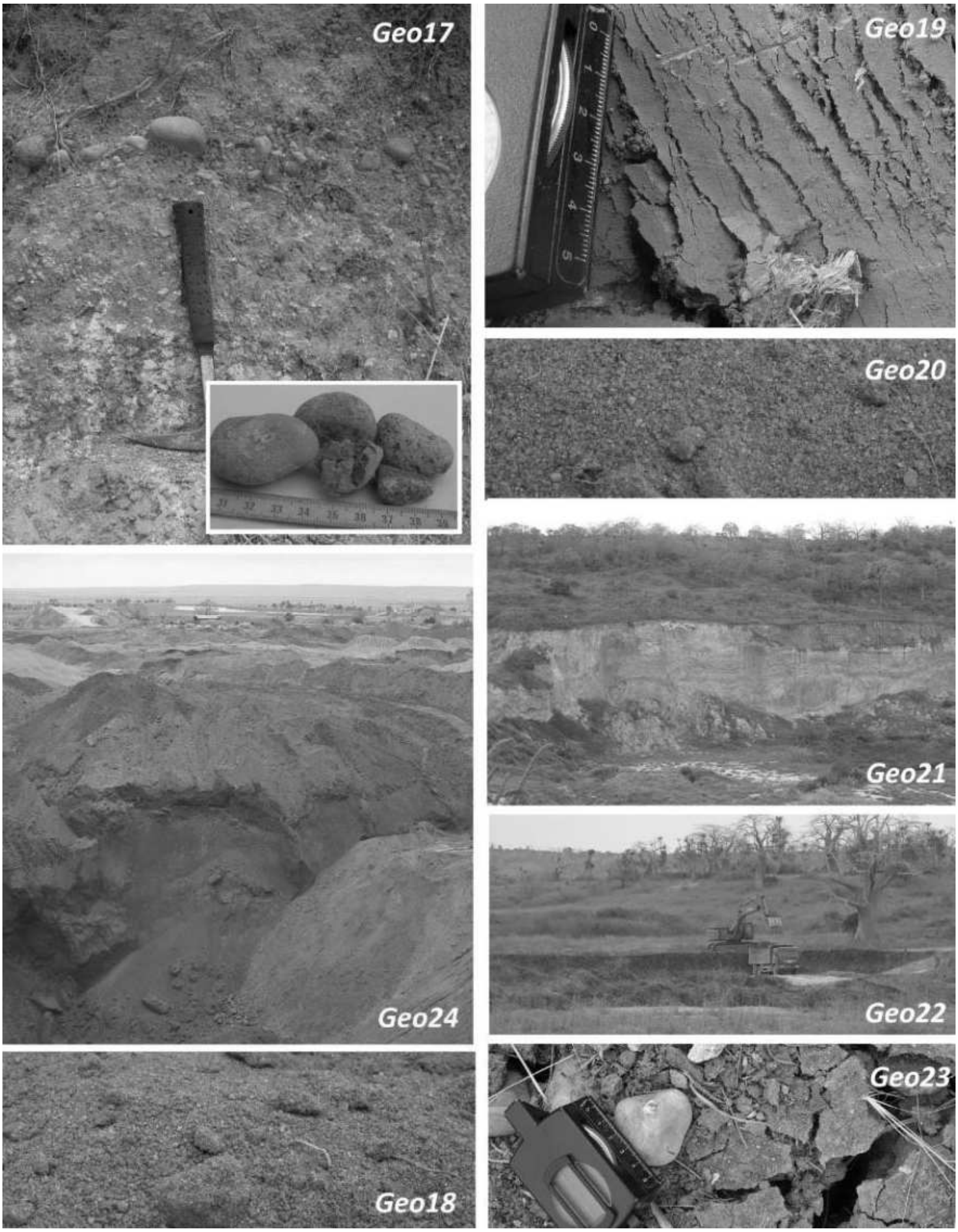


Figure 33 - Morphological and textural aspects of the outcrops visited (part 3)

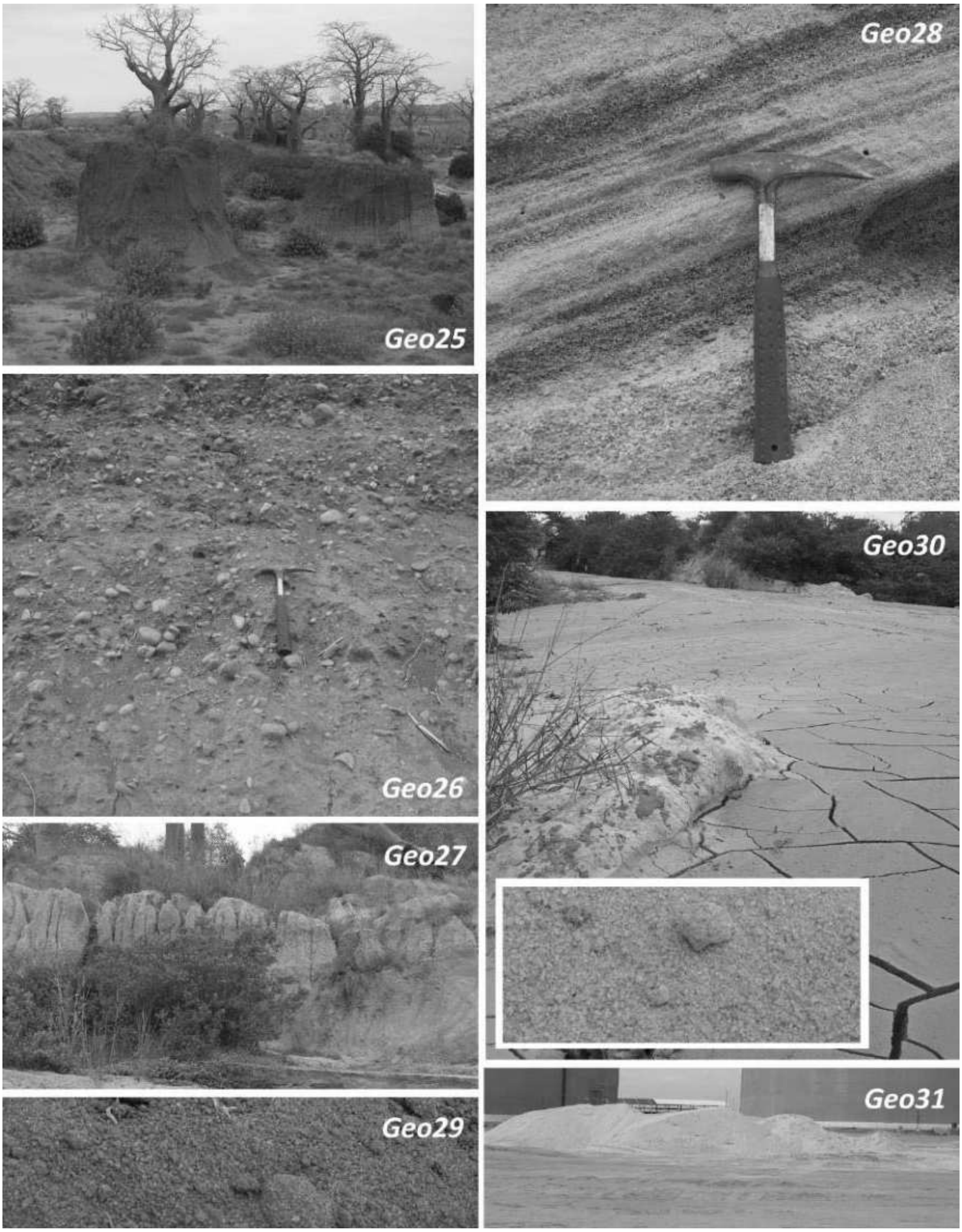


Figure 34 - Morphological and textural aspects of the outcrops visited (part 4)

III.2.3. Potential Geological Resources

In Angola there are known to be about 250 reservoirs and mineral deposits of economic interest. The most important those for oil, gas, diamonds, iron, manganese, gold, copper, lead, crystalline quartz, muscovite, anorthosite, marble, bitumen, fluorite, titanium, salt and potassium salts.

The Cretaceous, Paleogene and Neogene formations which hold oil deposits are considered productive. The distribution of the deposits is, for the most part, determined by the existence of salt domes and terrigen-carbonate block and step structures from the Cretaceous age. The deposits are related with anticlinal structures that are often located over sub-meridional tectonic accidents. There are three defined oil fields: Cabinda, Congo and Kwanza. Industrial oil reserves have been detected at depths up to 3000 meters.

The Kwanza deposit has 10 oil and gas fields (Benfica, Mulenvos, Benedict, Quenguela, Galinda and Tobias, among others). The most productive layers are located in the organogenic calcareous formations of Binga Tuenza and Catumbela, and those of less interest are in the Eocene, Oligocene and lower Miocene marls (Araujo & Guimaraes, 1992).

This same work, which is already over 20 years old, also stated that: "The exploitation of the majority of these deposits is already over. However, if it were possible to use more sophisticated methods of extraction they could still be profitable".

According to the Geographical Atlas of Angola for secondary schools (2008), In Luanda province there are still the following geological resources that have not been exploited: oil and limestone. In this same document, only limestone appears as a resource that is still being extracted (in the North of Luanda).

The scale of the figure does not allow one to be certain of the exact distance of oil deposits in relation to the areas of the Project.

III.2.4. Forecasts in the Absence of the Project

In the absence of the Project, surface geological resources will continue to be exploited (extracted), at a rate that will depend on the speed of growth in the province of Luanda and in adjoining provinces.

Growing environmental awareness, together with the tourist potential of the Kwanza river basin, may in the near future lead to the classification of some Miocene outcrops (particularly the limestone outcrops), along the right bank of the Kwanza river.

There is also the possibility of resuming deep geological prospecting with view to extracting hydrocarbons. Recently (in early 2014), several onshore blocks were given licenses in Kwanza.

It is noteworthy that the Project, between the Kwanza river catchment and the DC at Km44, is included in block KON5, meaning that it is one of blocks that has recently been licensed.

III.3. WATER RESOURCES

<u>Legal background</u>

The Constitution of Angola states that water is state property. The Law of Delimitation of Economic Activities (Law 13/94, recently revised and published as Law 5/02 of April 16, 2002) states in Article 13 that the abstraction, treatment and distribution of drinking water through fixed networks and the provision of sanitation are areas legislatively reserved. This means that companies or other private entities can participate in these sectors through the provision of fixed-term contracts signed with the State.

The Water Act is established by Law No. 6/02 of June 21th, which defines the management of water resources and water supply. There are specific provisions of the law that are determined through secondary legislation (regulations).

The Water Act states the possibility of granting a right to use water from a private entity and the latter subsequently apply for a license or a concession for water use. The most common situation is the allocation of a license for a renewable period of 15 years, with a more significant concession in several respects and given for a maximum period of 50 years.

The Water Act also establishes that the areas adjacent to the springs, licensed captures, margins of ponds are placed under protection areas defined in the Land Law. On the other hand, demands that all hydraulic works are subject to Environmental Impact Assessment (EIA) and prohibits any activity involving danger of pollution or degradation of the water and any changes to the hydrological regime that may endanger health, natural resources, environment or security and national sovereignty. The law embodies the polluter-pays principle expressly establishing the obligation to repair the damage and defines the system of fines and sanctions.

With the aim of complementing the Water Act, the National Water Directorate and the Ministry of Energy and Water prepared a Water Sector Development Program, which covers the management of water resources and water supply and sanitation to the population approved by Resolution n.º 10/2004, of 11th June, of the Council of Ministers.

More recently, the National Water Resources Institute (INARH) was created through Presidential Decree nº 253/10 of 16th November, to whom were assigned the following main responsibilities:

- planning and management of Water Resources;
- inventory and monitoring of Water Resources.

III.3.1 Surface Water Resources

In national or regional hydrographical terms, the Project area is bordered by the River Kwanza to the South (the longest river to flow entirely within Angola) and by the Bengo River to the North (Figure 35).

The Kwanza River rises in Mumbué, in the municipality of Chitembo, Bié province, in the Central Highlands of Angola, traversing 960 km (navigable for 258 km from the mouth to the Dondo) to drain into the Atlantic Ocean in Barra do Kwanza, to the South of Luanda. The Kwanza catchment basin drains 152570 km².

On the Kwanza river dams have been built at Cambambe (9º45'09,02''S / 14º28'53,01''E) and Capanda (9º48'37,26''S / 15º28'07,77''E, in the municipality of Cacuso, Malanje province), which produce much of the electricity consumed in the capital.

The Bengo river rises near Mota, a municipality of Samba Cajú, in the province of Kwanza-Norte, flowing about 290 km until drains into the Atlantic Ocean in Barra do Bengo, North of Luanda. The Bengo catchment basin drains 11026 km².

On the Bengo river there is a major water infrastructure: the Quiminha dam (8º57'52,43''S / 13º47'24,79''E). This river provides water to the city of Luanda (after treatment in Kifangondo and Chandelier plants), still feeding the Luanda refinery, the company Angomenha (distribution of raw water), and many other users.

Among these catchment basins of national importance, there are approximately twelve small catchment basins draining directly into the Atlantic Ocean, with drained areas of less than 460 km2 and maximum river length equal to 55 km.

Figure 35 - Geographical framework of catchment basins intersected by the Project

The system of water supply to the city of Luanda currently includes the S1 and S2 systems (from the Bengo river) and the S3 system (with origin in the waters of the Kwanza river). The first two supply the North and Central part of the city, and the last, the Southern and Southeastern part. (PIEUL, s/d).

The waters of the Bengo river are treated in the Water Treatment Plants (WTP) of Candelabro and Kifangondo, with a combined production capacity of 3,00 m3/s and, the waters of the Kwanza river are treated in the WTPs of Southeast Luanda, South Luanda, Kikuxi and Viana, with a combined production rate of 2,81 m3/s. (PIEUL, s/d).

Regarding ongoing projects, we can highlight the fact that in 2008, EPAL-EP (Public Water Company of Luanda) has begun implementing various projects to reinforce water supply in Luanda. These projects consist of the extension of reserve systems, distribution networks and standpipes networks. (PIEUL, s/d).

Besides the projects of expansion of reserves and pipeline systems, various projects are being implemented for the expansion/replacement of distribution networks in developed urban areas of the city and standpipe networks in peri-urban areas of Luanda (e.g. Talatona, Zango, etc.) (PIEUL, s/d).

According to the EPAL-EP's newspaper “Adutor”, in the first five months of 2012, the rate of pumping of the three joint systems was 322 829 m3/day.

Also according to the same newspaper, in its May 2013 edition, one can read: "Given the urban expansion of the villages of Viana, Cacuaco and Camama and the emergence of new residential townships(Kilamba Kiaxi, Zango, Sequele, Km44, Capari), the New Airport and the Industrial Estate of Viana, it will become necessary to implement new water systems for Luanda (Systems 4 and 5), Bita and Kilonga Grande respectively, each with a nominal capacity of 15m3/s and to be built in phases".

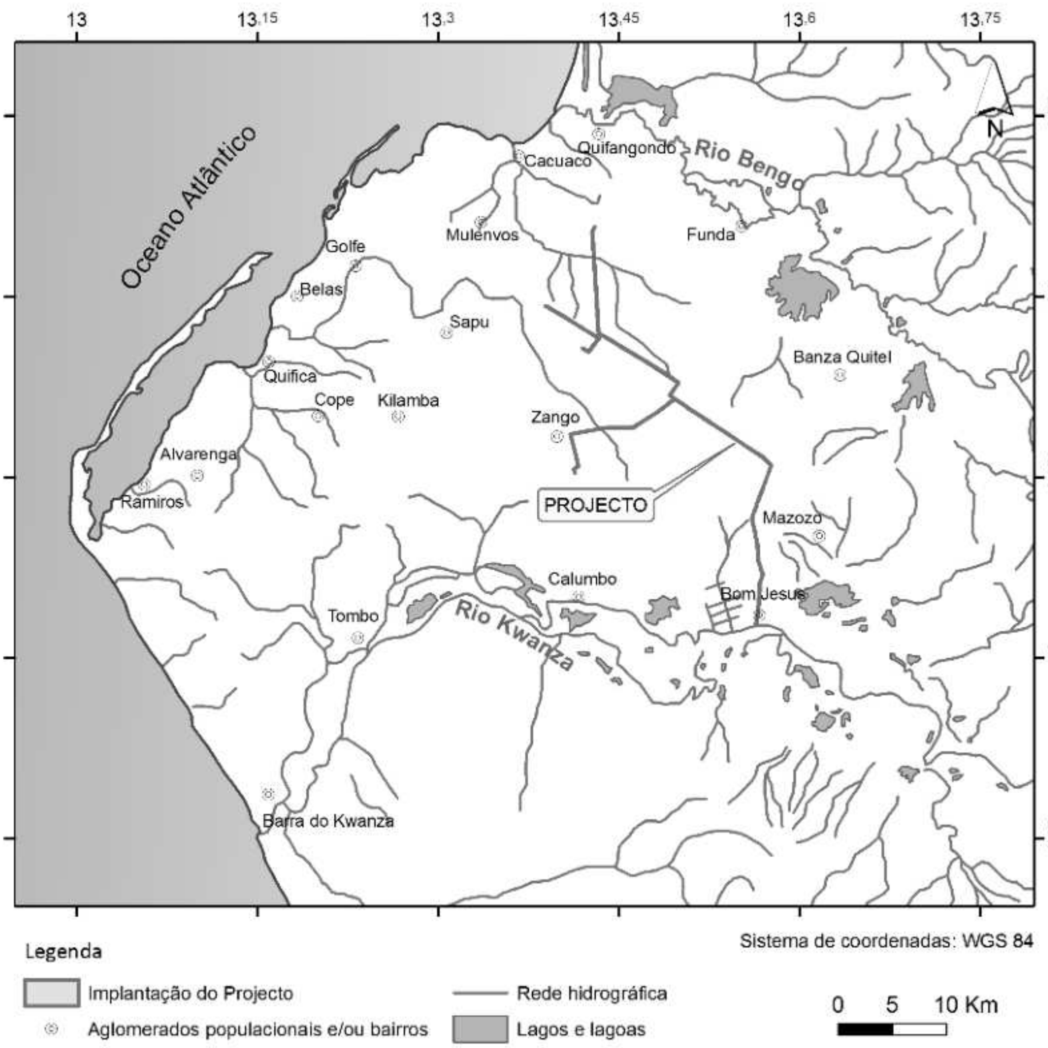


Figure 36 - Regional Hydrographic Structure

For a more local water analysis fifty-five (55) locations were visited during the field survey conducted between 27 August and 1 September 2014,. These are shown cartographically in Figure 37.

As regards the purely quantitative aspects of water resources, we would highlight the following situations:

- Absence of flowing or stagnant water in 26 of the 55 sites visited (represented in beige in Figure 37);

- In Bom Jesus there are a growing number of water abstractions from the Kwanza river (Figure 38), with special emphasis on the industrial supply. Some examples of large users are: the cement works China Fund Limited (CIF); Agro-Leader farm; Cuca brewery; Coca-Cola factory; bottled waters factories "Perla" and "Bom Jesus" etc.;

- In Bom Jesus can still be observed several abstractions for the supply of water for human consumption (three "giraffes" of raw water and a "giraffe" of treated water);

- With the exception of the Kwanza and Bengo rivers, the remaining rivers have very modest dimensions, and the flow of these streams is very temporary and dependent on the occurrence of precipitation;

- The accumulation of surface water in the area surrounding the Project (without direct connection to the Kwanza river or the Bengo river), is modest in size compared to the lakes of the region (e.g. Quilunda Lagoon, Lake Latama, etc.). The lakes of Zango ("RHid53") and various accumulations of water in abandoned quarries or types of activity (“RHid28”, “Rhid34” e “RHid47”) fall into this category.

With regard to the uses given to water the Kwanza River, water for human consumption (in some cases without any treatment), the provision of water for animals, washing, fishing, etc., predominate.

We would like to point out that the current situation report, i.e., the field survey, was conducted in the "low water" season. In the "high water" season and, according to information from the local population, the water level of the Kwanza river rises to over three feet higher than the current level (late August 2014).

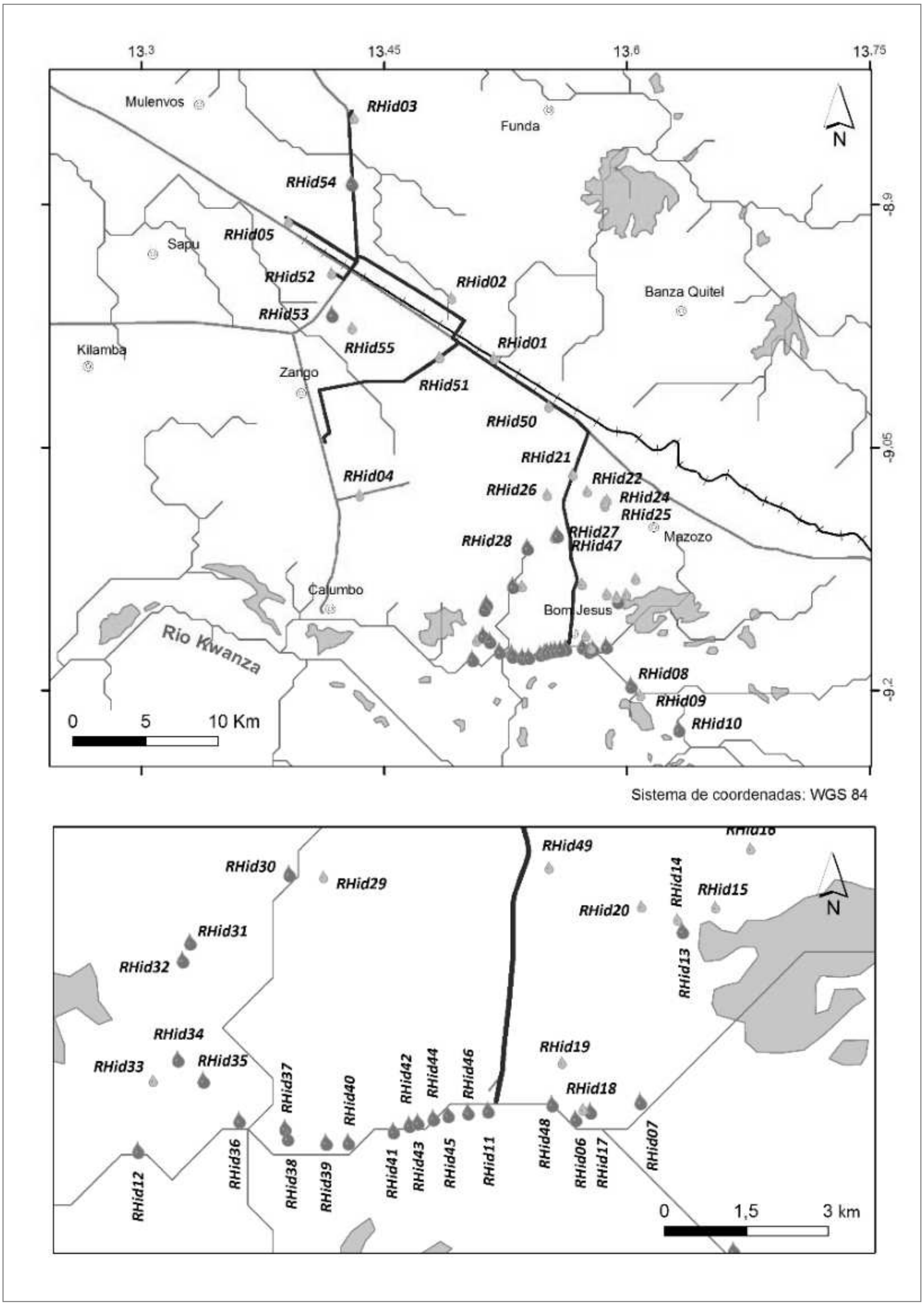


Figure 37 - Sites visited during the field survey (27/08/2014 a 01/09/2014)

Figure 38 - Water intakes in the Kwanza river in the region of Bom Jesus

III.3.2. Groundwater Resources (Hydrogeology)

In hydrogeological terms, the project area is based on the so-called Quelo-Luanda aquifer system. This aquifer, of detrital character, is developed for a length of 1900 km^2, standing between the parallel 8º 45’ S e 9º 21’ S and between the meridians 13º 02’ E and 13º 37’ E (Luís Miguel *et. al*., 2003).

According to these same authors, the Quelo-Luanda aquifer system is developed in stratigraphically detrital materials aged in the lower Pliocene and Holocene.

The permeability is in the range of values from 1 to 3 m/day, in contrast to the reduced permeability of the formation underlying miocene Quifangondo.

In hydraulic terms, Luís Miguel *et. al.* (2003) recommend that the overall system can function as a "multi-layer" system in which, due to vertical and horizontal variations numerous facies, the heterogeneity plays an important role.

As a conceptual model of the aquifer system, the same authors present the outline diagram in Figure 39, highlighting the geometric irregularity of the system as a result of tectonic activity (important normal fault with significant vertical tailings, by East). The thicknesses of the system, ranging from values below 100 m for Quelo, Luanda and Cacuaco formations (all around Luanda) and over 500 m in the southern sector of the region.

The regional groundwater system level is generally at depths between 60 and 100 m, despite at the local level can be identified some suspended aquifer levels (related to the lithological heterogeneity of Luanda Formation, including more clayey levels).

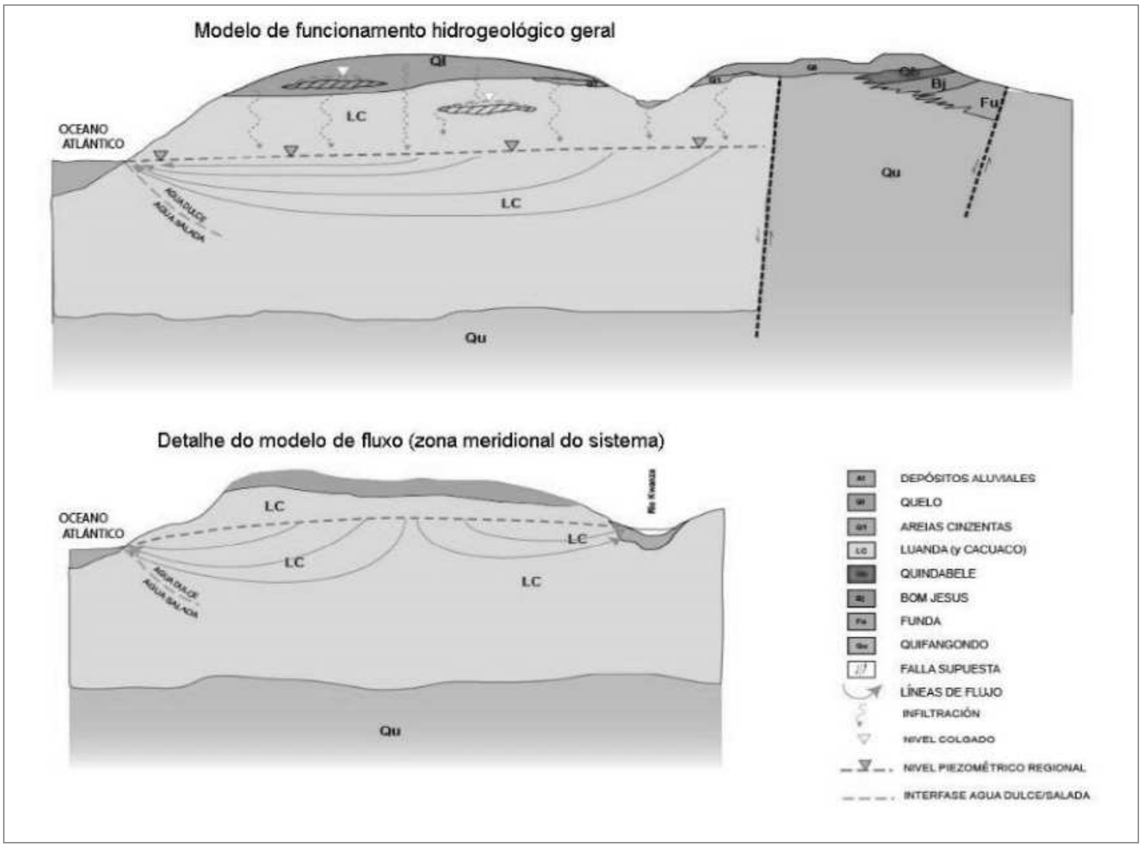


Figure 39 - Conceptual model (preliminary) of Quelo-Luanda aquifer system [adapted from Luis Miguel et. al. (2003)]

The underground water flow takes place predominantly at the E-W direction, generally at very low speeds in the system, as a result of the insufficient hydraulic gradient and moderate permeability. With an effective porosity of 20%, a permeability between 0,14 e 5,3 m/day and a maximum hydraulic gradient between 4.5 x 10-3 and a min. of 1 x 10-3, the maximum speed in the system is 0,12 m/day and minimum output levels in the order of 1 mm/day.

This range of speeds in underground movement, allow for a longer residence time in the same aquifer system, providing significant overall values of electrical conductivity even if the system is fundamentally made up of detrital type materials.

In terms of hydraulic relations groundwater/superfitial waters, mainly it is assumed that the river Kwanza receive a small part of underground disposal system, and occasionally even in extreme flood situations, the hydraulic conditions can be reversed (with the water inlet of Kwanza river in the aquifer system).

The hydrogeochemical characterization of the aquifer system indicates an operation that conforms broadly to that proposed by Chebotarev for large sedimentary basins scheme; This is characterized by a progressive field with higher ion solubility product particularly in the areas of the chloride ion discharge, even when they are simultaneously present in the region other factors may also play a role in this phenomenon (Luís Miguel et. al., 2003).

According to these same authors, the values of electrical conductivity of the groundwater measured in several wells located at distances greater than 7 km from the coastline, are of the order of 1200 µS/cm.

On a more local perspective interpretation we can highlight the fact that we have a single point of inventoried groundwater (hole) in the surrounding area of the Project. It is a vertical hole, built with the intention of capturing water for bottling. However, according to information from locals, salt water came up, having the hole been abandoned and littered (Figure 40). This occurred approximately 6 years, 5 km to the NE of Bom Jesus (9,141º S / 13,600º E).

Figure 40 - Inventoried hole (abandoned and crammed)

III.3.3. Water Quality

The regulation on water quality (which contains the national standards of water quality) was published in the Official Gazette, in the form of Presidential Decree 261/11 of 6 October 2011. This law establishes the standards and criteria for water quality, in order to protect the aquatic environment and improve water quality, in terms of its main uses. The provisions of this law apply to inland waters, whether surface or underground, the waters for aquaculture, livestock, agricultural irrigation and spas. Furthermore, this law regulates the standards for monitoring waste water discharge into national water bodies and the soil in order to preserve the quality of the aquatic environment and the protection of public health.

For the quality parameters laid down by that law the following were defined: maximum acceptable values (MAV), which indicate the values of quality that should not exceed the standard; recommended maximum values (RMV), which indicate the standard values of quality that must be met or not exceeded; and emission limit values (ELV) indicating that the value of the concentration of substances that cannot be exceeded in discharges into water and soil.

Standards of water quality for human consumption are laid down in Annex I and the minimum quality standards for surface waters are in Annex IX. The discharge of wastewater into the receiving aquatic environment is regulated generally in Annex VI of Presidential Decree 261/11.

The quality targets for effluent treated and released into the environment include the concentrations listed in Table 19.

Table 18 - Quality targets for effluent after primary treatment

Parameter	Characteristics of the effluent at intake into the system	Output characteristics of the effluent from the system (after primary treatment)
Total suspended solids (TSS)	300 mg/L	200 mg/L
CBO_5	300 mg/L	100 mg/L
pH	6 - 9	7 – 9
Coliforms	10^8 – 10^{10} UFC/100mL	0 MPN
Fecal coliforms	10^6 – 10^8 UFC/100mL	0 MPN
Total nitrogen	50 mg/L	50 mg/L
Total phosphorus	15 mg/L	15 mg/L
CBO_5 – Biochemical lack (or demand) of oxygen; UFC – Colony forming units; MPN – (***M**aximum **P**robable **N**umber*)		

Although the water quality, in the more densely occupied parts of Luanda, has been a critical issue and a problem for several years, a direct result of the sudden increase of population in the capital, in the vicinity of most of the project area (the nearest to the place of abstraction and WTP), this issue is not so critical. One reason for this has to do with a substantially lower population density.

The sanitation of the villages in Bom Jesus region, when existing, consists of individual septic tanks (of the kind represented in Figure 41) that collect wastewater from individual homes or groups of homes.

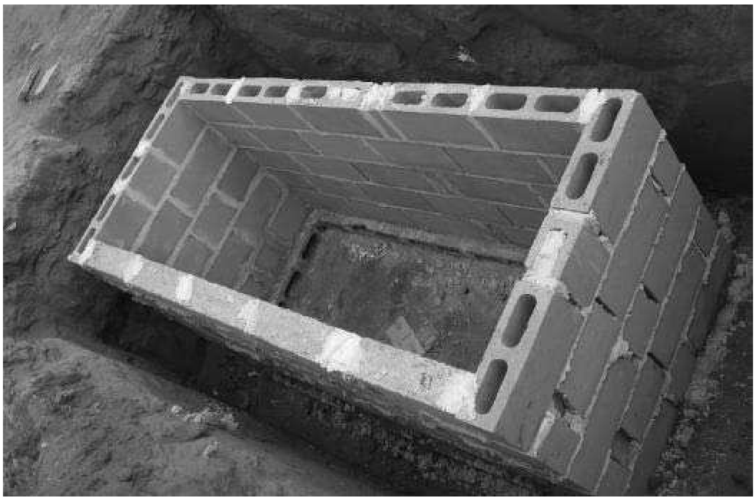


Figure 41 - Individual septic tank under construction

In Luanda, the water quality is monitored by the water analysis laboratory EPAL-EP. Consultation of the EPAL-EP site [4] (http://epal.webuild.pt/pt) however failed to show any analytical results of such monitoring.

The only reference to values found in the literature reviewed relates to a paper presented at a workshop (World Bank, 1996) where we can read: "Mean values of turbidity are around 4 NTU, with the maximum values occurring during the rainy season (August - December) never exceeding 100 NTU. Oxidizability values range between 2 – 3 mg/L $KMnO_4$ with maximum values of 7 mg / L, indicating a reduced relative presence of organic matter in the river water. Colour values correlate significantly with variations in the turbidity and oxidizability".

Given the scarcity of analytical results available to the public, we placed added emphasis on characterizing water quality in the Project area (especially along the river Kwanza itself) and its immediate surroundings, with measurements *in situ* (28/08/2014 to 01/09/2014) and collection of water samples for laboratory analysis. The location of the sampling points is depicted in Figure 42. A distance of approximately 18 km was covered by boat, from the sampling point furthest upstream ("RHid10") to the sampling point furthest downstream ("RHid12").

Measurements were taken *in situ* (water temperature, pH, redox potential, electrical conductivity, dissolved oxygen and turbidity) in ten local surface waters (predominantly on the Kwanza river). Table 20 show the results.

During the field work no groundwater extraction, production and/or possibly water sampling was identified.

[4] Consultation carried out on 12 September 2014.

Table 19 - Results of *in situ* measurements of water quality parameters

Sampling reference point	Water temperature (ºC)	pH	Eh (mV)	Electrical conductivity (μS/cm)	O_2 (mg/L)	O_2 (% sat.)	Turbidity (FNU)
RHid06	24,7	7,66	-24,0	41,4	8,13	97,5	-
RHid07	24,6	7,67	-24,9	41,6	7,76	92,9	9,35
RHid08	24,7	7,80	-32,1	41,6	8,05	97,3	9,05
Rhid10	25,0	8,11	-48,9	41,5	8,18	99,0	9,82
Rhid11	25,1	8,22	-54,7	41,5	8,13	98,6	6,92
Rhid12	24,7	7,93	-39,0	41,5	8,08	97,5	6,20
Rhid48	24,1	7,46	-13,1	41,9	7,30	86,2	8,63
Rhid53	27,2	7,77	-30,3	124,8	7,64	97,8	32,6
Rhid31	23,5	7,25	-1,6	107,3	4,92	58,0	21,5
Rhid47	22,9	8,09	-47,5	272,0	1,88	22,1	30,3

The measurements made in the bed of the river Kwanza are shaded.

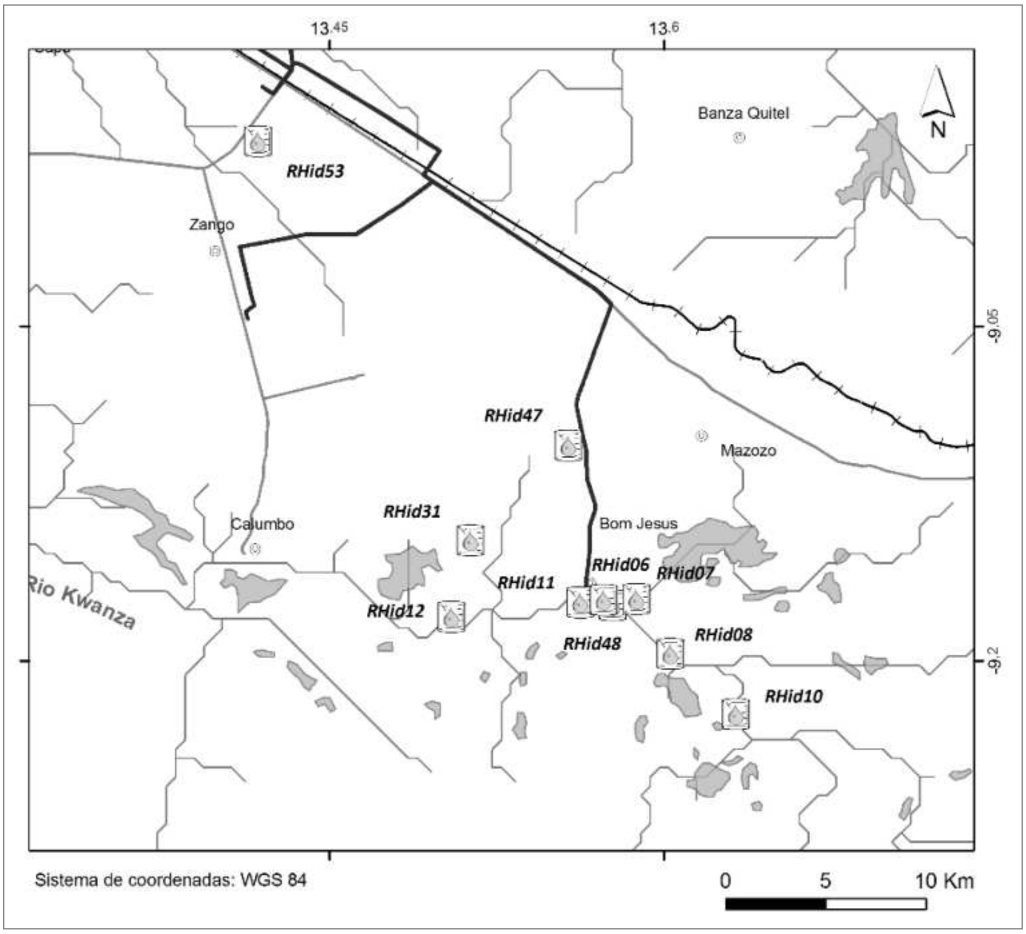


Figure 42 - Geographic locations of water quality monitoring

In the results presented in Table 20, it is possible to highlight the high homogeneity of the values measured at different locations along the river Kwanza (24,1 < T < 25,0 ºC; 7,5 < pH < 8,1; -55 < Eh < -13; 41,4 < CE < 41,9 µS/cm; 7,3 < O_2 < 8,2 mg/L; 6,2 < turbidity < 9,8 FNU).

These values, particularly with regard to the parameter of electrical conductivity, are perfectly comparable with values obtained in March 2013, in the same river Kwanza although some kilometres downstream. In this field survey, the electrical conductivity of the waters of the Kwanza river was found to be between 37 and 48 µS/cm. The water temperature was between 27.9 and 29,0 ºC (slightly higher than that measured this time) and showed slightly more acidic pH values, i.e., between 6,6 and 7,0.

The electrical conductivity and dissolved oxygen concentration of the sample "Rhid47" (less than 1km away from the CIF cement works) strongly suggest that these relate to an effluent from this factory.

A more complete characterization of the Kwanza river water samples (sample "Rhid48"), subject to laboratory analysis, is based on the results presented in Table 21.

The results of *in situ* measurements in seven different locations along the Kwanza river provide the assurance needed to consider the sample sent for laboratory analysis as representative of water quality in the Kwanza river, at the date of collection.

Table 20 - Analytical results of laboratory analysis of a water sample of river Kwanza

Parameter	RHid48	VMR	VMA
pH	7,7 (23,7ºC)	6,5 - 8,5	-
Electrical conductivity (µS/cm)	50	1000	-
Colour (mg/L, escala Pt-Co)	< 10 (LQ)	10	20
Odour (Dilution factor at 25 ºC)	1	3	-
Arsenic (mg/L As)	< 0,002 (LQ)	0,01	0,05
Cadmium (mg/L Cd)	< 0,0002 (LQ)	0,001	0,005
Chloride (mg/L Cl^-)	40	200	-
Sulphate (mg/L SO_4^{2-})	11	150	200
Total nitrogen (mg/L N-tot)	< 1,0 (LQ)	-	-
Calcium (mg/L Ca)	4	-	-
Aluminium (mg/L Al)	0,2	-	-

Parameter	RHid48	VMR	VMA
Total Hardness (mg $CaCO_3$/L)	18	-	-
CQO (mg O_2/L)	8	-	-
Chromium VI (mg/L Cr^{6+})	0,02	-	0,05
Total alkalinity (mg $CaCO_3$/L)	20	-	-
Nitrates (mg/L NO_3^-)	1	25	50
Nitrites (mg/L NO_2^-)	< 2	-	-
Bicarbonates (mg $CaCO_3$/L)	20	-	-
Phosphate (mg/L P_2O_5)	< 0,02 (LQ)	0,4	-
Dissolved Iron (mg/L Fe)	0,1	0,1	0,3
Manganese (mg/L Mn)	0,05	0,05	-
Lead (mg/L Pb)	< 0,005 (LQ)	-	0,05
Cyanide (mg/L CN)	0,03	-	0,05
Magnesium (mg Mg/L)	3	-	-
Nickel (mg/L Ni)	< 0,006 (LQ)	-	-
Potassium (mg/L K)	1,6	-	-
E. coli and total coliforms (u.f.c /100 mL)	> 300	50	-
Fecal streptococci (u.f.c /100 mL)	> 300	20	-
Fecal Coliform (u.f.c /100 mL)	> 300	20	-
No. of Colonies at22ºC (u.f.c /mL)	77	100	-
No. of Colonies at 37ºC (u.f.c /mL)	118	10	-

LQ – Limit of quantification. The limit values are given in accordance with Presidential Decree nº 261/11 - Annex I (Class A1). VMR - Maximum Recommended Value/VMA - Maximum Admissible Value.

Reading the table, we highlight the following conclusions:

- The water of the river Kwanza is a very low mineral water with pH near neutrality. This little mineralization, gives reduced buffering to water, making it vulnerable to physical and chemical phenomena of contamination;

- - In physicochemical terms the water does not present any significant problems. Only manganese and iron parameters equate to the quality standard VMR level for drinking water;

- - Microbiological results show non-compliance with the criteria for potability (normative values of EPAL-EP, WHO, EU, etc.). Some of the causes of non-compliance are presented in sub-chapter Polluting Sources.

Figure 43 - Some aspects captured during measurements of water quality parameters

III.3.4. Sources of Pollution

Just as in much of the country, the region of Luanda has for some years now undergone intense construction activity (residential, industrial and various types of, infrastructure). With rare exceptions, this dynamic has not yet been accompanied by growing environmental concerns, particularly with regard to the preservation of water quality.

In the Project area and its surroundings there are some infrastructure and/or economic activities potentially polluting to the water environment, whether surface or underground (Figure 44).

Noteworthy are the following:

- The uncontrolled open-air deposit of various types of waste (sites referenced as FP01, FP02, FP03, FP12, FP13 e FP14) (Figure 45, Figure 46 e Figure 47);

- Extractive activity (namely sandy materials) with little or no concern for the environment (sites referenced as FP04, FP08 and FP09) (Figure 45 and Figure 46);

- Intensive agriculture and irrigation, in which typically are used large amounts of and chemically synthesised fertilizers and phytochemicals (sites referenced as FP05 and FP11), causing the eutrophication of water (Figure 45 and Figure 46);

- Washing of persons, clothing and crockery, with the use of detergents and/or soaps, directly in the Kwanza river or its most significant tributaries (site referenced as FP07, although these activities were observed at various locations on the banks of the Kwanza river) (Figure 45);

- Discharge of industrial liquid effluents (site referenced as FP13) (Figure 46);

- Discharge of fine-grained aggregates (silts and clays) in an abandoned sand pit (site referenced as FP14) (Figure 47);

- Sale of fuel, lubricants, additives and oils, on the roadside, without any containment of spills;

- Settlements (without, or with poorly constructed septic tanks).

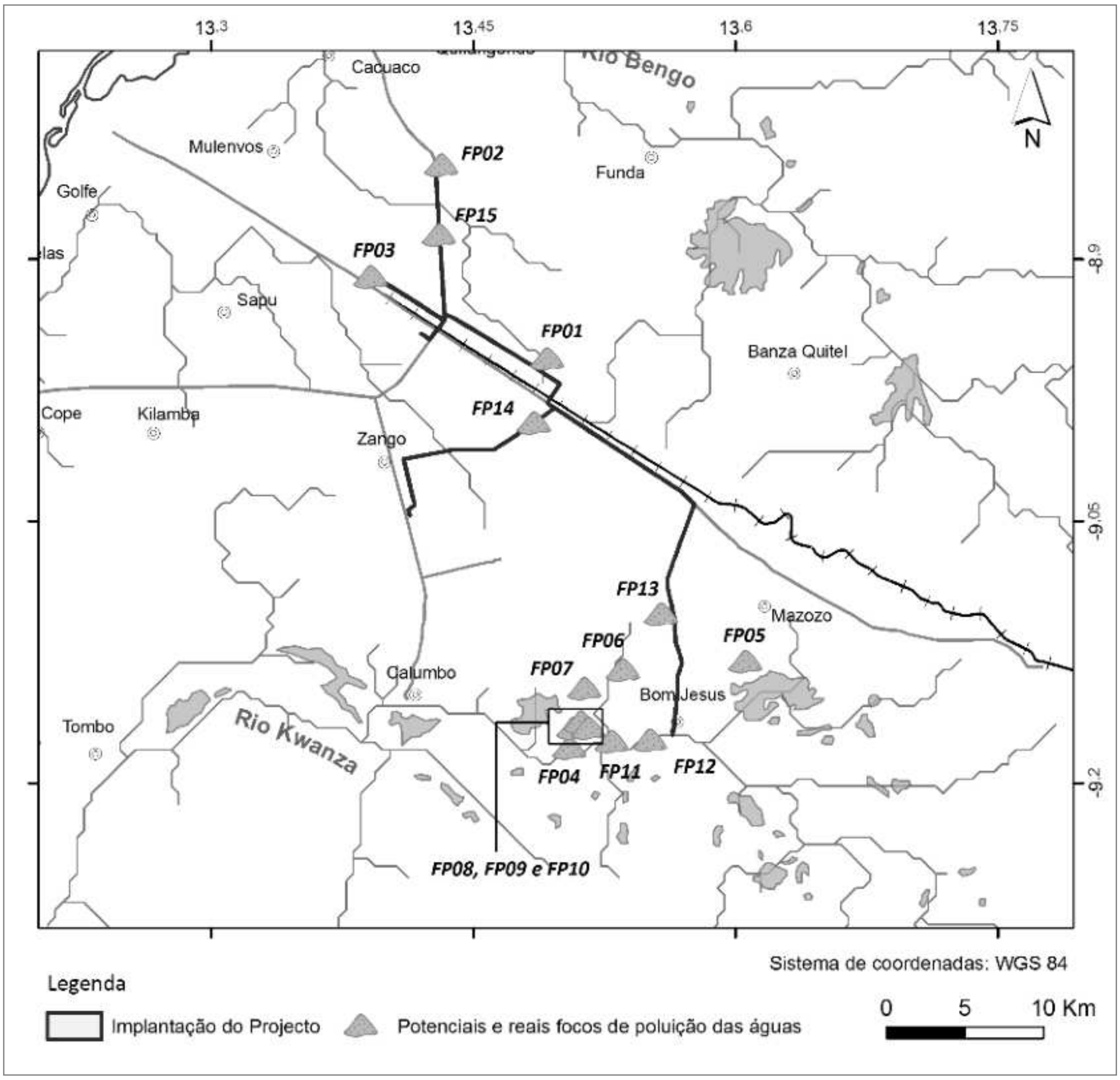


Figure 44 - Location of some potential and actual sources of water pollution

In some places can be observed stagnant water, eutrophic, at times with pronounced odour and colour (sites referenced as FP10 and FP15) .

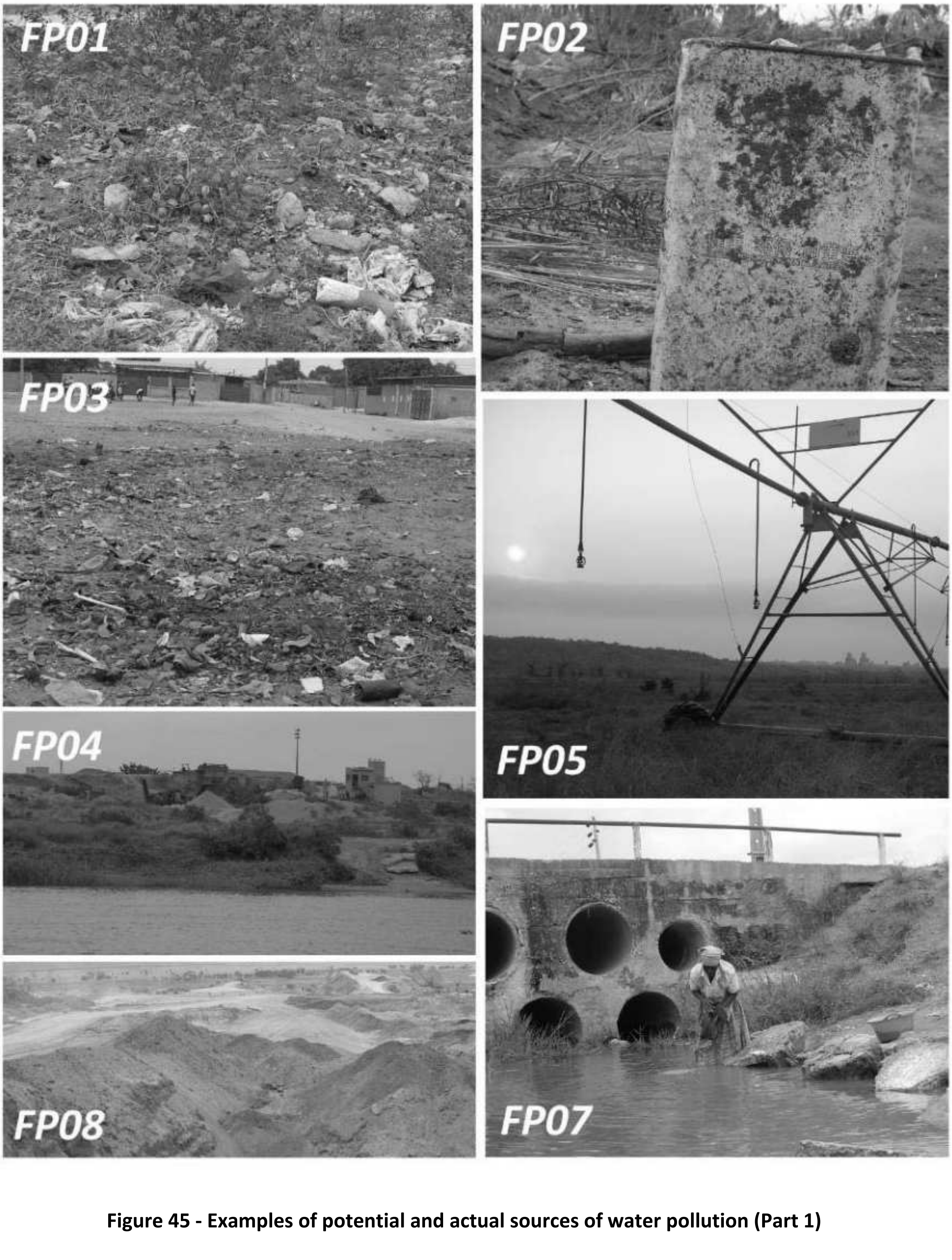


Figure 45 - Examples of potential and actual sources of water pollution (Part 1)

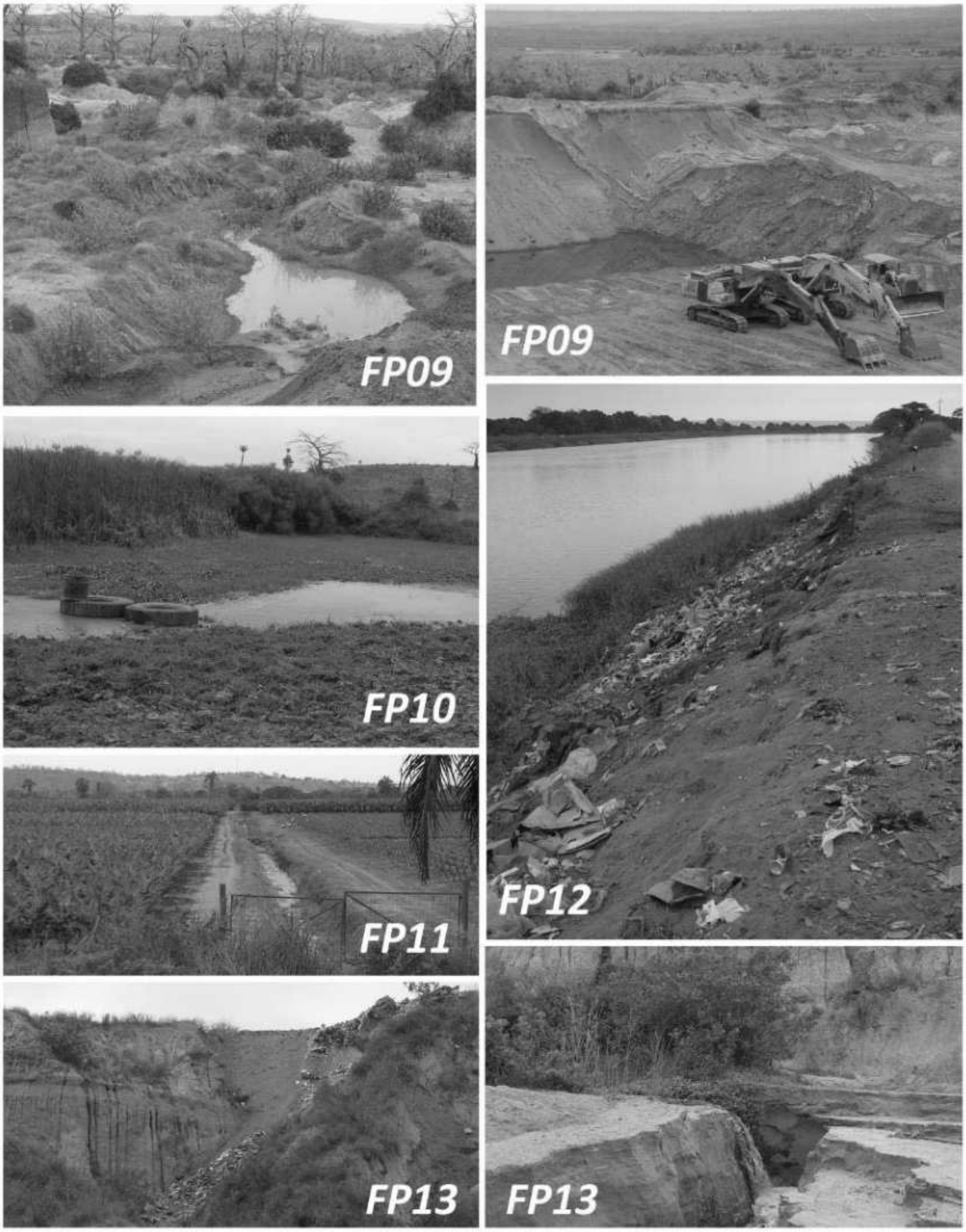


Figure 46 - Examples of potential and actual sources of water pollution (Part 2)

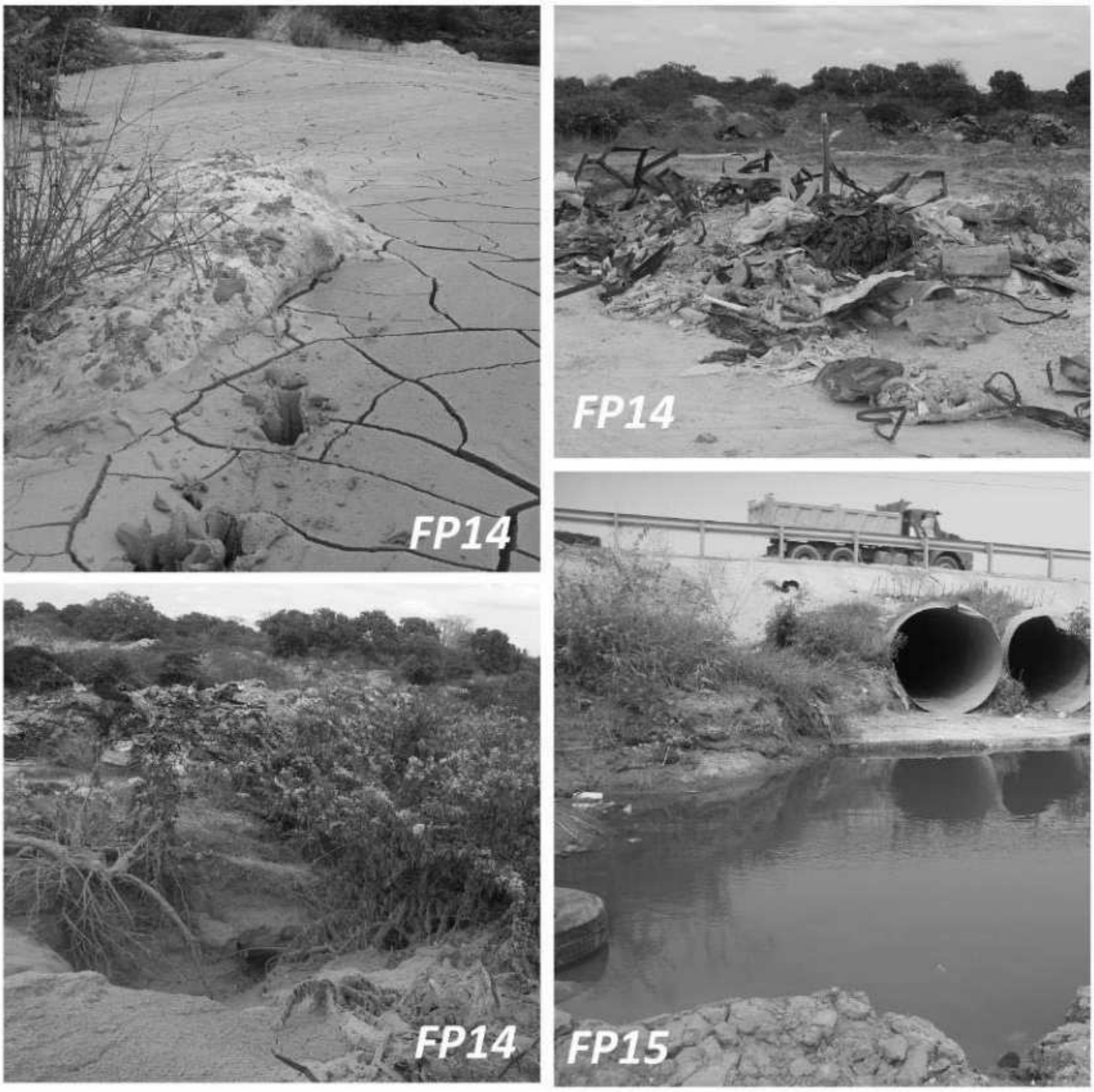


Figure 47 - Examples of potential and actual sources of water pollution (Part 3)

III.3.5. Forecast in Absence of the Project

With regard to the quantitative aspects of surface water resources, in the absence of the Project it can be expected that demand for water from both the Kwanza river and the Bengo river will continue to grow.

The demographic evolution of the region remains on the increase, which in itself implies increased water requirements. Additionally, it should be considered, at least for certain sectors of the population, that per capita consumption will grow due to new habits and significant improvements in health terms.

The industry and intensive agriculture also contribute to this increased requirement (demand).

Groundwater resources will continue to play a small role as source of water both to populations and for industrial and/or agricultural purposes, since their quality is low (mostly brackish or salt water). Even so, the natural recharge of the underlying aquifer formations will become decreased, due to the continued increase of impermeable area (particularly from new construction and impermeable surfacing).

In terms of water quality, its evolution will at least be the result of a combination of the following factors:

Increase in population, with consequent increase in effluent and waste produced thus causing degradation of water quality;

Less water available and more difficult to access, hence causing more concentrated wastewater at its source;

Increase in the number of Wastewater Treatment Plants (WWTP) as well as improvements in their efficiency, giving rise to a more purified effluent hence less pollutant of waters.

III.4. SOUND ENVIRONMENT

III.4.1. Measurements of baseline situation

Noise is a very sensitive component of the environment, potentially causing a negative effect on the quality of people's everyday lives, and can prove a decisive factor in driving out animal species present nearby.

From a human point of view, exposure to noise may cause adverse effects on health, in the behaviour of individuals and in the activities of mankind as well as psychological and social effects. We will then consider that the noise is a cause of annoyance, an obstacle to sound and verbal communications, which can cause general fatigue, and in extreme cases, auditory trauma and extra-auditory physiological changes.

Safeguards should be introduced against these aspects by way of prevention in the face of the economic costs that may arise from their correction. The primary objective of environmental noise control is to protect the population from intrusive noises that cause disruption in their daily activities and prevent the increasing ambient noise that will be translated later into a diminished quality of life.

For the characterization of the actual sound environment in areas of influence of the project under study, measurements of discrete noise of short duration were made at various locations in the vicinity of the future project, with a view to assessing noise levels that currently occur at each site.

Given the scope of the project points were selected based on the future installation of pumping systems and/or other noisy equipment (Abstraction, WTP and DC), with some points of characterization being selected along the pipeline network. The measurement points are marked in Figure 48.

Points R12, R13 and R14 are intended to characterize the noise levels near some existing clusters near the abstraction point, next to existing noise sources in the area, including breweries, packaging of existing water and cola, thus seeking to determine the most critical areas for noise level.

Point R5 aims to characterize the noise level from a cluster housing located along the pipeline to be installed with the road Bom Jesus. This cluster is closest to the CIF cement works in Bom Jesus, also being exposed to noise from the Bom Jesus road, which has heavy traffic. It thus represents an area of high noise levels, and is also located in the region surrounding the future of Bom Jesus WTP and DC.

Point R1 aims to characterize precisely the noise levels in the Bom Jesus WTP and DC area to determine the noise level present, taking this as the standard for the surrounding area.

Point R6 is located in the existing cluster surrounding the intersection between the roads of Bom Jesus with the Viana/Catete road, in the area of the pipeline installation , seeking to represent the characteristic noise level of this cluster, exposed to the associated noise traffic from both routes.

Point R7 characterizes the sound environment in the clusters surrounding the new Airport DC and the intermediate pumping station, being situated near the Viana Road and the Luanda/Malange Railway Line.

Point R8 is located at the DC construction site at Km 30,being in proximity to residential clusters (North, East and South), and an industrial area to the west.

Point R9 is located at the construction site of the DC for Cacuaco, a non-urban (forest) area, with the existence of an industrial area with housing clusters at north and west.

Point R10 aims to characterize the sound environment at the site of construction of the Zango V DC. It is a non-urbanized (forest) area, existing near several residential neighbourhoods still under construction or uninhabited.

Point R11 is located in the area of the future Kapalanga DC, being an urban area, with dwellings throughout the vicinity.

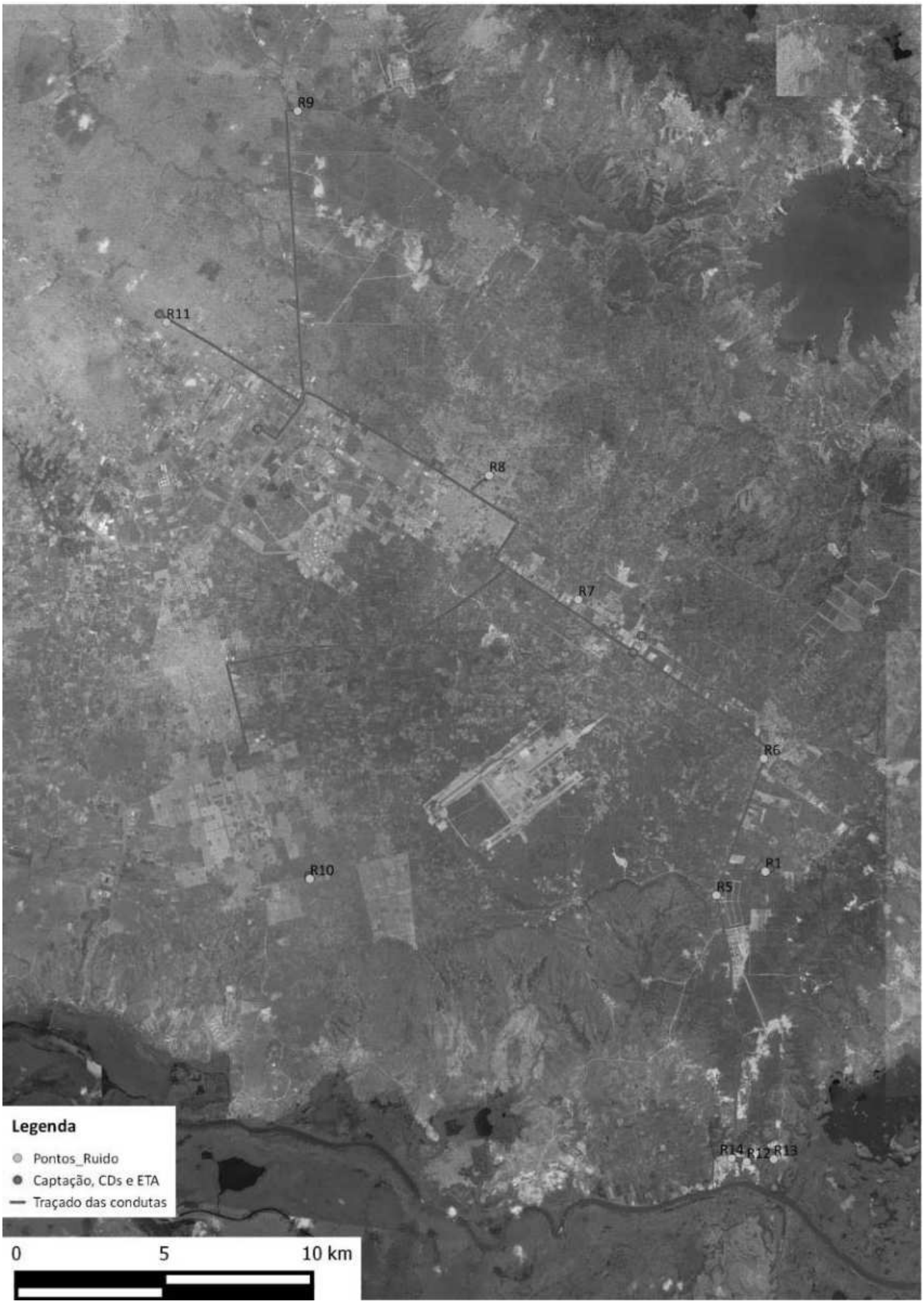


Figure 48 - Points of noise characterization

The measurements were performed with use of a Class 2 sound level meter (SLM) , model Casella CEL 320.

Measurements were taken by sampling, with sufficient time for stabilization of the signal, and the data was acquired with fast-time response and A-mesh filter weighting. The equipment was properly calibrated before the measurements, the calibration being confirmed at the end of the survey, and no deviation was found in the calibration positions.

Thus, the noise measurements for the characterization of the Baseline situation were taken on 26, 27 and 28 August 2014, during the daytime, and with favourable weather conditions.

In the absence of a national reference standard with respect to acoustic indicators, European benchmarks for sound evaluation were applied, with special emphasis on the document IMA32TR-040510-SP08 - Determination of Lden and Lnight using measurements.

Thus, we applied a division of the day into three periods, namely the Daytime period from 07:00 to 19:00, Evening period, from 19:00 to 23:00 and Night Time, from 23:00 to 07:00, with the production of two evaluation indicators, including a night indicator (Lnight) and an aggregate indicator Day-evening-night (Lden).

We took as a basis for an estimate of the noise level for the evening and nighttime periods the Lden formula set out in European reference document "IMA32TR-040510-SP08 - Determination of Lden and Lnight using measurements", thus applying a reduction of 5 dB(A) to obtain the noise level of the evening period and a reduction of 10 dB(A) to obtain the nighttime sound level.

The evaluation of these results, in the absence of national benchmarks, take into account the values given in the IFC-World Bank "Environmental, Health, and Safety (EHS) Guidelines - Noise Management", as indicated in the following table, considering an adaptation thereof, namely by applying the Lden indicator to the limits defined for the Daytime period.

Table 21 – Limit values in Table 1.7.1 of EHS Guidelines of IFC

Receptor Type		LAeq Values	
		Daytime (Considered to evaluate Lden)	Nighttime (Considered to evaluate Lnight)
Sensitive (S)	Residential, institutional, educational	55	45
Non-sensitive (NS)	Industrial, commercial	70	70

The evaluation points considered, the values and respective evaluation are also shown in the following tables

Table 22 - Characterization of measurement sites

Location	Background	Characteristics of the Site and Surroundings	Sources Surround Sound	Receiver Type Considered
R1	Site of Bom Jesus WTP and DC	Uninhabited wooded area. Existence of an area for the storage of materials in the vicinity. Main housing clusters at about 1000 m	Local road	NS
R5	Pipeline - Bom Jesus Road	Point near the housing cluster. Residential and forest environment .	Bom Jesus Road (primary source) and CIF cement factory at about 1000 m	S
R6	Pipeline - Junction Bom Jesus Road with Viana/Catete road	Existing housing cluster in the surroundings of both roads.	Roads (Bom Jesus road and Viana/Catete road	S
R7	Site of the New Airport DC and intermediate pumping station	Surrounding residential area with scattered woodlands.	Luanda/Malange Railway line and Viana road	S
R8	Km 30 DC site	Surrounding residential area, with the presence of an industrial area near West.	Local road	S
R9	Site of Cacuaco DC	Non-urban areas (forest), with the presence of an Industrial and residential area to the West (500m)	Local roads	NS
R10	Site of Zango V DC	Non-urbanized area (forest) with existence of residential neighbourhoods in the surrounding buildings (600m)	Local roads	NS
R11	Site of Kapalanga DC	Urban area, with homes in the surroundings	Local roads	S
R12	Pipeline - Proximity with Abstraction - Coca-cola Factory	Urban centre near Coca-cola factory	Surrounding industries and local roads	S
R13	Pipeline/Abstraction -	Point located near the brewery,	Surrounding	NS

Location	Background	Characteristics of the Site and Surroundings	Sources Surround Sound	Receiver Type Considered
	Brewery	without receivers in surroundings	industries and local roads	
R14	Pipeline –Bom Jesus Road	Housing cluster surrounding the of Bom Jesus road, near the town of Bom Jesus	Surrounding industries and local roads	S

Table 23 – Baseline data

Site	Day	Hour	L_{night} (dB(A))	L_{den} (dB(A))	Receiver type considered	Applicable limit		Evaluation against the defined limits
						L_{night}	L_{den}	
R1	26/08/2014	15:20	33	43	NS	70	70	meets
R5	26/08/2014	16:21	71	81	S	45	55	does not meet
R6	27/08/2014	09:08	64	74	S	45	55	does not meet
R7	27/08/2014	12:18	36	46	S	45	55	meets
R8	27/08/2014	13:25	48	58	S	45	55	does not meet
R9	27/08/2014	14:20	45	55	NS	70	70	meets
R10	27/08/2014	15:22	57	67	NS	70	70	meets
R11	27/08/2014	16:15	49	59	S	45	55	does not meet
R12	28/08/2014	09:28	50	60	S	45	55	does not meet
R13	28/08/2014	09:46	57	67	NS	70	70	meets
R14	28/08/2014	13:21	55	65	S	45	55	does not meet

By analyzing the figures obtained we confirm that there were significantly higher values in the vicinity of points R5, R6, R10, R13 and R14, leading to a situation of non-compliance with the limits considered in points R5, R6 and R14.

Despite these high figures, there is compliance with the limits considered in points R10 and R13, but only because there is no presence of dwellings on site, considering it is just not a sensitive situation.

These sites suffer strong influence from the noise on local roads, subject to heavy traffic, circulating between Luanda and existing industrial areas along the Bom Jesus road , and in the case of point R14, there is also the influence of emissions related to surrounding plants.

In the case of points R8, R11 and R12 moderate sound values were verified, characteristic of mixed-use zones including residential and commercial use. Thus, although they fall outside the referenced limits, it is considered that these situations represent a minor disturbance.

Points R1, R7 and R9 appear to be sites of reduced noise disturbance, given their remoteness from roads and other relevant sources.

III.4.2. Receptor Spots Survey and Sources Broadcasters

During the field work, we evaluated the main sound sources currently existing in the area of influence of the project, as well as those planned for the future, highlighting the existing roads, major industrial units, the future international airport and the railway line Luanda/Malange.

Have also identified the main spots of existing housing clusters in the surrounding area of the project, which emerge as the main recipients of the areas associated with the Quilonga project.

The main sound sources and receptors spots, existing in the surrounding of the project are well presented in the following figure:

Figure 49 - Identification of Key Sound Sources and Reception Spots

Indeed, as already identified above, there are currently highly relevant sound sources surrounding the project, with particular attention to the road of Bom Jesus and the Viana road, which are associated with high noise levels.

It also appears that in the surrounding road of Bom Jesus are recorded several industrial units, including various industries and shipyards, and are provided for several areas of industrial expansion, creating an area with high potential for noise disturbance. However, also note a minor presence of clusters in the area, reducing exposure to this disturbance.

In areas closer to Luanda since there is a progressive increase in urban density, with smaller industrial areas. Here the main noise sources are related to road bypass, with higher incidence of motor vehicles and motorcycles and associated commercial uses.

III.4.3. Forecast in the Absence of the Project

From the strictly acoustic point of view, the evolution of the current situation in the absence of the project is naturally a situation of lower sound levels than if it were to be implemented, thus representing lower impact.

One cannot however consider that the future situation in the absence of the project would entail a continuation of existing acoustic values.

Indeed, the entire region for the deployment of this project is undergoing marked change, with the development of the special economic zone (SEZ) of Viana, leading to the growth of a more developed industrial framework and the associated increased traffic of vehicles . Also, the development of the new international airport of Luanda will drastically change the local acoustic conditions, enhancing a very significant increase in noise levels in the surroundings.

The urban renewal that is occurring in several places is also of relevance, as for example the area of Zango, with a change in the type of existing dwellings, leading to changes in housing density, the typology of receivers and also the sound propagation on site.

Changes are also expected in the conditions of existing sources of noise emission, particularly linked to the progressive replacement of vehicles, leading to a higher percentage of vehicles with lower emissions, but also any changes in the conditions of local roads, with the adoption of surfaces with lower emissions.

In addition, technological and legislative developments may in the future foster the adoption of technologies with lower emissions from existing industries, situations that would lead to a reduction in noise emissions from sources already present.

Thus it can be foreseen that in the absence of the project there may be a possibly considerable increase in noise levels in the region, but subject to significant uncertainties due to the strong economic dynamics of the implementation area for this project.

It should be noted that the high noise levels already existing in some areas, augmented by future sources to be introduced (new industries, the international airport), may lead to the existence of noise levels capable of masking the emissions associated with the operation of the Quilonga Grande system, thus neutralising its acoustic impact.

III.5. WASTE

The production of solid waste is intrinsically linked to any human activity, regardless of its magnitude, size or type.

Considering the impossibility of eliminating waste, organizations must face the Waste Management as a tool to control their production and improve their management in order to maximize its value over other operations, such as the disposal landfill.

For a legal framework for such management should operate are listed some of the key texts in force, which apply to the project under study, in terms of waste management:

- Presidential Decree 196/2012, of 30 August approving the Strategic Plan for the Management of Urban Waste (PESGRU);
- Executive Decree 234/2013, of 18th July laying down guidelines for the Preparation of Provincial Plans Urban Waste Management;
- Executive Decree 17/2013, of 22th January, which approves the legal regime of Waste Management Construction & Demolition;
- Presidential Decree 190/12, 24 August, which approves the Regulation on Waste Management (RGR);

The latter statute establishes general rules for the production and final destination of waste and applies to all (public or private) natural or legal persons carrying out activities likely to produce waste or who are involved in its management. Therefore, are presented in the following table some definitions and concepts that will be used in this descriptor.

Table 24 – Definitions and concepts of the D.P. 190/12, of 24th of August

Waste Classification (art.º3 e 4º)	
Hazardous Waste	Those wastes that contain any of the characteristics described in Annex III of the RGR, ie containing one or more risk characteristics to be flammable, explosive, corrosive, toxic, infectious or radioactive, or which present any feature which constitutes a danger to health human and other living beings and of the environment quality
Non-hazardous waste	Wastes that do not exhibit the characteristics described in Annex III of RGR
Industrial waste	Waste generated in industrial, commercial and service activities, as well as resulting from the activities of production and distribution of electricity, gas and water
Urban solid waste	Waste from households or similar waste, because of its nature or composition, in particular from the service or commercial or industrial establishments and providers of health care sector units, provided that in either case, the daily production does not exceed 1100 litres per producer
Category of waste (art.º5º of RGR)	
Special waste	Waste with specific characteristics, namely, **packaging, waste electrical and electronic equipment, end of life vehicles, waste from construction and demolition, batteries, tires, and other mineral oils,** which shall be subject to collection and processing.
Industrial solid waste	Waste resulting from incidental and treated as solid waste activities: the similar characteristics to domestic solid waste and commercial solid waste, particularly from canteens canteen, offices and containers uncontaminated
Waste Management	All viable procedures to ensure an environmentally safe, **sustainable and efficient waste management**, taking into account the need for its **reduction, recycling and reuse,** including separation, collection, transportation, storage, treatment, recovery and **disposal of waste, and the subsequent protection of disposal sites in order to protect human health** and the environment against adverse effects which may result from the same
Use or Valuation	The whole procedure consisting in the use of these components or residues, through processes of **refining, recovery, reclamation, recycling, reuse** or any other action provided for in the list in Annex VI of the RGR, such as: • Use as a fuel or other means of energy production other than in direct incineration; • Utilization of organic substances not employed as solvents (e.g. paper / cardboard, wood); • Utilization of metals or metal compounds; • Use of other inorganic materials (plastic, glass); • Utilization of waste oils; • Land treatment resulting in benefit to agriculture and ecology.
Elimination	Directed to the **dump or to destruction, total or partial, of waste**, carried out without endangering human health and without using methods that may harm the environment procedure. Are included in defining the procedures listed in Annex VI of the RGR, such as **deposition on or under the ground** (e.g. Landfill), Land treatment (e.g.. Biodegradation of liquid or sludge into the soil), **Deposit in specially prepared landfill,** among others.
Proper acknowledgment	Disposal in watertight and hygienic conditions (clean containers and always with lid closed), if possible in plastic bags or paper, in order to avoid dispersion in the streets.
Angolan Waste	List defined in Annex X of the DP190 / 2012 which aims to standardize the

List (LAR)	language and classification of waste. Each residue is assigned a code consisting of six digits (e.g. 19 01 02) corresponding to each pair of digit identification of the activity giving rise to the residue **19. Resíduos de instalações de gestão dc resíduos, de estações de tratamento de águas residuais e da preparação de água para consumo humano e água para consumo industrial:** **19 01. Resíduos da incineração ou pirólise de resíduos:** **19 01 02. Materiais ferrosos removidos das cinzas.**

III.5.1. Characterization of Waste Management in the project area

Economic growth directly influences the increased production of urban solid waste (USW), since it is associated with increased quality of life, including in particular packaging waste. The environmental liabilities generated by municipal solid waste tend to increase with increasing of population and increasing of quality of life.

An analysis at national level, and according to the Report of the General State of the Environment of Angola (REAA), the main problems related to solid waste in the country occur in urban areas and result from weak capacity of waste collection by operators or administrations.

Furthermore, according to this source, there are several reasons that aggravate the accumulation of waste in urban centres and their peripheries, most notably:

- Increased population in major urban centres;
- Changes in the way of life of the population, with difficulty adapting to new lifestyles;
- Feeding habits, hygiene, etc;
- Lack of civic education;
- Lack of basic hygiene, and
- Lack of environmental education.

The following should also be mentioned:

- Lack of cleaning and waste collection companies in sufficient numbers in some provinces;
- Difficult access to the suburbs of the cities;

- Lack of or insufficient means of collection and transportation of waste to final destination;
- Uncontrolled urban development;
- Policy of commercial liberalisation and the consequent proliferation of small industries unable to manage their effluent, resulting in increasing volume of waste, both hazardous and non-hazardous.

The daily production of solid waste in Angola is estimated currently at around 0.50 kg of waste/inhabitant. Assuming that the population of Luanda will grow to approximately 8,000,000 inhabitants (Provincial Government of Luanda data), the production of waste in the province could rise to 4 million kilograms per day, which corresponds to 1,460,000 tonnes of waste per year. This data envisages grave negative impact for the population and environment through the production of USW.

Apart from the above, another problem of municipal solid waste in regard to its composition, since much landfilled waste could be destined for reuse and/ or recycling, for example, timber, paper/cardboard, plastic, glass, metals, is that it is waste that is subject to selective collection.

Another feature of the composition of the waste is the existence of a large volume of sand of about 40% (ENEA, 2006). Some of the reasons for this are:

- Adjacent sidewalks to roads are areas without any vegetation;
- About 80% of land in cities is land without vegetation, allowing high evapotranspiration of what is only a small amount of water stored in the interstitial parts of the soil - mostly sand - which predominate in the coastal cities, which facilitates surface drift of these sands;
- Street cleaning performed manually, without watering of roads and pavements. (REA, 2006).

Concerning methods of treatment of municipal solid waste used in the country, incineration is the main one, as well as for medical waste and some industrial waste, and in the case of oil exploitation.

The burning of waste accumulated along the streets and the squares is one of the unconventional solutions in Angola to reduce the accumulated volumes, and one that people widely use. It is found more in the suburbs, where the collection vehicles have difficult access, but also in the cities. The streets in these areas are narrow, the paved surface destroyed and bumpy, and not permitting the entry of collection trucks.

By-products of the incineration processes are air emissions, ash, slag, and the thermal energy released, which often also bring with them environmental problems and human health. The ash collected is often landfilled without any lining, enabling leachates to percolate into the groundwater (REAA 2006).

In an analysis of the project area it can be seen that the municipalities of implantation, Cacuaco, Icolo e Bengo and Viana are equipped with a System of Integrated Management of Solid Waste. This system is managed by the public company ELISAL - Cleaning and Sanitation Company of Luanda, and in each municipality the collection is the responsibility of private companies.

However, the coverage rate of this service is reduced, i.e., only the most populated places and those with best access, such as the administrative centre of the Commune of Bom Jesus (*see* Figure 52), Viana and Zango are covered by this service. In the remaining area of the project, the management of USW is undertaken by the inhabitants themselves, who bury them, burn them or merely leave them on the ground (*see* Figure 50).

Figure 50 – Top to Bottom: Waste management in Jambondo neighbourhood; Picture of waste disposal site in environs of DC Km 30 - Lot 6.

In Luanda there is only one final destination for municipal solid waste, the Landfill of Mulenvos, located in the Mulenvos district, at the confluence of the municipalities of Viana and Cacuaco. It was designed for a lifetime of 22 years, and has been in operation since 2007 receiving solid waste directly from municipalities, as well as from the transfer stations to be found in Cazenga and Camama (Kilamba Kiaxi) neighbourhoods.

To summarise, all the shortcomings and deficiencies of the Waste Management System listed on a national scale, were also identified in the area of direct project intervention and its immediate surroundings, including:

- disposal of waste (USW) in the open and under- and overground or in bodies of water (*see* Figure 53);
- disposal of waste (industrial and construction and demolition) on roadsides, in abandoned sandpits (see Figure 51);
- deficiencies in the systems of deposit, collection and transportation of USW in areas of difficult access, such as the villages located on the banks of Lake and River Kwanza;
- lack of awareness among the population regarding the deposit of USW in the appropriate place (containers).
- deficiencies in the collection and final disposal of industrial waste from industrial and commercial activities and construction and demolition waste;

The following figures illustrate this reality identified in the field survey conducted between 25 and 29 August 2014.

Figure 51 – Top to Bottom: Disposal of waste in an old sand pit west of the Cement works; Disposal of industrial waste in an old sand pit in the environs of the layout of Lot 4 - Zango 5; Deposit of waste on the roadside of Bom Jesus

Figure 52 – From left to right: View of facilities of waste collection company in area of Lot 6 – Km 30; Detail of USW container existing in the administrative centre of Bom Jesus Municipality.

This improper disposal of both industrial and domestic waste is not only an environmental attack from the point of view of soil degradation and contamination of the sub-soil and groundwater resources (see Figure 54), but also a public health problem.

Figure 53 – From left to right:, top to Bottom: Waste disposal in an existing open space within the Capalanga cluster; Waste near the fountain in a village located on the lake shore east of Bom Jesus; Waste disposal near the village.

Figure 54 – Waste disposal on the right bank of the Kwanza River to the west of the village of Bom Jesus; View of waste disposal in the surroundings of Lot 6 DC-Km 30.

III.5.2. Forecast in the Absence of the Project

It is expected that the generation of municipal solid waste increases due to population growth and changing modes of living, improved socio-economic conditions, coupled with the lack of environmental education and awareness.

Continued deposition of waste in an uncontrolled manner, particularly in the dumps and public open spaces, and the lack of cleaning and waste collection companies will continue to cause deterioration of public spaces, quality of life, as well as the public health conditions and public health.

Allied to this factor, the region where the project will be installed in study presents an expansion of the industrial sector and consequently an increase in waste generation from this sector.

III.6. AIR QUALITY

Human beings are extremely vulnerable and sensitive to air quality. Together with water quality, this descriptor is a major vehicle for conditioning public health, given that air pollution caused by the emission of pollutants, is a widespread type of pollution and is not confined to the place where one specific pollutant is emitted, although there are also of air pollution phenomena that are initially and mainly felt in a radius of where it is produced.

A loss of air quality, or significant concentrations of pollutants, causes pathological effects, leaving biological imprints on human health. Noteworthy are the following effects:

- ✓ Increased cardio – respiratory mortality;
- ✓ Increased utilization of health services and costs;
- ✓ Increased incidence of respiratory symptoms and diseases;
- ✓ Increased frequency of exacerbated bouts of asthma;
- ✓ Decreased lung function parameters;
- ✓ Lung inflammation and deterioration of defence mechanisms.

Suspended particles, originating from automobile emissions, industrial machinery and chimneys generate two types of particles:

- pm < 10µm – become attached to the bronchial wall
- pm < 2,5 µm – become attached to the alveoli

These particles play a role in aggravating or causing respiratory and cardiovascular disease, and are scientifically proven to be responsible for causing lung cancer . Pollens and dust also play an important role as a cause of diseases such as rhinitis or asthma.

Regarding damage to ecosystems, mention should be made of the oxidation of canopy structures which among other effects may cause premature leaf fall in some species and in some premature rotting of the fruit. Finally, when it comes to damage to built heritage we can give the example of acidifying pollutants that chemically attack built structures, causing the degradation of materials and consequently decreasing the useful life of these structures.

The effects of air pollution on health vary according to time and their concentrations. This means that, typically, there are acute and chronic effects of air pollution.

The acute effects reflect the high concentrations of a given pollutant which, when reached, may not immediately impact on receptors. Chronic effects are associated with a longer exposure time and at lower concentration levels. While this level is lower, the exposure occurs for a prolonged period, which causes effects that may arise derived from the cumulative exposure levels for these pollutants.

Air emissions generate problems on different scales, from a local scale (e.g. the concentrations of Greenhouse Gases (GHGs) as carbon monoxide (CO), Carbon Dioxide (CO_2), of nitrogen or sulphur oxides (NOx and SOx) from the traffic along congested roads, or from industrial activities, up to a global scale (the best example is climate change which, among many other effects, has resulted in global warming).

In the absence of monitoring stations of air quality in Angola to provide data, the characterization of the baseline in the project area was carried out using bibliographic data for an analysis on a national scale, and field reconnaissance, a more local scale, carried out in the period between 25 and 29 August 2014. In this survey major sources of emissions of air pollutants and the main recipients were identified in the area of direct project intervention and its surrounding.

III.6.1 Present Situation

As has happened in developing countries when starting their industrialisation process, in Angola there has also been a high influx of population into urban centres. The unplanned growth of urban areas and haphazard development of various sectors of industry have been contributing factors to the rising levels of air pollution.

Emissions to the atmosphere prevailing in the country are from the combustion of fossil fuels, originating from:

- Vehicles in circulation;
- Generators used for the supply of energy;
- Oil production flares, and
- Fires.

Road transport is responsible for the majority of CO (carbon monoxide), NMVOC (non-methane volatile organic compounds) and lead emissions. Emissions of CH_4 (methane) come almost entirely from the final disposal of urban solid waste, while water treatment plants can be regarded as significant emitters of NH3 (ammonia) and N2O (nitrous oxide) sources.

The large geographical area, the masses of existing water and meteorological factors also influence the quality of the existing air in Angola (REAA 2006).

Vehicles in circulation

The number of vehicles in circulation in Angola has increased significantly in recent years, both in terms of private transportation vehicles such as fleets of trucks and buses of state transport and private companies. However, this increase has not been met by an adequate expansion of road infrastructure.

This causes major congestion of roads, mainly in urban centres of major cities like Luanda, forcing vehicles to move around at low speeds.

Simultaneously the consumption of fuel (petrol and diesel) has increased, reaching very high levels, manifested, for example, in long lines of cars at the fuel stations.

In parallel there have also been increases in air contamination by small particles, or dust, particularly by particles of less than 10 micron (PM_{10}) in size coming from lorries and buses with diesel engines. Dust has become a risk to public health, particularly for people living along the roads (REAA 2006).

Vehicles that use diesel engines also release large amounts of lead into the atmosphere, mixing with the inhalable dust, being quite harmful to human health. Noteworthy is the prediction of the downward trend in such emissions, given the introduction of unleaded petrol and the renewal of the vehicle fleet, particularly with regard to gasoline vehicles, with better combustion technology, which will also cause a decrease of other emissions such as CO and COVNM.

Generators used for the supply of energy

Currently not all residential areas in Angola are connected to the mains and even for areas with access there are frequent interruptions. For this reason, a large portion of the population and business uses gasoline or diesel generators as an alternative source.

Oil production flares

Platforms for oil exploration emit greenhouse gases, specifically the various points of burning, which can be several on each block.

Fires

The main source of air pollution in Angola and neighbouring countries is the burning of biomass, done mainly during the dry season — between May and August. The fires occur for at least three reasons, briefly as follows:

- Obtaining charcoal for cooking and as a source of home heating;
- Hunting, and
- Cattle-breeding purposes.

The result of this biomass combustion is the emission of carbon monoxide (CO), nitrogen oxides (NOx), nitrous oxide (N_2O), methane (CH_4), non-methane hydrocarbons, and particles, in addition to carbon dioxide (CO_2).

Several factors indicate the existence of large amounts of particles, amongst which should be highlighted:

- Unpaved roads;
- Land without vegetation;
- Long periods without rain,
- High temperatures;

- Fires;
- Diesel generators;
- High number of vehicles in circulation;
- Factories and industries with uncontrolled air emissions. (Source: REAA 2006)

In the area of the project implementation, the main emission sources of air pollutants identified in the field survey were:

- The traffic of vehicles transporting people and goods along the roads linking Luanda to Bom Jesus (Expressway, Highway Catete, Bom Jesus Road, unpaved roads that connect the factories and aggregate extraction units in the Bom Jesus area) *see* Figure 55;
- The activity of industries and warehouses in the Special Economic Zone (SEZ), the industrial districts still under development, in the region of Viana and Zango, the CIF Cement works and factories in the Bom Jesus region (Coca Cola and Cuca beer factories, water bottling plants under the Bom Jesus, Perla, Buena brands);
- The activity of aggregate extraction in sandpits and quarries in the Bom Jesus and Cacuaco region and material transport for local consumption;
- The burning of agricultural and/or forest land for agriculture and pastoral purposes, see Figure 56;
- Civil works;
- The open-air burning of waste in;
- The operation of generators for public and private purposes, see Figure 57.

The Bom Jesus road which serves the areas of abstraction deployment, the WTP and sludge treatment plants is paved, but nevertheless presents a section in very bad conditions, as illustrated in the figure below. This route has a high traffic of heavy vehicles associated with the activities of Bom Jesus, the CIF works and the aggregates extraction that exist in that location.

The Catete road, the Expressway and Zango/Calumbo Highway linking Zango are busy roads for vehicles throughout the day.

Figure 55 – From top to bottom, left to right: Traffic on the main roads of the project area: Transport of aggregates on dirt road; Catete Road; Express Way (Cacuaco district); Bom Jesus Road with a road section with the damaged paved surface.

Fixed and diffuse emissions from industries and aggregate extraction installed in Bom Jesus region contribute to the reduction of air quality in the study area, as well as fires on agricultural land, very common almost everywhere in the region, see Figure 56 .

Figure 56 – From left to right: atmospheric emissions observed along the Kwanza River (burning on agricultural land); near the CIF Factory and industrial units located in Bom Jesus

In the field survey it was found that the generators are present in all industries, as a primary or supplementary source of electricity. In the Bom Jesus area and its environs dwellings that have electricity rely on generators.

In the more urban and industrial Viana and Zango (new housing area) areas there is already an electricity supply from the public network (ENE). However, almost all of the "neighbourhoods" surrounding urban areas have only generators as their source of electricity.

Figure 57 – View of generator for public supply at the administrative centre of the community of Bom Jesus; private generator in the village of Jambondo in the surroundings of Lot 1 - WTP.

Taking into account the various existing anthropogenic factors, it is considered that the air quality in the environs of the project is affected by various human activities in the surrounding area, exogenous to the project. However the most affected areas are those of Viana and Zango.

The receptors identified as being most affected by emission sources are mainly the villages located along the roads with heavier traffic.

III.6.2. Forecast in the Absence of the Project

If the project is not carried out is expected that the analyzed situation remain, or even get worse.

It is anticipated a growth of the industrial sector in the Exclusive Economic Zone surrounding the Airport as well as the standard of living of the population, with an expected Increase in traffic over time, and inherently Increased emissions and deterioration of air quality in particular, in the Bom Jesus road and on Catete road.

III.7. SOILS

According to the Geographic Atlas of Angola (1982), the most abundant soils in Angola are psamitic soils, which occupy an area of 716,000 km^2, corresponding to 57.5% of the country.

The remaining 42.5% of the area are occupied by the following soils: ferralitic, paraferalitic, tropical arid, lithosoil, hydromorphic, alluvial, clays, fersalitic, limestones, calsialitic and oxysialitic.

According to the same literature source, the Luanda region is characterized by the presence of cromopsamic type soils, which are part of the psamitic class soils, defined as little-evolved soils, consisting of more or less coarse and loose sandy detrital materials.

These soils are poorly or not differentiated, and their texture is extremely light, with low organic matter content and moderately acid pH.

According to Castanheira Diniz (2006), the area of implementation of the Project extends over four distinct soil types. It presents, from south to north, i.e. from water abstraction in the Kwanza river to the different Distribution Centres, the following types:

- Alluvial river soils;
- Lithosols associated with rocky outcrops;
- Black and brown muds;
- Musseque soils.

A brief description of each of the soils types include:

Alluvial riverine soils - recent alluvial deposits occupy large areas, corresponding to or, more precisely, within the limits of the Kwanza Sedimentary Basin.

The soils of the lower surfaces have certain heterogeneity, directly related to the mineralogical composition of the sediments and their size. In this point, they have remarkable influence on the soils of the entire watershed upstream, which, after all, are the main power supply of the means transported by water.

In general, river alluvial soils of medium and fine textures predominate, the former occurring with the highest incidence in the upstream section downwards and the latter in the middle and lower sections, corresponding to the surface of the lower elevations, which will progressively decrease towards the mouth and the banks to the periphery. Not infrequently large areas subject to prolonged, or even permanent flooding , occur here, where the soils are influenced by hydromorphism.

The better-drained alluvial soils with a higher degree of fertility, are distributed generally in the range adjoining the course of the river, whose elevation is slightly higher than the rest of the floodplain.

Figure 58 - Alluvial soils - some places visited during the field survey (August 2014)

Lithosols associated with rocky outcrops - Soils of thin layer, lying on rocky substratum 20 cm or less deep (Lithosols), often associated with rocky material, both in the soil and lying abundantly on its surface (lithic soils).

Such soils often occur in areas where rocky outcrops are shown, with which they are typically associated.

Lithosols occur in sedimentary belts in rugged surfaces that mark gaps along dune formations.

Figure 59 - Lithosols - some places visited during the field survey (August 2014)

Black and Brown Clays - Clays, heavy texture soils, are well represented, particularly between the Kwanza and Dande, corresponding to Oligo-Miocene formations, especially when clay loam or marly limestones emerge, often enriched by materials.

Clays are usually black or dark grey in colour when corresponding to the flattened or depressed valley areas (Black Topomorphic Clays) and brown or diluted olivaceous-brown in situations on slopes (Brown Litomorphic Clays). The former are quite thick and, often, due to their topographical situation, involve poor drainage, present hydromorphic underlying horizon or horizons, characterized by their primatic structure. As for brown litomorfic Clays, their thickness is generally related to the degree of slope with frequent occurrence in the mass of ground limestone concentration and gypsum crystals.

The Clays are clay soils, very sticky and plastic consisting essentially of montmorilonitic clays. While drying out, they shrink, opening wider and deeper cracks; when wet, they become relatively expandable; this alternation gives rise to a typical microrelief called "Gilgai".

Well provided with nutrients, especially calcium and magnesium, they have high usable capacity for water and a very high degree of saturation, factors that provide a high production capacity. However, due to their physical characteristics, severe limitations on their agricultural use, which can only be mitigated by possible appropriate cultivation. Moreover, due to their susceptibility to erosion arising as a result of their low degree of permeability, they require appropriate protection and conservation practices.

Still, in regard to agricultural use and taking into account the ecological and edaphic requirements of the various types of tillage, regard is taken of the fact that the Clays are better suited to cotton, corn and sorghum, and in certain situations to sugar cane. However, given the quantitative scarce rainfall and high degree of variability in its distribution, irrigation is advocated, preferably by adopting the sprinkling technique.

Black and brown Clays, known regionally as "Catete's black lands" correlate with "Vertisols" from the American Classification (7th approximation) and with the Carta de Solos de África de D'Hoore.

Figure 60- Clay soils in the surrounding area of the Project

Musseque soils - In this great pedological unit are included soils that are in correspondence with the raised mushroom surfaces of quartz sediments of Pleistocene, known by the regional name of "musseques", a vernacular term meaning sandy terrain. The musseques soils are generally coarse in texture, very deep, structureless, with pale or bright colours.

Within the gently undulating general relief reddish soils, the most representative, correlate with the desiccated or salient dimensions of flattening surfaces, while the pale soils usually occupy positions surrounding small inland basins. Among the situations occupied by these two types of soil are distributed those of orange and yellow colour, but identified with flattened relief situations. The musseque soils are further characterized by their excessive permeability, weak usable water capacity, low in nutrients, compactness and very low consistency. However, if the underlying horizons are sized textures, a fact which occurs more frequently when there is less quartz and mantle sediment, these soils can be of great interest to agriculture, since they are benefited by irrigation.

The musseque soils of coarse texture, brown or pale, correlate with the "Xeropsamorrególicos" and bright colours with the little saturated chromic ones while medium-textured "Psamo-fersiálicos" musseques are akin to the little saturated, clayey "Fersialíticos" within the classification of the Missão de Pedologia de Angola e Moçambique e Centro de Estudos de Pedologia Tropical.

Figure 61 - Musseque soils - some places visited during the field survey (August 2014)

In Figure 62, textural and colour aspects of some soils are presented, including sandy soils of coarse texture, the project area and surrounding regions. The cartographic projection of the sampling sites is depicted in Figure 63.

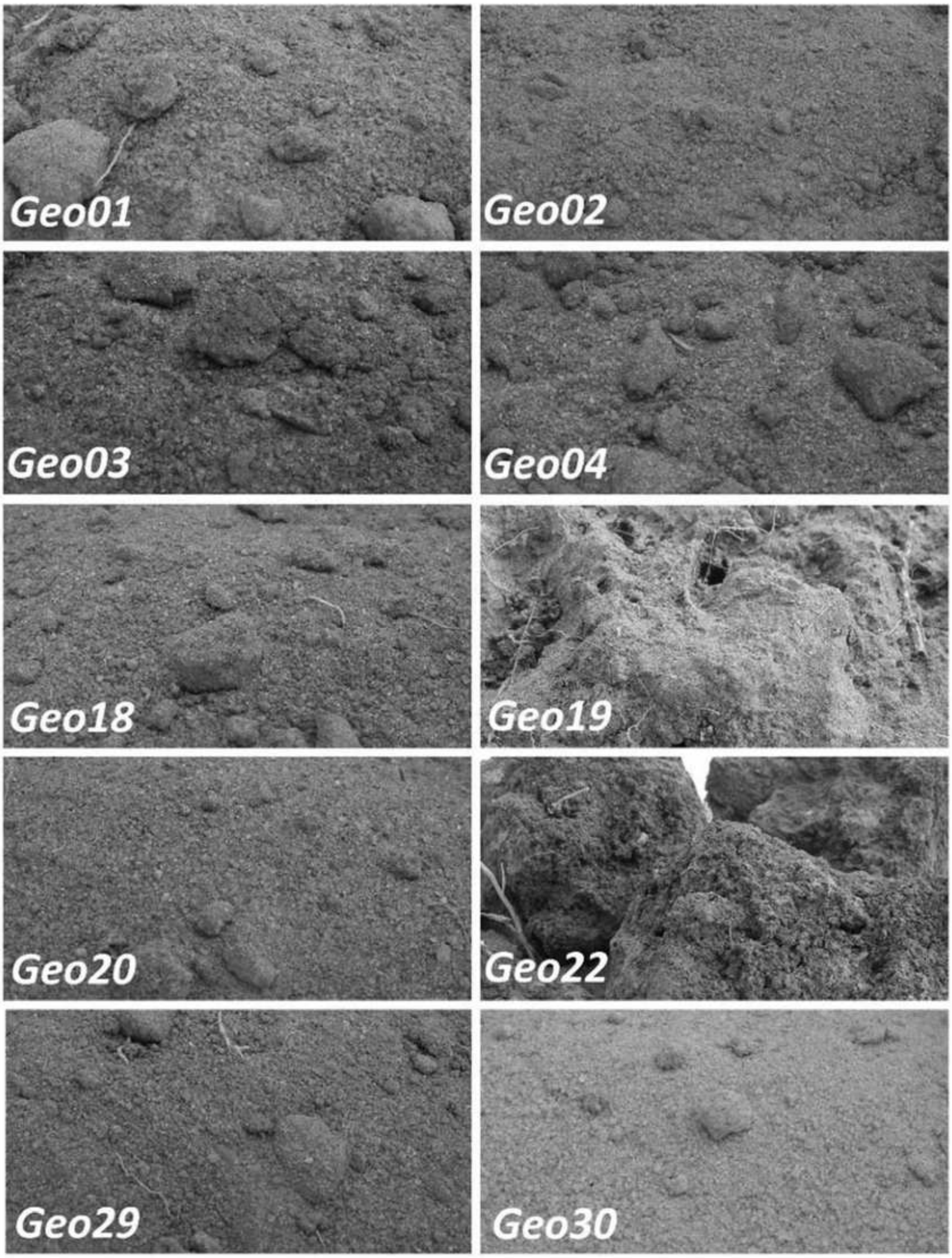


Figure 62 - Textural and colour aspects of some soils of the project area and surrounding regions

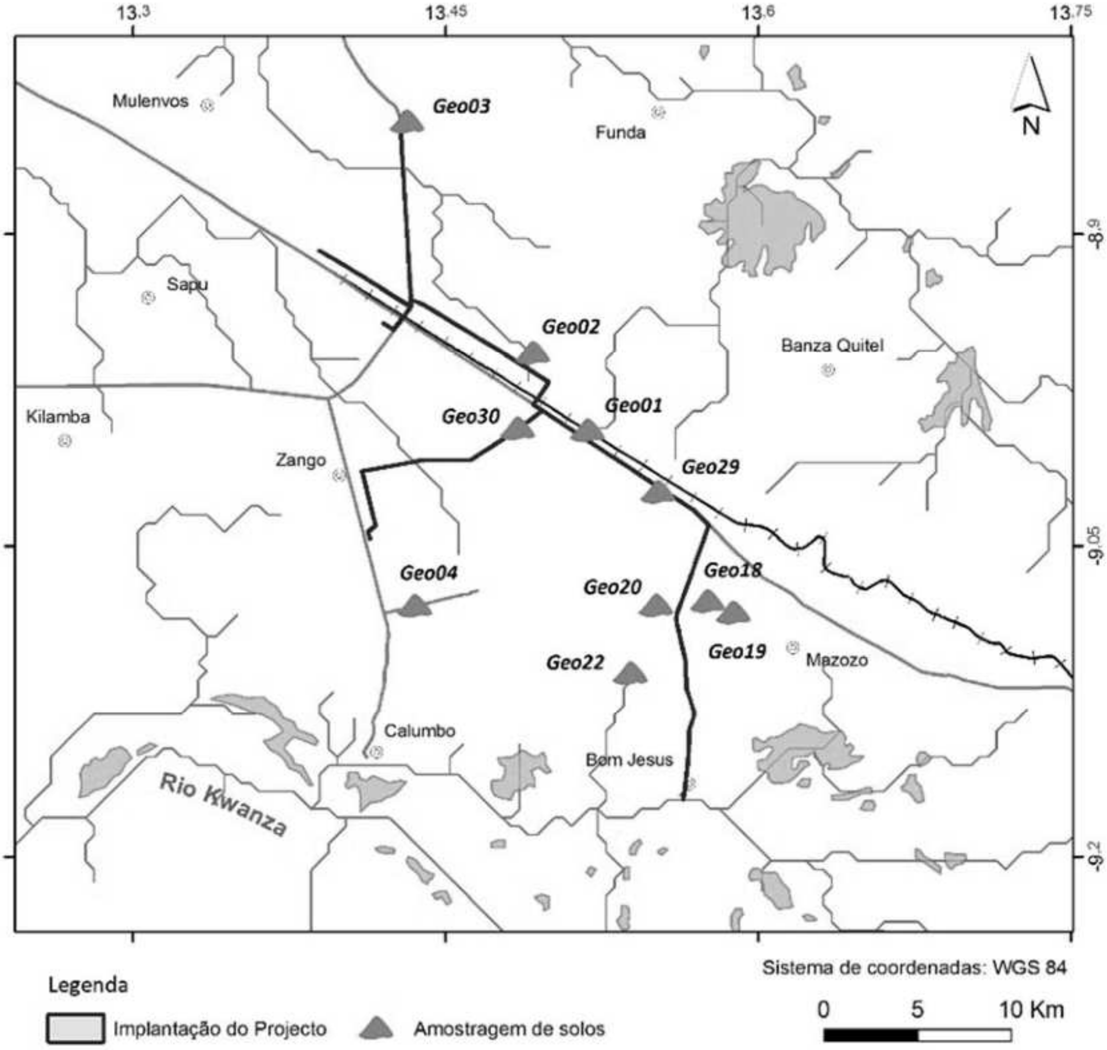


Figure 63 - Soil sampling locations (August 2014)

According to the *Africa Soil Information Service*, in the Project area, roughly comprised between the Kwanza river and the Bengo river, soils have features predominantly displayed in the following table, for the pH and total organic carbon parameters.

Table 25 - Forecast of average values for different soil depths

Soil depth (cm)	Soil pH*	Organic Carbon (g/kg)
0 – 5	5,3 – 6,3	6 – 8
5 - 15	5,3 – 6,3	6 – 8
15 - 30	5,3 – 6,3	6 – 8
30 - 60	5,3 – 6,3	4 – 5
60 - 100	5,3 – 6,3	2 - 3
* In a 1:5 solution (soil/water)		

Also according to the same bibliographic source, and with regard to the availability of nutrients in the soil, the area under study (roughly between the Kwanza and Bengo rivers and west of Catete) is classified as having "no constraints or light constraints ", with some areas have the classification of "moderate constraints".

In terms of soil salinity, nutrient retention capacity and toxicity of the soil, the classification of the whole area reads "without constraints or light constraints".

We must emphasize however that these classifications herein are based on indirect predictive methods on a rough scale, lacking validation on the ground on a finer scale (detailed).

III.7.1. Forecast in Absence of the Project

In the absence of the Project, it is anticipated that the majority of the soils in the region of Luanda will undergo human occupation, both through its use for permanent infrastructure but also with removable and temporary occupations. Human presence, will certainly to a greater or lesser degree bring about the same degradation, via either compressions (e.g. passage of heavy vehicles) or contamination with various substances (e.g. migration of oils and/or hydrocarbons).

Agricultural soils of alluvial origin, and closer to the Kwanza River, certainly will be occupied for intensive agriculture.

III.8. SOIL USE AND PLANNING

With this descriptor, we intend to describe and analyze the area planned for implementation of the Project, as well as its nearest surroundings, in terms of its current occupation.

Spatial planning should be considered a fundamental policy, where different global and sectoral measures are integrated in order to contribute to the promotion of local development and to improve the living conditions of the resident population in the study area. In this context, we sought to identify which planning and management instruments are in place or in preparation that encompass the study area.

The information presented here is based on available literature and cartography, and complemented with field work. Planning instruments are under development.

In an article published in http://www.ipgul.org/ and dated of December 2013, it reads: "The Plano Director Geral Metropolitano de Luanda will be completed in eighteen months (...)". The Plano Director Municipal de Viana was presented to the citizens on 8 July 2014, so that they could submit their suggestions to enrich the document (news published in http://www.portalangop.co.ao/).

The area in which the Project is to be implemented lies within the municipalities of Icolo and Bengo, Viana and Cacuaco. The municipalities involved are: Funda, Viana (Administrative centre), Kabiri, Calumbo and Bom Jesus (Figure 64).

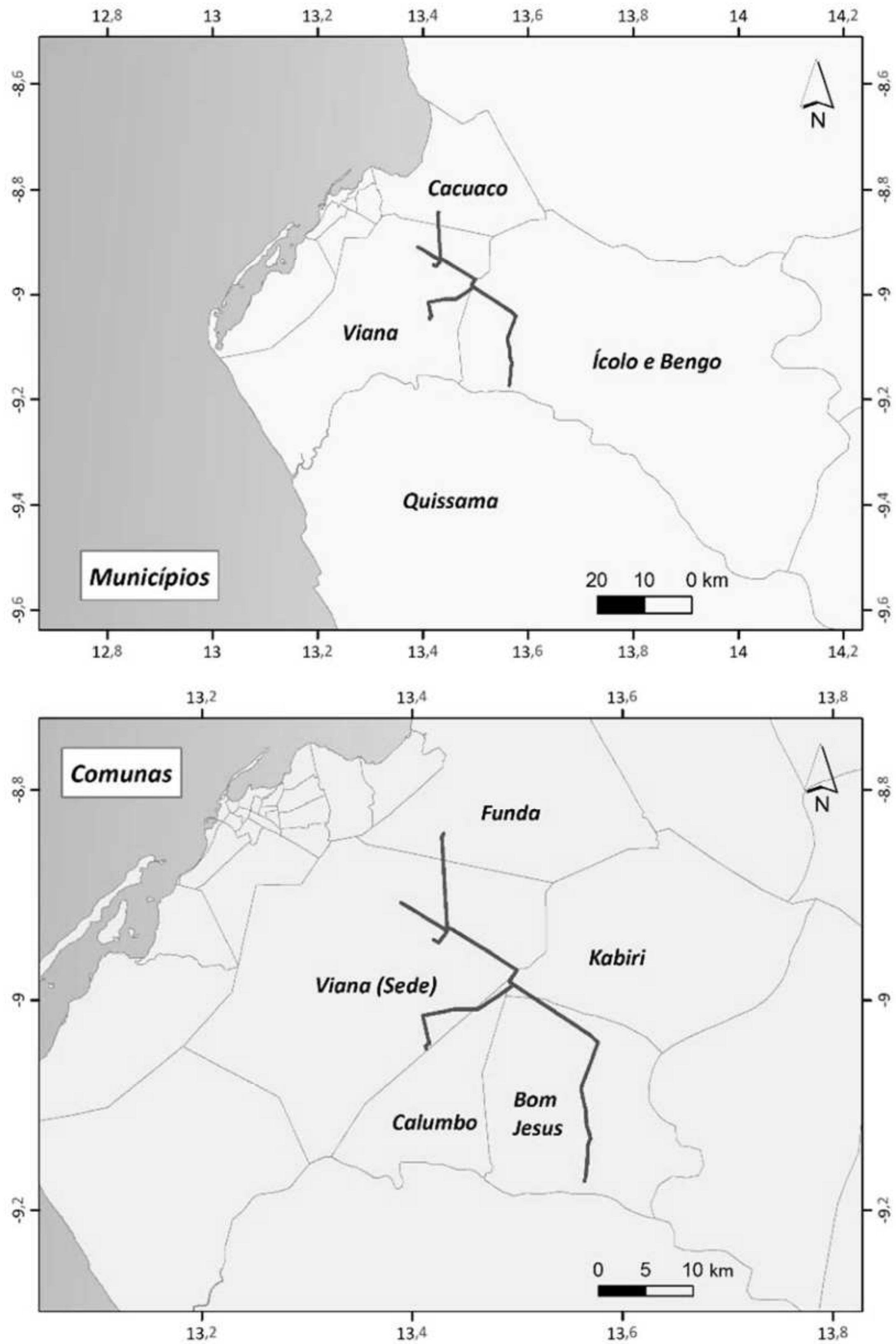


Figure 64 - Implementation of the Project in the territorial context of municipalities and communes

III.8.1 Soil Usage

The province of Luanda is characterized by having cromopsamic type soils, characterized by being directly related to the sandy deposit covers of coarse texture (characteristic of dry regions), generally not very fertile and showing serious problems for retention of water, and for this reason less required for agriculture.

The project area extends longitudinally for approximately 40 km. This extension, along with the proximity of the consolidated urban centre of Luanda, is sufficient to allow great heterogeneity to be observed in terms of land use. This is in addition to the fact that, by reason of the strong economic development of Angola, land use is systematically changing, particularly in the Zango area and parallel to the road to Catete.

Going contrary to the direction of recent land use, associated with new buildings, whether residential, industrial or commercial, we observe a wide variety of areas of abandoned of geological resources exploration without any effort towards landscape and/or environmental restoration. Some of these areas are "transformed" into waste dumps of different kinds, without any visible control.

The following table lists a set of soil occupations, confirmed during field surveys conducted in late August 2014. These uses of the soil are still cartographically represented in Figure 65.

It is noted however that this list is neither exhaustive or complete, and neither is the cartographic representation binding and/or official in nature.

Table 26 - Soil occupations (uses) surrounding the Project area

REF	Brief description	REF	Brief description
01	Extensive agriculture (irrigation). (Figure 66)	02	New Luanda International Airport (under construction).
03	Several sand extraction holdings (some active, others abandoned).	04	Coca-Cola bottling unit.
05	"Perla" brand water bottling unit.	06	Cuca beer bottling unit. (Figure 66)
07	Set of quarries, some with abandoned features.	08	Set of quarries, some with abandoned features.
09	Cement glue factory. (Figure 66)	10	Quarries.

REF	Brief description	REF	Brief description
11	Quarries.	12	Quarries. (Figure 66)
13	Abandoned megrim. Local reception of industrial wastewater. (Figure 66)	14	Quarries.
15	Quarries.	16	Bom Jesus cemetery.
17	China International Fund, Ltd (CIF) Cement works. (Figure 66)	18	Machinery yard and parking.
19	Electricity pylons factory.	20	Fuel station.
21	Yard and large company GDK tanks. (Figure 66)	22	AC Angola construction company.
23	"Telhas do Vale" Factory.	24	Block and tile factory.
25	Centor Car Dealership. Wine warehouse.	26	Novagrolíder company warehouse.
27	Business centre (under construction).	28	CAPI 38 building materials.
29	Sale of building materials. (Figure 66)	30	Tracto-Lena. Building materials.
31	Auto-Sueco (under construction).	32	Customs Logistics Centre.
33	Sonangalp Fuel station.	34	Sonangalp Fuel station (under construction).
35	CIF Brewing.	36	Mercedes (under construction).
37	ETAR.	38	Viana Hotel.
39	Damazé furniture warehouse.	40	Electricity pylons factory.
41	Kero hypermarket.	42	Sogepor. Dealership.
43	IVECO (trucks).	44	Viana Municipal Hospital.
45	Fuel station.	46	Quarries.
47	Abandoned quarry. Currently serves as a dumping ground for apparently Aggregate construction materials.	48	Pond. (Figure 66)
49	Pond.	50	Drainage ditch (endorheic?).
51	Drainage ditch (endorheic?).	52	Quarries.
53	Quarries.	54	Residential area.
55	Residential area.	56	Residential area.
57	"Buena" brand water bottling unit.	58	Residential area.

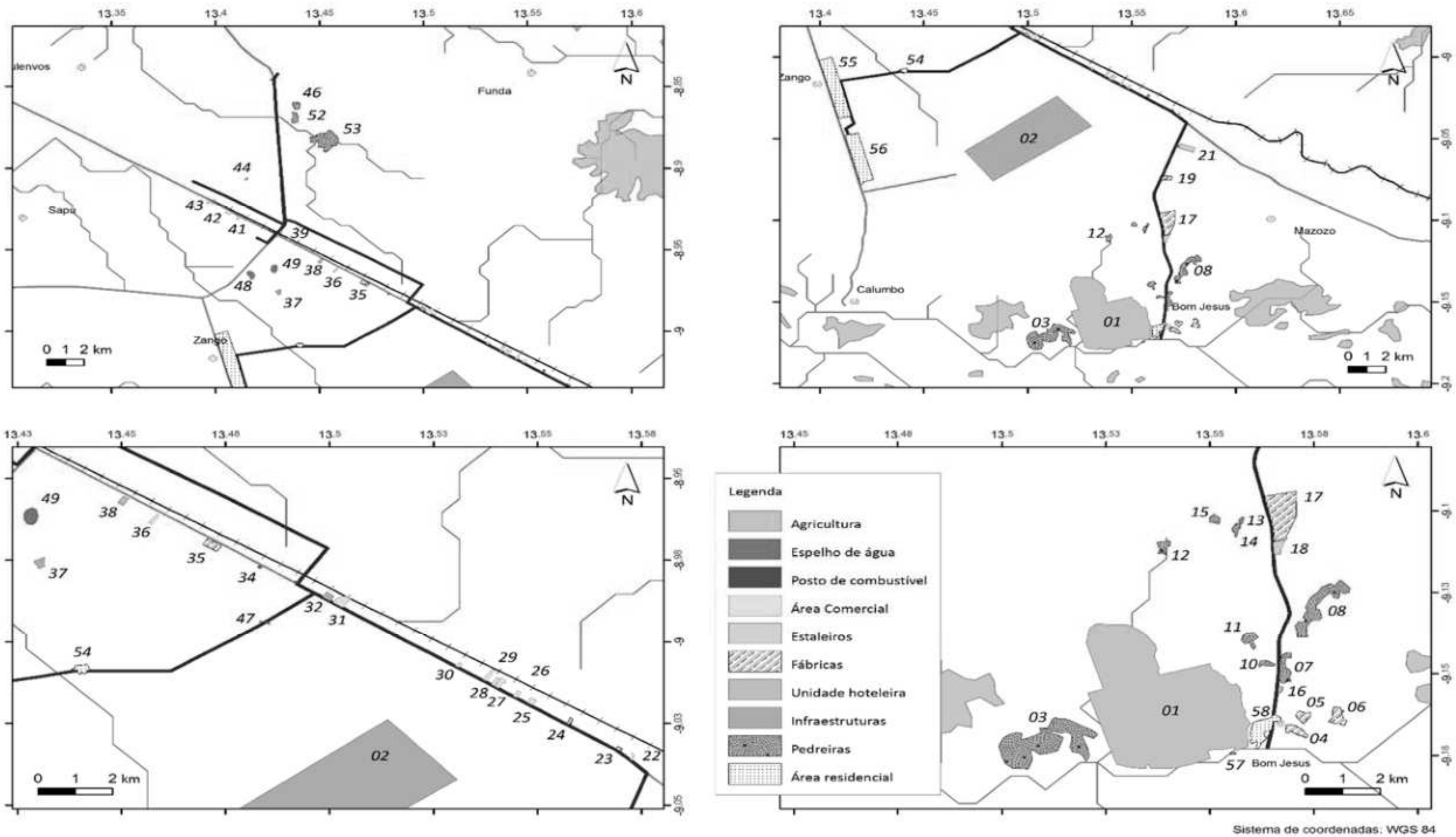


Figure 65 - Soil occupation - not exhaustive cartographic delimitation of different types of soil occupation resulting from field surveys (August 2014)

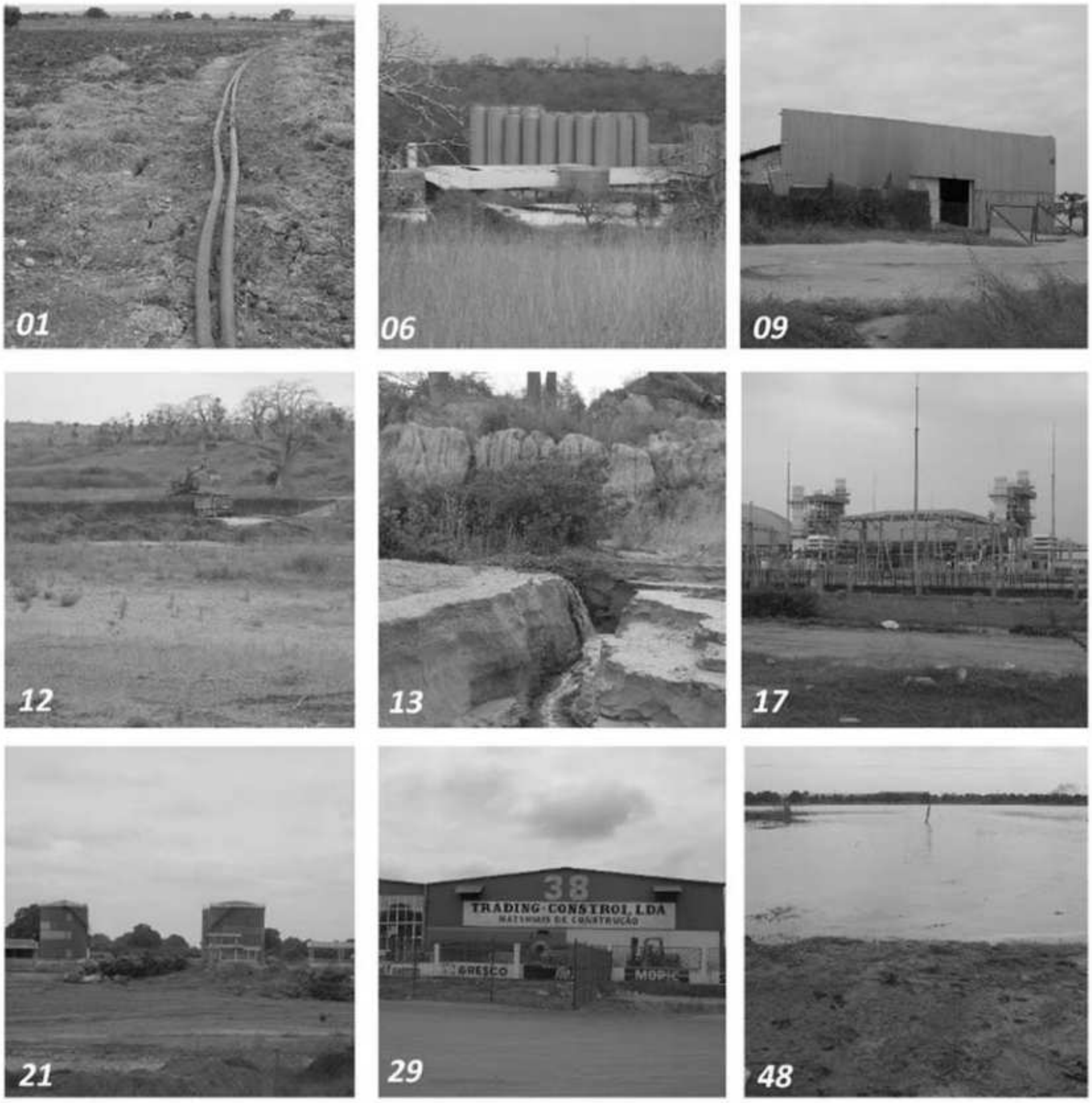


Figure 66 - Examples of different types of soil occupation in the region

III.8.1.1. Accessibility

In recent years, the Luanda region has been characterized by an increasingly improved road and access network, either by improving the state of the highways or by building new roads, as exemplified by the new Luanda ring road.

The Project, with an approximate length of 40km, starts parallel to the Bom Jesus road, paved but quite deteriorated between the CIF cement works and the town of Bom Jesus. Between this factory and Km 44 on the Luanda - Catete road, the ground is in very good condition.

Between Km 44 and Km 33 and the layout of the Project (water pipelines), it follows alongside the Luanda - Catete road, which features terrain, similarly, in good condition.

Between the elements of the Project the PIV DC and the Cacuaco DC, the 11.5 km of pipelines will more or less follow parallel to the Expressway (road with several lanes, in good condition and traffic flow).

III.8.2Planning

The Lei de Terras de Angola (Law 9/4 of November 9th) and the Lei do Ordenamento do Território e do Urbanismo (Law 3/04 of June 25th), approved in 2004, are the only legal instruments to support regulation and development of the project complemented by the basic law of the environment. Spatial planning aims in general to create favourable conditions to ensure the objectives of economic and social development, social welfare, environmental protection and quality of life.

The study area is developed in the province of Luanda, and is still in drafting the leading images of Planning, in compliance with the established in Law. The absence of the final drafts, promulgated and published in the Official Gazette, makes unfeasible, at present, any analysis of compatibility or incompatibility with restrictive areas or public easements.

III.8.3. Forecast in Absence of the Project

In the absence of the Project, land use may have diverse destinations, and it is a difficult and highly uncertain exercise to forecast these future occupations.

At Planning and Territorial level, it is not possible at present to check what projects currently exist, with regard to strategies for the municipality or to the province.

III.9. ECOLOGICAL FACTORS

III.9.1 Methodology

For this characterization the study area is defined as that directly covering the implementation of the project, in its various aspects - pipelines, abstraction, pumping stations, distribution centres and WTP, as well as their local environment, where possible disturbances on ecological systems can manifest themselves.

Regarding the area surrounding the implementation of the project, the specialised field study, focused on the areas of greatest ecological relevance, particularly at the Kwanza River abstraction site, upstream and downstream of this, the lagoon and wetland systems associated with it and the natural strips extending along both sides of the Bom Jesus road. Despite being highly artificialised sites, all the future layout of pipelines and locations of future distribution centres and WTP were also covered.

It is considered that with the definition of this area of study the current state of the project implementation area should be properly assessed , but also its surroundings, where any possible impacts may also be evidenced.

Since the project implementation area is generally artificialised, but also there are gaps in the information on the biodiversity of the region, in this study, rather than a quantitative determination, we intend to make a qualitative evaluation of the floristic and faunal community with special emphasis on species conservation and/or scientific interest.

Thus, rather than determining abundance rates, the experimental design adopted aims to take a census of the main species present that characterise the local ecosystems.

The collection of information in situ, its intersection with the bibliographic data and further discussion, enabled us to determine the value and relevance of the study area for nature conservation, as well as to estimate the impacts associated with the project and the definition of possible applicable measures in mitigation.

The methodology used for the assessment of flora and habitats consisted of a preliminary analysis and a macro scale of the study area from aerial photography, then field work with reconnaissance and definition in situ of the study area, as well as identification of key existing biotopes.

Then sampling points were selected in different biotopes detected, with a focus on those , of greatest importance in conservation terms, which allowed the verification of the presence of priority species or habitats, as well as analysis of the degree of plant communities conservation/maturation through the presence of bioindicators. This analysis allowed a full scale validation of the assumptions made at a macro scale.

Note that the floristic survey was not exhaustive, and for this we would need successive monitoring over an annual cycle. Thus, the methodology adopted for the flora, particularly aimed at finding RELAPE Species (Rare, Endemic, Located, Threatened or Endangered). It also sought to assess the phytosanitary status of each sampling site, the identification of sites of disorder, the characterization of the structure of vegetation and detection of exotic species.

Through this methodology to characterize the baseline flora and habitats, it is possible to estimate the degree of allocation of floristic communities, i.e. the magnitude of the impacts which will support the definition of mitigation and/or compensation measures.

To characterize the faunal community transects were made, intersecting the different biotopes and vegetation types previously considered for identification of different species/groups and to characterize in detail the local fauna.

This characterization enabled the potential Specific Wealth list of the study area to be added to with data on presence/absence, as well as to draw inferences on the phenology of the species present, which habitat is used and the analysis of their conservation status according to the criteria of the IUCN Red List of Threatened species and other specific legislation with relevance to particular species.

For this, a systematic survey was carried out on foot in the most favourable areas, complemented with circuits made at low speed in an all-terrain vehicle. Additionally, surveys were carried out amongst the rural population, to obtain more data about the presence/absence of key species.

Simultaneously and given that the banks of the Kwanza River generally have a very dense vegetation and as such are not easily accessible and very limited visibility, a trip was made up the river using a motorboat, covering the sections upstream and downstream of the future abstraction point at f Bom Jesus, as well as lagoons and wetlands located to the east.

To characterize the fauna community a survey was thus performed supported by various registers, bibliographic data about the ecological requirements of different species and their subsequent linkage with the data concerning the identification of biotopes present. Through this methodology to characterize the faunistic communities, it was possible to estimate the degree of allocation of floristic communities, i.e., the magnitude of the impacts which will support the definition of mitigation and/or compensation measures.

As previously stated, given the gaps in existing information, it was considered preferable to carry out a comprehensive survey of existing species, registering all direct or indirect contact, rather than the use of census methodologies and calculation of abundance rates, which would cause the exclusion of many species.

The community of non-flying terrestrial mammals was carried out by direct observation, or indirectly, using indications of presence (droppings, tracks, burrows, footprints, traces of food, etc.), through the implementation of pedestrian transects, supplemented with transects by automobile at low speed and boat in the Kwanza River and lagoon/wetlands adjacent.

In the case of birds, their presence was confirmed by viewing directly or indirectly by auditory identification, with several breaks being made along the transects to listen for vocalizations. This sampling was carried out during periods of increased activity for most species – at dawn and late afternoon.

To detect terrestrial reptiles potential places of shelter (rocks, stumps and tufts of vegetation) that were detected along the transects were prospected.

Regarding amphibians, prospecting was directed primarily at a search in small ponds or pools that may have relevance for the conservation of amphibians and of course in nearby areas of the Kwanza River. This monitoring generally needs to be carried out at nighttime, however the security conditions allowing this methodology to be applied in the river area were not met.

The Specific Wealth obtained was then listed, allowing inferences to be drawn regarding the phenology, existence of endemisms and the evaluation of the status of conservation of the different species.

III.9.2 Interaction with Sensitive Areas

The area where the project is located lies between two ecologically important areas. Namely the *Important Bird Area* (IBA) of the Mussulo (Code AO021), whose boundary is located about 30 kilometres west of the final section of the Project (Capalanga DC) and the National Park of Quiçama (which overlaps with the IBA Quiçama (Code AO022) whose northern boundary is located about 5 miles south of the Abstraction Point of Bom Jesus, as depicted below in Figure 67.

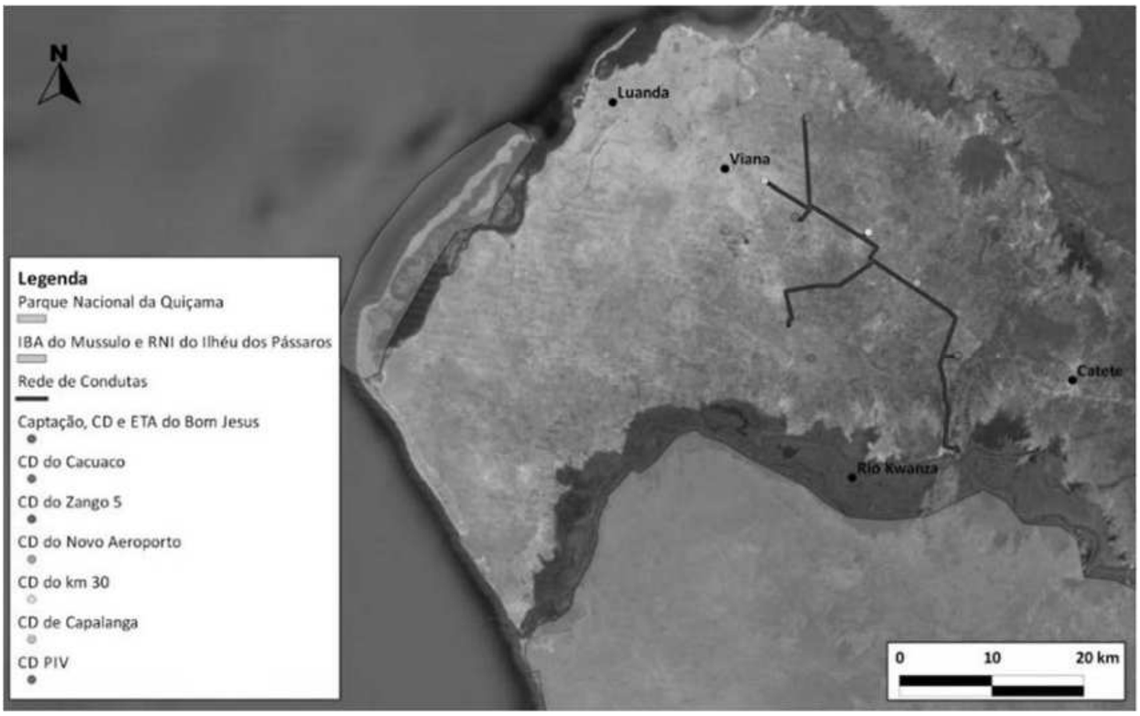


Figure 67 - Framework for implementation of the project area on sensitive/classified areas.

It is not considered that the study area corresponds to an ecological corridor of non-flying terrestrial vertebrates between the two areas classified, since not only the ecological characteristics of both are very different, but also there is a physical barrier – the Kwanza River.

With regard to birds, the study area does not correspond to an ecological corridor between the two areas, since it will be preferably carried out via the river and the coastal strip.

This coastal strip corresponds to the one proposed in 1985 to the creation of the *Reserva da Biosfera Quiçama-Mussulo*, which encompassed the current Quiçama National Park and the entire coastal strip to the far north of Mussulo.

Figure 68 - Photograph taken in July 2014 from the Project site showing the National Park of Quiçama in the distance over the Kwanza River

Within the area that is internationally classified (by BirdLife International) as IBA do Mussulo, is the Integral Natural Reserve of Birds Islet, created in 1973 due to its importance as a place of refuge/breeding for birds but also because of its mangroves, which have a high wealth of species. This reserve currently has no type of management or supervision.

Nevertheless, and as discussed below, future water abstraction is located in the vicinity of an important wetland.

III.9.3 Flora and Habitats

III.9.3.1 Bio and Phytogeographical Framework

The area of implementation of the project, like all sub-Saharan African country with the exception of Madagascar is part of the Afrotropical Biogeographical Region, the Phytogeographic Zambeziac Region (White, F. 1983).

According to Classificação Climática de Köppen-Geiger in its updated version (June 2006), the climate in the study area is the type *BSh - Hot Arid Steppe*, with a $T_{ann} \geq +18$ ° C.

The floristic diversity of a region is a good indicator of existing anthropogenic action, since it is directly resulting from the interaction between the various biotic and abiotic factors, allowing the assessment of the degree of departure from the successional climax stage.

According to the *Carta Fitogenética de Angola* (Barbosa. 1970), which describes 32 vegetation units, the Province of Luanda features a vegetation typically comprised of a *Mosaic of xeric grasslands, shrub and xeric scrub forests of Adansonia.*. The study area is mostly member of the Sociological Zone of *Adansonia digitata*, with Grass from *Hymenostegia loxiflora*, *Ptaeroxylon obliquum* and *Commiphora angolensis*, poor in grass.

III.9.3.2 Floristic Inventory

The study area has a concentrated human occupation from Cacuaco and Capalanga to the vicinity of the *New Airport*. From here southwards, to Bom Jesus, there are some settlements, a more rural environment, with clear evidence of anthropogenic pressure on the surrounding areas, with a focus on waste disposal, trampling and clearing, however it appears that the remaining areas are remain generally well preserved and without major disturbance.

During the field survey it was possible to identify four major biotopes in the study area: Aquatic (Kwanza River/lagoon areas system), Forests of Adansonia and Euphorbia, Wetlands and Agricultural Areas, as illustrated in Figure 68. The remaining area (under the influence of the project) is fully artificialized or in an advanced state of ecological degradation, which was not targeted by this macro biotope analysis.

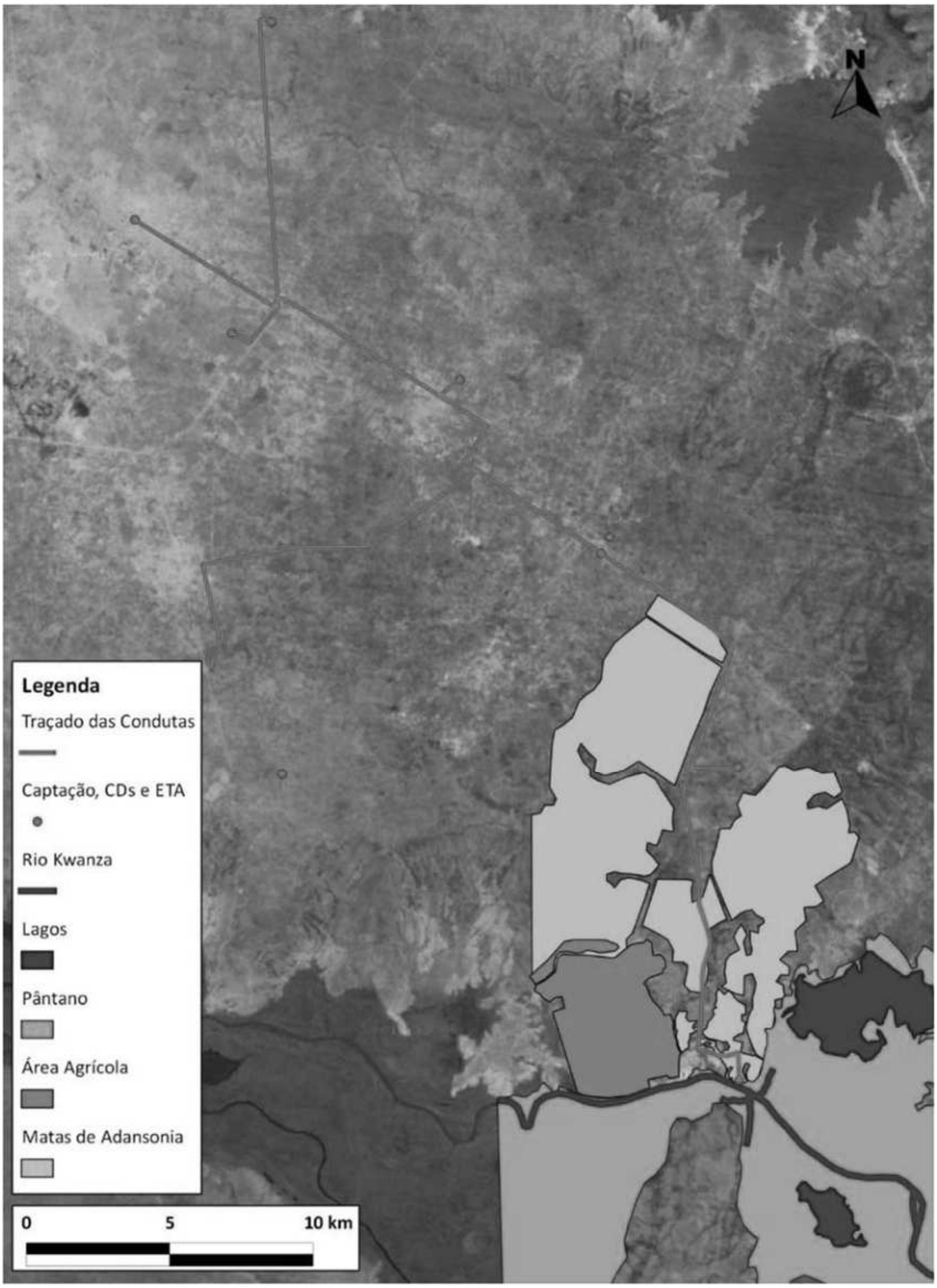


Figure 69 - Distribution of key biotopes in the study area (areas not marked are outside the direct area of influence of the project, totally artificialized or in an advanced state of ecological degradation

The aquatic biotope, as mentioned above, corresponds to the Kwanza River and numerous lakes that are associated with it. The interface between this biotope and land on the other biotope is made, as discussed below, highly prominent in the study area: the marshes, or through the alluvial riverbanks. Here there was the occurrence of a riparian gallery, before the sometimes isolated presence of palm and mango trees, but especially of herbaceous cover, mostly composed of reeds (*Phragmites mauritianus*). These banks are seasonally flooded, still used as small areas of cultivation, especially for corn. Due to the very dry climate, the transition between the banks and the typical *Adansonia* Forest is very abrupt, not allowing the development of a true riparian gallery.

Figure 70 - Kwanza River Banks.

The marshes cover a significant area surrounding the future abstraction point of Bom Jesus and has high ecological wealth, mainly because of the functions they perform, such as breeding and feeding area for many species, but also by representing a buffer between the lagoon system and the river itself.

As expected and as shown in the following Image, this biotope is completely dominated by herbaceous stratum, with a coverage of 100%, with the exception of narrow channels through which water flows, maintained by anglers. The main constituent species are Reed (*Phragmites mauritianus*), alternating with patches of Papyrus (*Cyperus papyrus*), Bulrush (*Typha capensis*) and Barnyardgrass (*Echinochloa stagnina*). This biotope, partially dependent on seasonal fires, was seen to be in good phytosanitary condition. Finally the presence of an exotic species, Water Hyacinth (*Eichhornia crassipes*) should be noted.

Figure 71 - Swampy area

The agricultural area, located west of Bom Jesus, presents no great ecological importance, the exception being the existence of some ponds retained for irrigation, which play an important role as drinking places for wildlife.

Figure 72 - Wetlands surrounding agricultural fields

In the area north of the Kwanza River and both sides of the site of the pipeline for the WTP, lies the largest biotope in the study area. This biotope is formed by a mosaic of Dry Savannah and *Adansonia* and *Euphorbia* Forests, and the unit corresponding to the dominant local vegetation described by the *Carta Fitogenética de Angola* (Barbosa. 1970).

This biotope is characterized by dry soil conditions, with the tree stratum being almost exclusive dominated by Embondeiro, with shrubby undergrowth in general not exceeding 2 m in height, interspersed by certain typical Miombo species such as *Brachystegia spiciformis*, *Sterculia setigera*, *Parinari curatellifolia*, *Syzygium guineense* and *Strychnos spinosa*.

The area of construction of the Pumping Station associated with the abstraction point, located in this biotope, as illustrated in the following Image.

Figure 73 - Adansonia and Euphorbia Forest near the future abstraction point

The composition of this biotope varies according to human pressure (such as burning for turning to cultivation), water availability, land topography, the flat areas consisting of tree stratum and more scattered shrubs and ground cover made almost entirely of grass (*Pennisetum purpureum*), a Savannah-type mosaic. In turn, growth in the more embedded valleys is in the form of pure forest, with a total prevalence of tree strata (which often supports a developed stratum of liana-type growth) and shrubs, the latter varying according to available moisture, or the existence of water courses (although short-lived).

The following Images illustrate the variation in the composition depending on the topography of the biotope and humidity conditions.

Figure 74 - From left to right and top to bottom, Mosaic of Adansonia Forest/Savannah; Adansonia forest flanking a water course dominated at herbaceous level by Typha capensis; Adansonia and Euphorbia Forests with liana growth and well-developed shrub layer embedded in the valley; Adansonia Forest subject to pressure by fires not destroying mature trees, influencing the development of new trees, as well as the shrub layer

In general, this biotope is healthy and shows little disturbance. The massive presence of an exotic species, Sweet prickly-pear (Opuntia ficus-indica) should be highlighted.

The following table shows the Specific Wealth obtained for the study area, as well as the Statutes of Conservation of different species .

This list contains some food species such as cassava, mango, cashew, banana and sugar cane, since apart from their socio-economic importance, there is its spontaneous emergence in the study area, in abandoned areas of cultivation in the immediate vicinity of villages and areas of greater water availability.

Table 27 - Floristic inventory of study area *vs* Conservation Statutes

Family	Species	Common name [1]	IUCN
Anacardiaceae	*Anacardium occidentale*	Cashew nut	NE
	Mangifera indica	Mango tree	DD
Araceae	*Colocasia esculenta*	Coco yam	LC
Arecaceae	*Elaeis guineensis*	African oil palm	NE
	Hyphaene guineensis	Matebeira	NE
Cactaceae	*Opuntia ficus-indica* [3]	Sweet prickly-pear	DD
Caricaceae	*Carica papaya*	Papaya	NE
Chrysobalanaceae	*Chrysobalanus icaco*	Cocoplum	NE
	Parinari curatellifolia	Ombulucha	NE
Compositae	Non-identified Species	-	-
Cyperaceae	*Cyperus papyrus*	Papyrus	LC
	Cyperus sp.	-	-
Erythroxylaceae	*Erythroxylum emarginatum*	[2]	NE
Euphorbiaceae	*Euphorbia ingens*	Candelabra tree	NE
	Manihot esculenta	Manioc	NE
Fabaceae	*Acacia tortilis*	Umbrella thorn	NE
	Brachystegia spiciformis	Onduko	NE
	Tamarindus indica	Tamarind	NE
Loganiaceae	*Strychnos spinosa*	Spiny monkey-orange	NE
Malvaceae	*Adansonia digitata*	Baobab	NE
	Sterculia setigera	Karaya gum tree	NE
Moraceae	*Ficus* sp.	Fig tree (gen)	-
Myrtaceae	*Syzygium guineense*	Forest waterberry	NE
Nymphaeaceae	*Nymphaea nouchali*	Waterlily	LC
Poaceae	*Echinochloa stagnina*	Burgu grass	LC
	Non-identified Species	-	-
	Pennisetum purpureum	Grass	NE
	Phragmites mauritianus	Reed grass	NE
	Saccharum officinarum	Sugar cane	NE

Pontederiaceae	*Eichhornia crassipes* (3)	Water hyacinth	NE
Pteridaceae	*Acrostichum aureum*	Swamp fern	LC
Thyphaceae	*Typha capensis*	Bulrush	LC
Xanthorrhoeaceae	*Aloe* sp.	Aloe (gender)	-

Caption: IUCN – Conservation Status according to the *International Union for Conservation of Nature* (Version 3.1);**NE –** Not evaluated; **LC** – Least concern;**(1) -** Since there is no official list of vernacular names of the species, (when available) the most consensual designations were used. **(2) -** Unknown common name; **(3) -** Exotic/Invasive Species.

A survey carried out confirms that the floristic diversity of the area of implementation of the project and the surrounding area is moderately diverse, being somewhat conditioned by the dry climate and anthropogenic pressure. It is in the *Adansonia* e *Euphorbia* Forests that Specific Wealth is greater, especially in valley areas, where humidity is increased and at the same time there is an absence of burning.

It should also be noted that during the field survey no flowering was observed, which influenced identification of more species of flora, especially at the level of the herbaceous stratum.

During the prospecting work carried out the presence of any kind of *RELAPE* (*rare, endemic, localized, threatened or endangered*) specie was not detected.

The presence of two infesting exotic species was detected: in the Kwanza river, the water hyacinth (*Eichhornia crassipes*) and in the driest areas the Sweet prickly-pear (*Opuntia ficus-indica*).

In terms of habitats, it was found that the study area presents an interesting mosaic, different biotopes and ecotones having been detected, which in itself allows a diverse community of fauna to be accommodated, as will be examined below.

Regarding the sites of direct implementation of the project, the Abstraction Point and its Pumping Station is located in a forest of baobabs in reasonable condition. There is no riparian gallery associated with the bank at abstraction point, only herbaceous and seasonal areas of cultivation.

Regarding the implementation of pipelines, most of the layout will be parallel to existing roads, consequently with little or no vegetation, while not dismissing the occasional overlap with adult specimens of Baobab, a situation that should be identified in the work of surveying.

The sites of future of distribution centres, as well as the WTP, consist of ecologically degraded areas dominated by herbaceous vegetation, including grass, as well as some scattered bushes and Manioca. At these locations the existence of Baobabs has also been verified, especially at the future Cacuaco Distribution Centre, as illustrated in the following Image.

Figure 75 - Location of the deployment of future Cacuaco DC with many Baobabs

III.9.4 Fauna

III.9.4.1 Faunistic Inventory

As previously mentioned, the mosaic of vegetation in the study area forms different biotopes that can be used by different species as a place of refuge, feeding and reproduction.

Simultaneously and despite the anthropogenic pressure that exists on the area, due to the existence of road infrastructure, large industrial areas (and eventually an airport) and housing units, the study area appears relatively well preserved and quite unfragmented, especially between the New Airport and Bom Jesus, with special emphasis on the eastern side of the Bom Jesus Road, the existing wetland area.

The faunal community detected during the field survey consists mostly of common species and distributed quite widely; however is relatively diverse and in places some species of high conservation importance occur.

As stated previously, given the gaps in existing information about the local fauna community, rather than drawing up indices of abundance or diversity, we chose a methodology that allowed the detection of as many species as possible, by performing sampling transects targeted at the different animal groups, allowing us to draw inferences regarding the Specific Wealth of the site and record baseline data for future comparison.

In the work for this descriptor, we identified 56 families and 94 species, which are listed in the following table, as well as their statutes conservation internationally.

Table 28 - Study area faunistic inventory *vs* Conservation Statutes

Family	Species	Common name (1)	IUCN
	Birds		
Accipitridae	*Circaetus cinereus*	Brown Snake Eagle	LC
	Gypohierax angolensis	Palm-nut vulture	LC
	Gyps africanus	White-backed vulture	EN
	Haliaeetus vocifer	African Fish-eagle	LC
	Hieraaetus wahlbergi	Wahlberg's Eagle	LC
	Micronisus gabar	Gabar goshawk	LC
	Polyboroides typus	African Harrier-hawk	LC
Alcedinidae	*Ceryle rudis*	Pied kingfisher	LC
	Halcyon malimbica	Blue-breasted kingfisher	LC
	Halcyon senegalensis	Woodland kingfisher	LC
Anatidae	*Dendrocygna viduata*	White-faced whistling-duck	LC
Apodidae	*Apus caffer*	White-rumped Swift	LC
	Cypsiurus parvus	African Palm-swift	LC
Ardeidae	*Ardea alba*	Great White Egret	LC
	Ardea cinerea	Grey Heron	LC
	Ardea goliath	Goliath Heron	LC
	Ardea melanocephala	Black-headed Heron	LC
	Ardea purpurea	Purple Heron	LC
	Ardeola ralloides	Squacco Heron	LC
	Bubulcus-ibis	Cattle Egret	LC
	Butorides striata	Green-backed Heron	LC
	Egretta garzetta	Little Egret	LC
Bucerotidae	*Tockus alboterminatus*	Crowned Hornbill	LC
Burhinidae	*Burhinus capensis*	Spotted Thick-knee	LC
Charadriidae	*Vanellus senegallus*	Wattled Lapwing	LC
Ciconiidae	*Anastomus lamelligerus*	African Openbill	LC

Family	Species	Common name [(1)]	IUCN
	Birds		
Collidae	*Colius castanotus*	Red-backed Mousebird	LC
	Urocolius indicus	Red-faced Mousebird	LC
	Urocolius indicus	Red-faced Mousebird	LC
Columbidae	*Streptopelia capicola*	Ring-necked Dove	LC
	Streptopelia decipiens	Mourning Collared-dove	LC
	Streptopelia senegalensis	Laughing Dove	LC
	Turtur chalcospilos	Emerald-spotted Wood-dove	LC
Coraciidae	*Coracias caudatus*	Lilac-breasted Roller	LC
Corvidae	*Corvus albus*	Pied Crow	LC
Cuculidae	*Centropus grillii*	Black Coucal	LC
Dricuridae	*Dicrurus adsimilis*	Fork-tailed Drongo	LC
Estrildidae	*Estrilda astrild*	Common Waxbill	LC
	Lonchura cucullata	Bronze Munia	LC
	Uraeginthus angolensis	Blue-breasted Cordonbleu	LC
Fringillidae	*Serinus mozambicus*	Yellow-fronted Canary	LC
Glareolidae	*Glareola pratincola*	Collared Pratincole	LC
Hirundinidae	*Hirundo rufigula*	Red-throated Swallow	LC
	Riparia cincta	Banded Martin	LC
Jacanidae	*Actophilornis africanus*	African Jacana	LC
Meropidae	*Merops apiaster*	European Bee-eater	LC
	Merops pusillus	Little Bee-eater	LC
	Merops superciliosus	Olive Bee-eater	LC
Motacillidae	*Anthus pallidiventris*	Long-legged Pipit	LC
Muscicapidae	*Bradornis pallidus*	Pale Flycatcher	LC
Musophagidae	*Corythaixoides concolor*	Grey Go-away-bird	LC
Nectariniidae	*Cinnyris bifasciatus*	Common Purple-banded Sunbird	LC
Numididae	*Numida meleagris*	Helmeted Guineafowl	LC
Passeridae	*Passer domesticus*	House Sparrow	LC
	Passer griseus	Northern Grey-headed Sparrow	LC
Phalacrocoracidae	*Microcarbo africanus*	Long-tailed Cormorant	LC
Phasianidae	*Pternistis afer*	Red-necked Francolin	LC
Picidae	*Campethera bennettii*	Bennett's Woodpecker	LC
	Dendropicos fuscescens	Cardinal Woodpecker	LC
Ploceidae	*Ploceus cucullatus*	Village Weaver	LC
	Ploceus intermedius	Lesser Masked Weaver	LC
	Ploceus intermedius	Lesser Masked Weaver	LC
	Ploceus xanthops	Holub's Golden Weaver	LC
	Quelea quelea	Red-billed Quelea	LC
Pluvianidae	*Pluvianus aegyptius*	Egyptian Plover	LC

Family	Species	Common name [1]	IUCN
Birds			
Rallidae	*Amaurornis flavirostra*	Black Crake	LC
Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt	LC
Scolopacidae	*Arenaria interpres*	Ruddy Turnstone	LC
	Tringa stagnatilis	Marsh Sandpiper	LC
Sturnidae	*Lamprotornis acuticaudus*	Sharp-tailed Glossy-starling	LC
	Lamprotornis nitens	Red-shouldered Glossy-starling	LC
Upupidae	*Upupa africana*	African Hoopoe	NE
Viduidae	*Vidua macroura*	Pin-tailed Whydah	LC
	Vidua paradisaea	Eastern Paradise-whydah	LC
Mammals			
Bovidae	*Sylvicapra grimmia* [2]	Common Duiker	LC
	Tragelaphus scriptus [2]	Bushbuck	LC
Cercopithecidae	*Chlorocebus pygerythrus* (super-species *Cercopithecus aethiops*)	Vervet	LC
Felidae	*Felis silvestris lybica* [2]	African Wildcat	LC
Herpestidae	*Ichneumia albicauda*	White-tailed Mongoose	LC
Leporidae	*Lepus microtis*	African Savannah Hare	LC
Muridae	*Pelomys* sp.	Swamp Rat (gender)	LC
Mustelidae	*Aonyx capensis*	African Clawless Otter	LC
Sciuridae	*Paraxerus cepapi*	Smith's Bush Squirrel	LC
Suidae	*Potamochoerus larvatus*	Bushpig	LC
Trichechidae	*Trichechus senegalensis* [2]	West African Manatee	VU
Viverridae	*Genetta* sp.	Genet (gender)	-
Herpetofauna			
Agamidae	*Agama* sp.	Agama (gender)	-
Colubridae	*Philothamnus angolensis*	Western Green Snake	LC
Crocodylidae	*Crocodylus niloticus*	Nile Crocodile	LC
Elapidae	*Dendroaspis viridis* [2]	Western Green Mamba	NE
	Naja nigricollis [2]	Black-necked Spitting Cobra	NE
Gerrhosauridae	*Gerrhosaurus bulsi*	Common name unknown	NE
Scincidae	*Trachylepis acutilabris*	Common name unknown	NE
Varanidae	*Varanus niloticus* [2]	Water Leguaan	NE

Caption: IUCN – Conservation Status according to the *International Union for Conservation of Nature* (Version 3.1);**NE –** Not evaluated; **DD -** Data deficient; **LC** – Least concern; **NT -** Near threatened; **EN -** Endangered; **CR -** Critically endangered; **(1) -** Since there is no official list of vernacular names of the species, (when available) the most consensual designations were used. Bird taxonomy is according to inventory by Mills & Melo, 2013; (2) - not detected by the team but considered as highly probable and proven by survey among inhabitants.

In the study area, 74 bird species were detected, most residents. It should be noted that the scope of this study covers the general characterization of the faunal community, not including field studies undertaken of an exclusively ornithological aspect, issuing birdcalls or the placement of Japanese nets to make catches in areas of denser vegetation. Thus, less conspicuous species may have been subjected to a sub-sampling. Simultaneously, the sample is not representative of an annual cycle, and require that the presence of some species undertake migrations, even if they are only intra-African context. From the above it is considered that the study area has a high diversity of bird life, particularly in terms of wetlands, which are nesting sites for many species, a fact that is further reinforced by the large number of families (38) identified.

Of birds detected, the White-backed Vulture (Gyps africanus) presents the most unfavourable conservation status: *EN – Endangered*.

Also noteworthy was the abundant presence of a species considered by several authors as endemic to Angola, the Red-backed Mousebird (Colius castanotus). Finally it should be noted detecting the Kwanza River, an example of an Egyptian Plover(Pluvianus aegyptius), whose records of occurrence in Angola are very rare, since the Congo is considered as the southern limit of their distribution.

Figure 76 - Red-backed Mousebird (Colius castanotus) and Egyptian Plover (Pluvianus aegyptius)

During the surveys carried no core arboreal bat cave or shelter used by bats was found. Given the information gaps (*see* **Chapter VII- Information gaps**) on the fauna of small mammals and the short period in which the study was undertaken, trapping techniques were not used to capture and characterize them. At the same time, no food pellets of birds of prey were found that allowed their identification through skulls or hair.

In the study area 11 species of non-flying terrestrial mammals were detected, members of 10 families. It should be noted that in two cases it was only possible to identify with certainty the genus, since these identifications were based on indirect evidence of the presence (in this case droppings) virtually indistinguishable within the genus (*Genetta* sp. and *Pelomys* sp.).

For aquatic mammals, although no specific methodology has been applied to research the African Manatee (*Trichechus senegalensis*), its occurrence has been confirmed in the Kwanza river, by surveys among the fishing community. Secondly, possible to confirm because occasionally specimens of this species are killed by drowning in nets or directly by the fishermen, who due to ignorance deem them to be a dangerous animal given their large size, and in competition for the fish, although they are a mostly herbivorous species.

Due to the depletion of the population of mammals that occurred during the civil war and human pressure on the area, the herbivores are virtually nonexistent in the area and consequently, medium/large carnivores as well. The most abundant species of mammals in the study area are Vervet and Smith's Bush Squirrel.

Figure 77 - Vervet (Chlorocebus pygerythrus) and Smith's Bush Squirrel (Paraxerus cepapi).

No species of non-flying land mammal with unfavourable conservation status, or a more restricted distribution area, was detected.

In terms of herpetofauna, 8 species of terrestrial reptiles, were detected in the study area members of 7 Families. We did not detect the presence of any species of frog in the study area.

The largest percentage of the study area corresponds to a relatively arid zone and the time of year is extremely dry, so hardly conducive to the occurrence of amphibians. On the banks of the Kwanza/River Swamp the safety conditions for prospecting amphibians were not met.

No terrestrial reptile species with unfavourable conservation status was detected; however this is a class which, like amphibians, in Angola presents important information gaps regarding specific inventory, population trends and conservation status.

III.9.5 Cinegetic Interest

The area of implementation of the project and on a larger scale, the defined area of study, given the ecological components described above regarding the absence of large mammals, but also the presence of roads, industry, a future airport and the existence of several villages scattered around the area, has no relevance to the hunting practice.

III.9.6 Forecast in Absence of the Project

In light of the biological and ecological characteristics found in the study area and described above, it is considered that this area has the capacity to accommodate a diverse fauna and flora community, consequently with a good biodiversity.

The main sources of anthropogenic disturbance on the study area are due to industry, which besides having large units, leads to the existence of numerous extractions of aggregates and water abstraction. Simultaneously, also human occupation itself, since the existence of some villages generates effects in the surrounding areas, with particular emphasis on waste disposal.

In the absence of the project in question it is to be supposed that the evolution of the study area due to heavy human settlement, housing and industrial level, will maintain this course of development, with consequent loss of habitat in the area of Bom Jesus and strong increase in disturbance on the adjacent wetland, the uncontrolled increase of abstraction and discharge of effluents.

III.9.7 Synthesis

Since the sampling carried out is not representative of an annual cycle and presented a general nature (the sampling was not targeted to the search for a single group or species), the high number of species and families confirmed on the site suggest a high biodiversity of the area between Bom Jesus and the future Airport, resulting from its location adjacent to an important wetland.

In terms of flora the presence of any endemic species, of localized distribution, with special scientific importance or unfavourable status, was not detected. The swampy area is seen to be in good ecological condition, with very little fragmentation.

As regards fauna, despite the community being in general characterized by its composition by ordinary species, relatively tolerant to human presence and widespread distribution, species of high conservation importance were identified in the area, with emphasis on the African Manatee (Trichechus senegalensis).

Despite the existence of large gaps in information for the study area in relation to groups of amphibians and bats, surveys conducted in the field suggest a low conservation importance of this area for these groups. The exception is made for wetland that can accommodate an important community of these groups (and represents a feeding area for bats).

In terms of fauna reptiles, mammals and birds were found to be a diverse community, which reflects the relevance of the study area for these groups. It should be noted that in the case of small mammals there are large gaps in information about the constituent species of the area and their population trends.

Despite the human occupation of the area with the existence of some villages, roads with considerable traffic, heavy industry and numerous water abstractions, the Southern project area, between the abstraction point and the WTP has ecological significance and conservation interest, because it acts as a protection zone for the Quiçama National Park.

III.10. LANDSCAPE

The landscape can be defined as the geographical, ecological and aesthetic unity resulting from human action and reaction of nature. It is the image resulting from the synthesis of all the elements present in a particular location and can be described as the portion of the earth's surface visually apprehended and that results from dynamic combination of physico-chemical, biological and human elements.

The landscape is so all you see and all that achieves the vision is defined not only by volume but also by colours, movements, smells, sounds, etc. It is a complex and dynamic system, where different natural and cultural factors interact and evolve together.

The main objective of this chapter was to develop a study that would allow a reasoned reality of landscape local knowledge in study.

In order to make a precise and objective characterization, since the appreciation of the landscape takes on a subjective character, an expeditious methodology was used for this purpose.

III.10.1. Delineation of Homogeneous Landscape Units

The study area of the landscape descriptor included the area of direct project intervention and its surroundings. To characterize the landscape in the study area, a reconnaissance of the land was made using photographic recording. Based on this information, from the Google Earth satellite images from 2014 and DEMS (Digital Elevation Model) of the region of Luanda, the delimitation of homogeneous landscape units was undertaken, presented in Figure 78.

For a better assessment of impacts on the landscape the infrastructure for the project was superimposed on the landscape units defined.

The landscape in the area of intervention of the project taking into account geographical, ecological and aesthetic criteria can be divided into 3 homogeneous units, see Figure 78, which we call A, B and C.

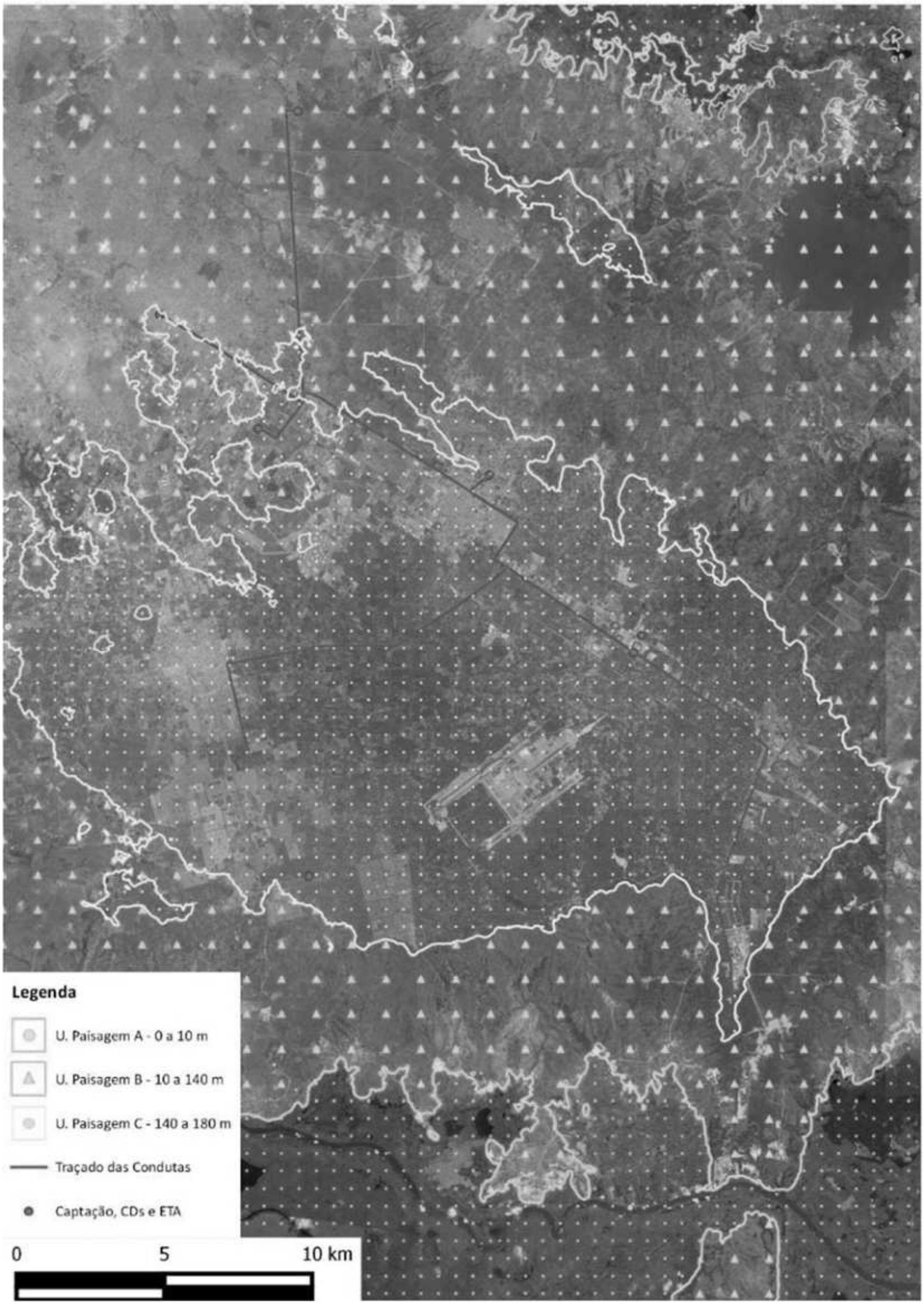


Figure 78 - Delineation of Homogeneous Landscape Units in the Project Area

Unit A

This includes the Kwanza river bed and its banks, as well as the marshy areas surrounding the lake lying NE of Bom Jesus. This area is characterized by flat areas with elevations between 5 and 10m where the green tones of the vegetation and blue water predominate. The herbaceous and shrubby vegetation consists mainly of reeds, papyrus, palm and mango trees.

Figure 79 - From top to bottom: View of lake lying NE of Bom Jesus; View of the right bank of the Kwanza River;

Human occupation in this area is minor, composed of small, scattered clusters, some of which are nomadic people who live on fishing and agricultural cultivation of cassava, corn for subsistence, on the river banks. It should be noted that much of this landscape unit is subject to flooding during the rainy season.

Mention should also be made of an extensive patch of intensive agriculture located west of Bom Jesus which creates a grid of green and brown tones in this area.

Figure 80 - From top to bottom: Detail of subsistence agricultural occupation along the river.

There are already some established industries set up in this unit (water bottling plants), as well as various abstractions of public and private water supply and some housing of the Administrative centre of the Commune of Bom Jesus.

Figure 81 - View of the old and new WTP of Bom Jesus located on the right bank of the Kwanza River.

Figure 82 - From left to right: View of water bottling plant located near the area of intensive agriculture; View of the houses located West of Bom Jesus along the riverbank; View of aggregate extraction on the right bank Kwanza River, west of Bom Jesus.

Figure 83 - View of Kwanza River (landscape unit - A) from the site of the Lot 1 abstraction point (landscape unit B)

Unit B

This unit is part of a range of valleys with rocky outcrops that make the transition between areas flattened by the river and the area of higher plain. The altitude of this unit ranges between 10m and 140m.

Figure 84 - From top to bottom: Overview of the landscape of the existing unit B NNE of Bom Jesus, the road from Bom Jesus; View the range of transition between Bom Jesus and the airport.

Beyond dominate the green tones of woody vegetation, created by baobab forests, the brownish tones of grass and other herbaceous and shrub species. The more embedded valleys create darker green tones that meander through the area, these shades from denser shrubs and trees as a result of greater availability of water bands.

Figure 85 - From top to bottom: Forest of baobabs located NW of the lake; View of the vegetation of a thalweg east of Bom Jesus;

Human occupation in this unit is more marked than in Unit A, as it is this unit that is to be found inside the agglomeration of Bom Jesus, some of the villages surrounding the lake and several existing industries in Bom Jesus, such as the Coca-Cola and Cuca beer factories (*see* Figure 87) and other water bottling plants.

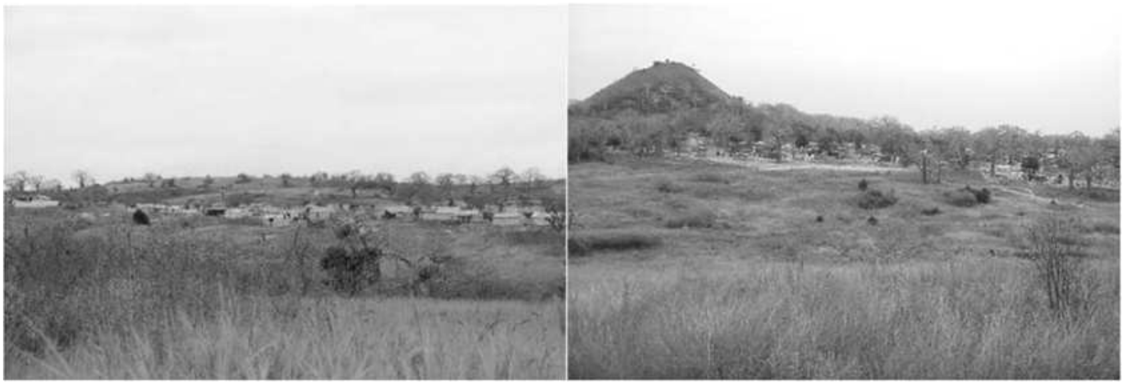


Figure 86 - From left to right - View of the Quarter Augusto Northeast of the site of the future Lot 1 abstraction point; View of the village to the northwest of the lake;

Impacts on existing landscape in this unit are due to the presence of the above-mentioned infrastructure as well as the existence of areas of extraction of aggregate such as sand and burgau without any planning. Many of these mines are inactive and were not undergone landscape rehabilitation, refer to Figure 88. Most of these mines are located north and west of Bom Jesus.

Figure 87 - From left to right: View from the Coca-Cola and Cuca beer factories

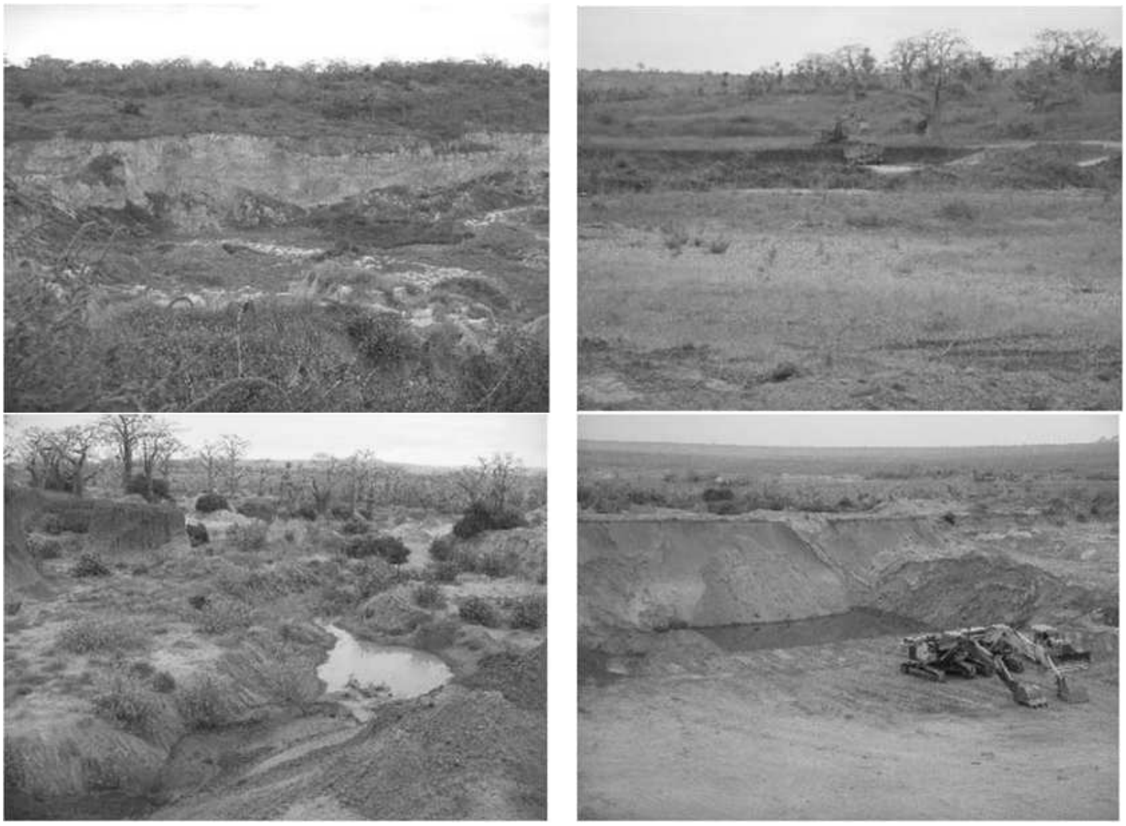


Figure 88 - From left to right, from bottom to top. Abandoned sandpit west of the Cement works (CIF); Clay extraction to the west of CIF; Clay extraction to the west of Bom Jesus with and without activity.

Unit C

This unit comprises a flatter area with medium altitudes between 140 and 180m where the brownish earth tones and savannah vegetation such as grasses and the baobab predominate, either alone or in small dense spots more or less define the unit C.

The presence of small parcels of cultivation can still be observed, mainly cassava, which are either temporary or permanent.

Figure 89 - View of the landscape surrounding the village of Jambondo, near the site of the -Lot 1 WTP; View of a cassava plantation in surrounding Lot 1

This area has high human occupation, whether for residential, commercial and/or industrial purposes (see Figure 91), occupation that becomes denser the closer to the road network and the province of Luanda.

Figure 90 - View of flat relief of unit C landscape - Expressway in Cacuaco district

The striking features of the landscape are numerous and of particular note are the Cement works (CIF) (Figure 92), whose towers are visible for 5 miles SE and SSW of the site, the of active and abandoned areas of aggregate extraction , industrial zones and warehouses that proliferate without any order along the roads in particular Catete road and in the Exclusive Economic Zone, as well as the larger settlements of Cacuaco, Capalanga and Zango.

Figure 91 - From top to bottom, from left to right: View of village, warehouses and trade settlements along the road Catete.

Figure 92 - From top to bottom: View of the Cement works (CIF) from 6.5 km WSW of the unit; View from the Bom Jesus road, towards Bom Jesus.

III.10.2. Photomontage of abstraction plant design

Figure 93 - – Looking south from the north bank of the Kuanza River (photograph, August 2014)

This project visualization shows that it is proposed to situate the abstraction plant on a wooded promontory with the abstraction feed pipes in the floodplain of the river.

Figure 94– Photomontage of a 3D drawing of the proposed abstraction plant infrastructure

III.10.3. Proposed location and aerial view drawing of water treatment plant

Figure 95– Proposed location, looking east

Figure 96 – Proposed location, looking north

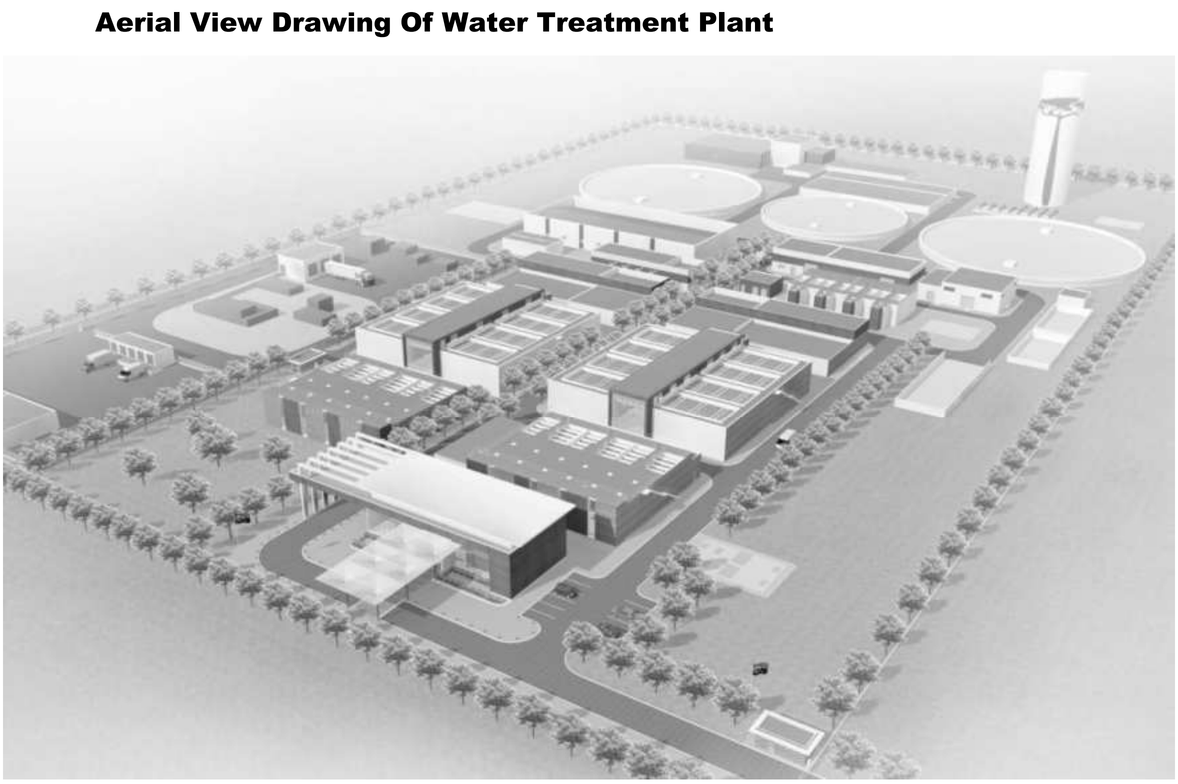


Figure 97 – Aerial View Drawing Of Water Treatment Plant

III.10.4. Landscape Quality and Vulnerability

In order to systematize the information and make an unbiased and objective characterization of the visual quality of the landscape we have used the methodology applied by the Bureau of Land Management - BLM (1980), whose criteria are presented in Table 30. For each landscape unit various aspects such as morphology, vegetation, water, scenic background, rarity and human interventions are evaluated.

According to the total points earned, landscape units are integrated into three classes of visual quality, defined as follows:

- **Class A**: areas that meet exceptional characteristics, with high visual quality (19-33 points).
- **Class B**: areas that meet characteristics of high quality in regard to some of the aspects considered and common to others, or who exhibit characteristics of average visual quality for most aspects considered (12-18 points).
- **Class C**: areas with common characteristics in the study area, with reduced visual quality (0-11 points).

This method, although with a range of predetermined value, is not free of subjectivity, although the risk of subjectivity is substantially smaller.

Table 29 - evaluation criteria for assessing visual quality (Source: adapted from MOPT (1992))

Parameter	Features and Enhancement of Landscape Visual Quality		
Morphology	Very hilly relief, marked and prominent (cliffs, large rock formations). Dune system. Relief or very large surface eroded variety. Unique risk presence.	Interesting erosive or varied relief in size and shape. Presence of interesting shapes and details, but not dominant or exceptional.	Gentle hills, valleys fund plans, little or no unique detail.
Score	**5**	**3**	**1**

Parameter	Features and Enhancement of Landscape Visual Quality		
Vegetation	Variety of vegetation types, with shapes, textures and interesting distribution.	Some variety of vegetation, but only one or two types.	Little or no variety or contrast in vegetation.
Score	**5**	**3**	**1**
Water	Dominant factor in the landscape; clean and clear appearance; white water (fast or cascades) or peaceful bodies of water.	Water in motion or at rest, but not dominant in the landscape.	Lack of, little or not at all appreciable.
Score	**5**	**3**	**0**
Colour	Various combinations of intense colour and pleasing contrast between the soil, vegetation, rock, water and/or snow.	Some variety and intensity in the colours and contrasts soil, rock and vegetation, but not acting as a dominant element.	Little variation in colour or contrast.
Score	**5**	**3**	**1**
Scenic background	The surrounding power much visual quality.	The surrounding moderately potentiates the visual quality of the whole.	The landscape adjacent has no influence on the quality of the setting.
Score	**5**	**3**	**0**
Rarity	Unique or unusual, or very rare in the region. Real possibility of incorporating exceptional fauna and vegetation.	Characteristic, although similar to the other region.	Quite common in the region.
Score	**5**	**3**	**1**
Human actions	Free of aesthetically undesirable actions or changes that favourably affect the visual quality.	The scenic quality is affected by changes little harmonic, but not in their entirety.	Intense modifications that reduce or nullify the scenic quality.
Score	**2**	**0**	**-1**

Regarding the visual quality of the existing landscape in the potential areas of intervention, according to the methodology mentioned and with the characteristics mentioned in the previous point, the score appearing in the following table was attributed.

Table 30 - Landscape quality rating based on the BLM methodology (1980)

Parameter	Visual Quality Valuation		
	Area A	**Area B**	**Area C**
Morphology	1	3	1
Vegetation	5	3	1
Water	5	0	0
Colour	5	3	1
Scenic background	5	5	0
Rarity	3	3	1
Human actions	0	0	-1
Total	**24**	**17**	**3**

In Table 31 it can be seen that the analysis allowed the landscape under study to be classified in the three classes described above. Unit A has a high visual quality (class A), unit B moderate (Class B), and C reduced (Class C).

While the quality of a landscape is an intrinsic attribute of a territory, its vulnerability is directly dependent on the type of activity that develops at the site. The vulnerability (or fragility) of a landscape is the degree of susceptibility to decay.

Table 31 - Characteristics of the landscape under study, in regard to the various visual vulnerability determining factors

Factors	Notes		
	Unit A	**Unit B**	**Unit C**
Biophysical	There are biophysical elements of interest, which could be affected by the project implemented.		There are no points of interest.
Visualization	The area of influence of the project is reduced to zero.	The area of influence of the project is moderate.	The area of influence of the project is high.
Historical-cultural	There are no historical points of interest.		
Visual accessibility	The visual accessibility is reduced to moderate	The visual accessibility varies between moderate and low, due to be a ridge line or thalweg, respectively	The project area is located at a high visual exposure
Visual vulnerability	Moderate	Moderate	High

By observation from Table 32, it can be concluded that the landscape under study is characterized in general by a moderate to high vulnerability.

The interaction between visual quality and vulnerability allows criteria to be established for determining the capacity of the development of the territory under study, under the visual perspective. Comparing Table 31 with Table 32, it can be concluded that the studied landscape in unit A features high quality and moderate vulnerability, which is not of concern because the intervention of the project will be reduced. In unit B where the abstraction station, Cacuaco DC and some sections of Lot 2 pipelines will be constructed, the quality and the fragility is average/moderate, which implies some care in terms of landscaping infrastructure. Finally, unit C where most of the infrastructure will be built, such as the WTP and distribution centres, is highly vulnerable, given the visual accessibility, which however has a reduced visual quality, a result of lack of territorial planning and the occupation it has currently.

III.10.5. Predictions in Absence of the Project

In the absence of the project, we predict that the area being studied would maintain the same scenic qualities and fragilities now observed, without any predictable modification.

III.11. SOCIO-ECONOMICS

Luanda has a long history of potable water supply problems which with a rapidly growing population, economy and general infrastructure is also a contemporary problem of the highest importance. Therefore, the Quilonga Grande Project, which is intended to deliver large volumes of potable water to large numbers of Luandan citizens, provides a very significant positive social and socio-economic impact.

The Project will contribute significantly to improving Angola's fulfillment of the Millennium Development Goals, especially Goal 7 of Environmental Sustainability, Target 10 of reducing to half the number of people with no access to drinking water by 2015 (UNDP Millennium Development Goals Report Angola 2010). Improvement to access to drinking water is also one of the measures on the UN Human Development Index and therefore the Project would improve Angola's current standing (149 out of 187 countries, UNDP Human Development Report 2013),

According to the 2013 edition of the Angolan Inquérito Domiciliar Integrado e Relatório do Bem-Estar da População, only 5% of the poor population (slightly over 35% of all the population in Angola) had access to the three basic sanitation infrastructures (drinking water, sanitation and electricity), therefore the Project stands to bring very significant improvement to this situation in respect of drinking water.

These significant and positive social macro-contributions imply a major construction effort requiring considerable amounts of new infrastructure; and it is the local environment that will receive such infrastructure. Therefore, the positive and negative social impacts at the localities affected need to be determined and where possible, mitigated through appropriate management and actions.

As with all major public works and construction projects, there will be temporary social impacts during the Construction phase of employment and disturbance, and longer term impacts during Operation.

Socio-economic data collection is improving in Angola, and in 2014, the first Census in independent Angola was performed, as the last one had been done by the Portuguese administration in 1970. However, the results of this Census were not available during our Impact Assessment Study.

However, the latest population estimates for the town likely to be most affected by the water abstraction infrastructure required by the Project, Bom Jesus, suggest 20,825 inhabitants in the area (personal communication, Bom Jesus Communal Administrator supporting this ESIS Report, perhaps already indicating preliminary results from the Angola Census 2014), a value quite different from the 12,097 that were mentioned in a 2013 activity report from the same communal administrator (ibid). This situation depicts well the challenges faced when trying to obtain accurate and reliable information in Angola.

Large tracts of the local population do not have access to services such as potable water (they use untreated river water or some use water from a fountain that the Cuca-Nocal factory have installed next to it). Therefore any improvements to drinking water access to Bom Jesus and other local communities would be a major positive local social impact.

III.11.1. Methodology

The guidelines of the World Bank and the applicable Angolan legislation are used to characterise the social and economic environment of this Project. The environmental matters contained in the *SADC Environmental Legislation Handbook 2012*, DBSA 2012 and in the Handbook on Environmental Assessment Legislation in the SADC Region, DBSA 2007 will also be considered. The current Portuguese and European legislation will be considered, in the absence of specific legislation

Social and economic characterisation is based on published literature, available statistical elements (national and international), official Angolan information (published and/or available in the several governmental body portals) and on fieldwork carried out locally by members of this study's team. The information made available by the Bom Jesus Commune Administration was used for characterisation at the local level.

Fieldwork being carried out locally consisted in general reconnaissance of the 3 municipalities and respective boroughs within the scope of the study, in structured and unstructured interviews made to local administrative entities and to representatives of the local society and culture. This component will be addressed in a specific subchapter.

The national, regional and local levels were adopted as scales of analysis, whenever data (existing or collected) allowed and/or was relevant for this environmental assessment. This assessment intends to be as objective as possible and be focused on the more sensitive social and economic aspects of a project of this nature.

The characterisation of the reference situation in the projected area for the execution of the water supply system begins with a brief overview of the Angolan territory, and the recent development in the economy and society of the Republic of Angola, as a whole, by presenting a set of demographic, macroeconomic and social indicators.

The macroeconomic characterisation of the Republic of Angola will be based on the National Development Plan (PND) for 2013-2017, with reference to the Strategic Options for the Provincial Infrastructure Projects, particularly for the province of Luanda, the information available in the National Bank of Angola and in the *African Economic Outlook 2014, Southern Africa,* among others.

The characterisation of the State's local administrative and organisation structure is based on Presidential Decree (DP) No. 3/14, which adjusts the Statutes of the Ministry of Territorial Management, and Law No. 17/10, that regulates the State's Local Administration.

The characterisation of the Water Sector will be based on the Immediate Strategic National Programme for Water 2013-2017 (PNEA 2013-2017), approved and published in the Presidential Decree No. 9/13, of January 31, 2013.

Several indicators are considered at the regional level, which allow characterising the province of Luanda in comparison with all others. At this level of characterisation, we preferentially consider the elements contained in the Portal of the Ministry of Territorial Management and in the remaining governmental portals, with information applicable to the Province of Luanda and respective Municipalities. At the local level, we consider municipalities, boroughs and communes, with a breakdown until a level as local as the data permits, complemented with direct observation. The direct impact of the execution of this project will be more felt at the level of local communities, .

It should be readily noted that there is a lack of demographic, social and economic statistical data at the local level, and this information gap will be bridged, whenever possible, with local observation and interviews conducted.

In summary, the economic and social characterisation, based on the elements available and surveyed locally, reflects the aspects related to the territory and population - with economic activity and levels of activity, with social conditions and quality of life of the populations residing in the municipalities covered by this project, and, whenever possible, in local communities.

Within the scope of this characterisation, special attention is given to the ways of life and livelihoods of local communities and to health issues, particularly the main endemics that affect the local population. Another aspect, which is a determining factor in this type of projects and respective environmental assessment (and mandatory for the World Bank), is the issue of the return and resettlement of displaced populations, in case these occur.

Considering the project elements, it appears that at the site predicted for the catchment there are no population settlements, that the distribution pipelines follow the alignment of existing roads, and that the sites chosen for the remaining elements of the project (Water Treatment Plan, Pumping Station and Distribution Centres) will be mostly located at arid places.

III.11.2. Definition of the Areas of Influence, Deployment and Study

The area of influence of the drinking water supply project is the Province of Luanda and, within this area, covers three of the current seven municipalities in which it is divided, namely: Cacuaco, Ícolo e Bengo and Viana.

The V – Quilonga Grande System unfolds from south to north, from the right bank of the Kwanza River in the Bom Jesus Commune, Municipality of Ícolo e Bengo, where the facilities - raw water catchment plant and the Water Treatment Plant (WTP) will be constructed. The remaining components of the project (Pumping Stations and Distribution Centres) are to be deployed in the municipalities of Viana and Cacuaco.

While characterising the reference situation, special attention is given to the locations of the deployment of several project components, as impacts resulting from the construction and exploitation phase will be felt most strongly in those areas and in the surrounding locations. Primary information was surveyed with official entities of the municipalities and important members of local society to fill some gaps in official information at the local level (Commune and Boroughs).

On a broader scale, the study area is located in the Province of Luanda and in the municipalities of Cacuaco, Ícolo e Bengo and Viana, where the project is administratively located. The specific study area is considered to be the three municipalities, as there is no official secondary statistical information published at the level of the concerned Commune and Boroughs.

III.11.3. National Framework of the Republic of Angola

III.11.3.1. General Framework

Angola attained its independence from Portugal in 1975 and then faced 25 years of internal conflict which adversely affected a great part of the social, economic and productive structures of the country. After the signing of the Peace Agreement in 2002, Angola started a process of recovery and national prosperity.

During the last decades, Angola saw an increase in the migration of rural population towards urban centres, and in particular to its capital, Luanda. It is estimated that nearly 60% of Angola's population is now urban. This migratory dynamics has led to the progressive abandonment of natural habitats and traditional ways of subsistence, ultimately leading to an abandonment of agricultural lands to the main urban areas. Luanda has been progressively attracting great population contingents, which has accentuated the fragilities of an urban system with few structures and lacking at the level of equipment and basic services.

Unemployment, lack of equipment and lack of sanitary conditions have increased in the urban peripheries, as a result of the rural exodus and increase in the urbanisation rate. Luanda, as is the case with other capitals in developing countries, is faced with shortages at the level of the percentage of population served by fundamental goods and services, namely the supply of drinkable water.

Despite this less favourable framework, and nearly a decade and a half after the signing of the peace treaty, Angola is heading towards economic growth and social development, asserting itself as one of the main powers of the vast African Continent.

In 1990, year of the first development report of the United Nations – *Human Development Report 1990* – Angola ranked 22nd in the Human Development Index (HDI), out of 130 countries, with a score of 0.304, in an ascending order.

In the first formulation of the HDI, the highest score belonged to Japan (HDI 0.996), with 1 being the maximum possible score. The 1995 report, already with the countries organised by decreasing HDI score, ranked Angola on the 165th place, with HDI score 0.283. In that year, Angola was placed between Djibouti (0.287) and Burundi (0.282).

In the peace year, 2002, the United Nations report placed Angola on the 161st place, with HDI score 0.403, out of 173 countries. Finally, in the 2013 report, Angola is still placed in the category of countries with "Low Human Development", occupying 149th position out of 187 countries listed, with HDI score 0.526, thus maintaining the trend over the years of rising in the order and raising its HDI score.

Angola is a vast country rich in natural resources. Petroleum continues to be great driving force of the Angolan economy, with the country now being one of the major petroleum exporters in Africa, only behind Nigeria, but with production volumes very close to those recorded in that country. Angola is an OPEC member since 2007.

III.11.3.2. Territory and Resources

The Republic of Angola is located in the Southwest of the African Continent. In terms of territory, including the Enclave of Cabinda, it comprises an area of 12,46,700 km^2, which represents about 4% of the African territory.

Angola is bordered by the Atlantic Ocean on the west, with a coastline extending up to 1650 km. In terms of terrestrial borders, Angola is surrounded by 4 states: in the south, by The Republic of Namibia; in the east by the Republic of Zambia; to the east and north by DR Congo – Kinshasa (former Zaire); and to the north by Congo – Brazzaville (Figure 98).

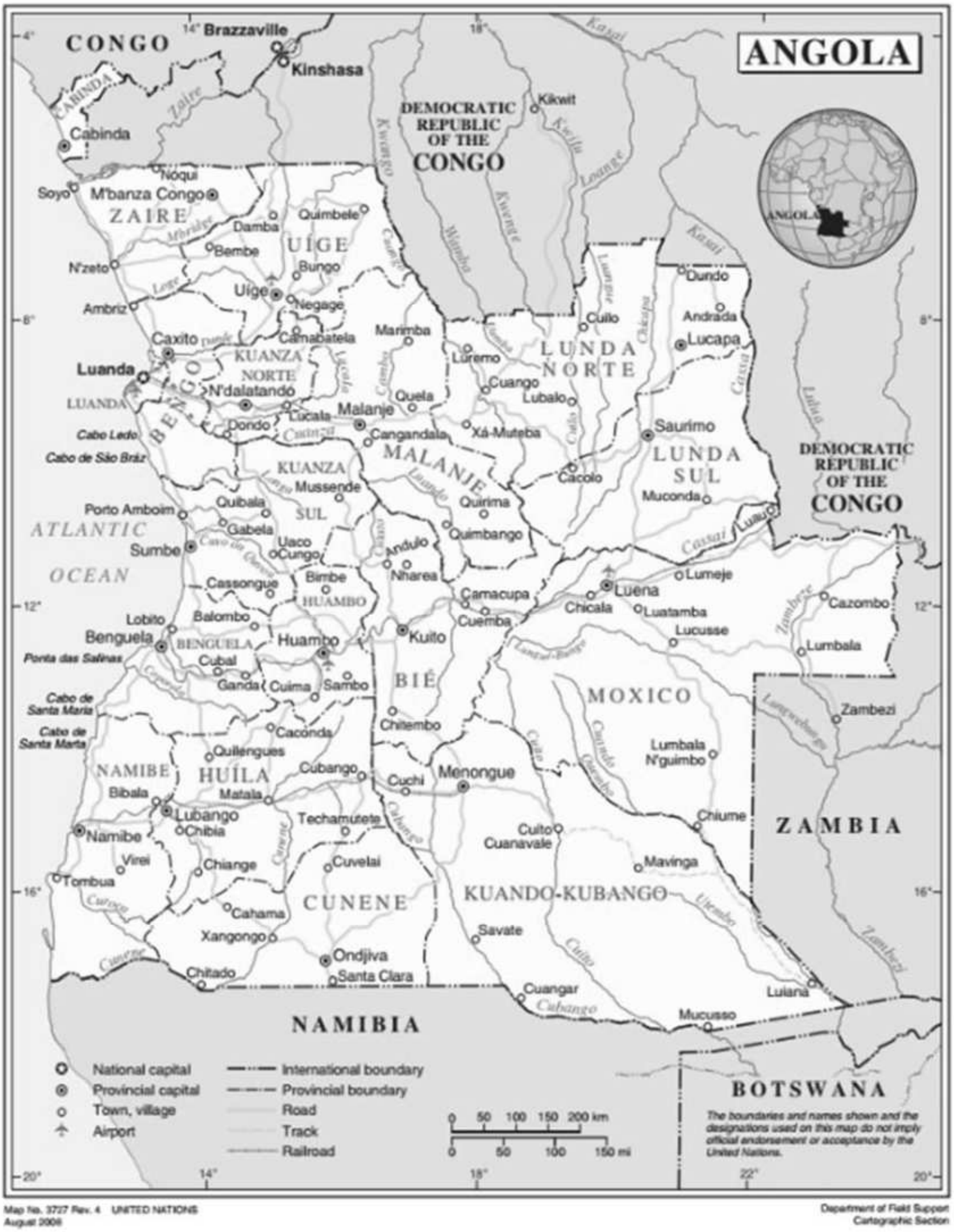


Figure 98– Administrative Framework of the Republic of Angola

(Source: http://www.un.org/Depts/Cartographic/map/profile/angola.pdf)

Angola's largest terrestrial border is with the Democratic Republic of Congo, from the northwestern tip to the East, where it meets up with Zambia. This country separates the Enclave of Cabinda from the rest of the Angolan territory. The smallest terrestrial border is with Congo (Brazzaville), which is limited to the north side of the Enclave of Cabinda.

From the coastline rises a mountain range, where the two highest points in the territory: Mount Moco (2620 m) and Mount Meco (2538 m) are present, followed by a plateau where the basins of the main rivers – Zaire, Cunene, Kwanza, Kubango and Queve – are formed. In its territory, Angola encompasses a diversity of habitats ranging from tropical forest, open forest, savannah and even a desert area to the South.

Angola enjoys good agricultural resources on the plateau and the entire south coast of Luanda is potentially rich in fishing resources. The country has a variety of minerals, especially petroleum resources and alluvial diamonds.

Angola is currently the second largest producer of petroleum in Africa. Petroleum extraction is primarily located offshore, and maintains a steady growth since independence. The known reserves are over 5 billion barrels and a recent estimate points to a potential of nearly 2 billion barrels for the reserves yet to be discovered. According to the 2013 OPEC Annual Report (OPEC Annual Report 2013), Angola's production totalled 1737 thousand barrels/day in 2013, while Nigeria recorded a production of 1912 thousand barrels /day in 2013.

Diamonds are another of Angola's natural riches. The first diamonds were discovered in Angola in 1912, starting exploration on the Chicapa River and its tributaries. Angola has exceptional reserves, mainly of kimberlite, and recent estimates point to the potential of the reserves found so far being nearly 200,000,000 carats of good quality. Diamond fields are scattered around Cuango, north of the Uíge province and in the provinces of Lunda North and Lunda South.

Angola is a country eminently rich in natural resources. It is estimated that its subsoil features 35 of the 45 most important minerals in the world trade such as petroleum, natural gas, phosphates, bituminous substances, iron, copper, manganese, gold and ornamental rocks.

With substantial deposits of gold, iron ore, phosphates, manganese, copper, quartz, gypsum, marble, black granite, beryllium, zinc and numerous strategic metals. Angola has been described as one of the largest and least developed mineral havens still remaining.

Angola has a massive hydroelectric potential, because of the great and powerful rivers flowing through the Country.

Fisheries is another sector least destroyed by war, although its operational results still fall short of the post-independence years. Effectively, the Angolan territorial waters have an enormous potential along its 1650 km of coastline, with plankton in abundance.

Agriculture is another of the Angola's strengths although, just like the case with fisheries, it is not being fully tapped. Climatic variety and quality is highly favourable for the diversification of crops and increased production levels. At the time of independence, Angola had a high agricultural potential for tropical and semi-tropical crops.

Angola is striving for rehabilitating its agricultural soils. With demining operations going well, and communication lines being re-established, it is expected that populations return to their traditional way of life. The different climate zones of the country allow farmers to develop a wide variety of crops, including: cassava, potato, corn, banana, been, cotton, palm oil, tobacco, wheat, sunflowers, citrus trees and numerous vegetables.

III.11.3.3. Population and Administrative Organisation

According to the estimates of the several international bodies, Angola's population has been growing significantly since the end of the civil war. Based on the *African Economic Outlook 2013* – OECD (AEO 2014), the Angolan territory should include a population of around 18.5 million in 2009 and around 21.5 million in 2013, representing an increase of over 16%. Table 33 presents a set of indicators that place Angola within the African context.

Table 32 – Basic Indicators, Angola and Africa, 2013

	Population	**Area**	**Population density**	**GDP in PPC**	**GDP per capita**	**Real annual GDP growth**
	(thousands)	(thousands of km^2)	(inhab / km^2)	(Millions of US $)	(base PPP, US $)	(average from 2005-2013)
Angola	21 472	1 247	17	130 238	6 066	10.8
Africa	1 108 966	30 066	37	3 827 029	3 520	5.4

Source: *African Economic Outlook 2013* – OECD 2014.

Based on the estimates and the data collected by the Ministry of Territorial Management of Angola, most of the population is concentrated in the province of Luana, in the coastal area of Benguela-Lobito and in the highlands, especially Huíla, Huambo, Bié, South Kwanza, Malanje and Uíge. The eastern and extremely southern parts of the country are scarcely populated. Based on the information available, Luanda alone concentrates around 6 million inhabitants, i.e., a little under 1/3 of the estimated population of Angola.

Angola is administratively divided into 18 provinces, lead by province governors, nominated by the President of the Republic, who is also the Head of Government. The province of Cabinda is an enclave that forms a small territory separated from the country's main territory by the Democratic Republic of Congo, being confined in the north and northeast by the Republic of Congo Brazzaville. The Angolan territory comprises huge diversity in terms of both geophysical and human occupation. Table 34 presents systemised data of a brief characterisation of the Angolan provinces, in terms of area and population.

Table 33 - Provinces of Angola, Surface, Population and Administrative Division

Province	Capital	Area (km^2)	Total Population (Estimated)	Population density Inhab/km^2	Municipalities	Communes
Bengo	Caxito	31 370	279 000	8.9	6	24
Benguela	Benguela	31 788	1 062 000	33.4	9	38
Bié	Kuito	70 314	1 889 000	26.9	9	39
Cabinda	Cabinda	7 283	293 000	40.2	4	7
Cuando Cubango	Menongue	199 049	207 000	1.0	9	16
North Kuanza	N' Dalatando	24 190	648 000	26.8	10	36
South Kuanza	Sumbe	55 658	1 046 000	18.8	12	36
Cunene	Ondjiva	89 342	376 000	4.2	6	28
Huambo	Huambo	34 274	2 551 000	74.4	11	36
Huila	Lubango	75 002	1 412 000	18.8	13	40
Luanda	Luanda	2 416	2 982 000	1234.3	7	47
North Lunda	Lucapa	102 782	473 000	4.6	10	27
South Lunda	Saurimo	45 647	243 000	5.3	4	14
Malange	Malange	97 600	1 505 000	15.4	14	67
Moxico	Luena	223 023	531 000	2.4	9	26
Namibe	Namibe	58 137	227 000	3.9	5	21
Uige	Uige	58 696	1 452 000	24.7	16	49
Zaire	Mbanza Congo	40 129	385 000	9.6	6	37
Total		**1 246 700**	**17 561 000**	**20.2**	**160**	**588**

Source: Statistical Yearbook 2009, Edition Year 2011. NSI, Republic of Angola

With the publication of the new Constitution of the Republic of Angola in February 2010, a new chapter named "Local Power" was introduced. Here, the existence of autonomous local authorities is determined and, in particular, the possibility for the setting up of municipalities is established.

The Constitution determines that the organisation and functioning of municipalities, as well as the competence of its governing bodies are regulated by the law under the principle of administrative decentralisation.

Table 34 – Angolan Territorial Structure and Local Powers

Territorial Unit	Total	Designation / Nomination / Responsibitlites
Provinces	18	The highest representative is the Governor of the province nominated by the President of the Republic to ensure the proper functioning of the local administrative bodies.
Municipalities	160	The highest representative is the Municipal Administrator nominated by the order of the Governor of the Province in prior consultation with the Ministry of State Administration. The Municipal Administrator is responsible for governing the district.
Communes	635	The highest representative is the Communal Administrator nominated by the order of the Governor of the Province acting on the proposal of the Municipal Administrator. The Communal Administrator’s job is to ensure the smooth functioning of the local administration.
Traditional Authorities	a)	Represented by the great soba, the soba and the século. Formally recognised, the role of traditional authorities is to exercise the prerogatives of traditional power, as long as they do not violate the State law.

Source: Information compiled from several documents and governmental portals
a) Values not available

In Angola all the land and natural resources are officially the property of the State (Articles 4 and 10 of the Law of the Lands of Angola, “Lei de Terras de Angola”, Law 9/04 enacted in 9 November 2004). According to this Law, there is land that is a part of the Public Domain and of the Private Domain (Article 1). All land, assets, goods and natural resources that are a part of the Public Domain cannot be sold or have a right of surface/property created upon, they are inalienable, imprescriptible and non-transferable.

Government and public body authorities are in practice often prepared to tolerate the informal occupation of land, though squatters may occupy land that could be the object of inheritance disputes, due to displacements.

In Angola, land that is part of the private domain can be transmitted or charged for by the State or local councils (article 12 of Law 9/04). The acquisition of land property rights by usucapio, or positive land prescription (acquisition of land use rights due to continued, daily use of a land for a set number of years), is not possible in Angola (article 6 of Law 9/04), even though local populations do seem to assume that they have the right of ownership, despite not having any papers to prove it.

Land from rural communities may be expropriated by public utility or be the object of conscription subject to the concept of "fair compensation" (article 9 of Law 9/04). Article 12 of the same Lei de Terras de Angola also refers that the State or local authorities have the onus of paying a "fair compensation". Point 10 of Article 27 of the same law also refers that in case of expropriation, that this "fair compensation" to the "land owners and holders of other real rights that have been affected is also not exclusive of these opting for the subscription of equity of the commercial companies that are constituted for the exploration of activities connected to the reserved land". On the other hand, land use rights are abolished when there is an expropriation by public utility (article 64e of the Lei de Terras and article 15 of the Constituição da República de Angola of 2010), which is the case for the Quilonga Grande Project.

The Angolan law does not enshrine anything regarding the type and level of compensation for land expropriations, so these are done on a case by case basis. Affected Communities or Persons are able to activate a grievance, given sufficient legal and societal jurisdiction to achieve a settlement.

The Civil Code (Código Civil) also mentions on its Article 1308 that "a person can only be deprived of his right to property under the law", and its Article 1310 states that "adequate compensation should be given to holders of any real rights that may have been affected". However, according to an Amnesty International report, "these legal dispositions on expropriation do not protect sufficiently against forced evictions, because they only protect those who have rights over property, as recognized by the law, and that they do not constitute, therefore, an effective guarantee against the forced evictions of informal establishments (Angola: vidas em ruína, Amnesty International, January 2007).

The Angolan system of territorial organization is organised in the following levels and plans: National – POOTN (Principais Opções de Ordenamento do Território Nacional); Provincial (PIPOT - Plano Inter - Provincial; PPOT - Plano Provincial) and Municipal (PIMOT – Plano Intermunicipal; PDM – Plano Director Municipal; PDG – Plano Director Geral (grandes cidades); PU – Plano de Urbanização/IOEU; PP – Plano de Pormenor; POR – Plano de Ordenamento Rural).

III.11.3.4. Social, Educational and Economic Framework

Angola has registered a significant growth in its Gross Domestic Product (GDP), even though the 5.1% increase in 2013 was below the expected values. Despite economic growth, the country still faces significant levels of poverty in several sections of the population; and unemployment, particularly among youth, remains one of the crucial problems of Angola. The various development initiatives in progress in the Angolan territory should reap benefits in the medium to long term and will certainly contribute in solving the more serious problems faced by Angolan society today.

Approximately 46% of Angola's inhabitants are aged below 18, and with a population that is expected to grow from the current 18 to 24.5 million in 2020, it is expected that the country will face demographic pressures and difficulties.

Human resources remain a major obstacle in the education and health sectors. It is very hard to convince professors and qualified health professionals to work in rural areas away from the capital, already scarce in qualified labour. Administration and execution of public planning also share the same problem. Qualified labour is scarce and concentrated in urban centres (especially Luanda), which continues to undermine carrying out the ambitious projects of the State.

Within the scope of the Republic of Angola's reconstruction and development policies, the Education Sector Reform assumes a vital role and establishes itself as a strategic vector in combating poverty and illiteracy, health promotion, reduction of social and gender inequalities, in socioeconomic recovery, and in the consolidation of a democratic and lawful society.

The Government of Angola has been undertaking an ongoing Reform in the Education System since 2004, which aims to attain a primary school completion rate of 90% in 2015. Moreover, as school results and attendance are closely dependent on nutrition, a free school meal project (*merenda escolar)* was proposed. It is estimated that over a million children could benefit from this initiative, although it was suspended due to its costs and support from donors is awaited.

In Angola, there is a large contingent of youths outside the school system, due to the instability period prior to peace. As a result, there are still situations of absolute illiteracy and considerable school delay. Studies show that, in 2005, from a total estimated population around 17.5 million inhabitants, about 20% were in the age group between 10 - 18 years, and not attending school.

Since the "Literacy and School Acceleration Programme", in 2005, over 3,600,000 youths, aged between 10 and 18 years were not part of the Educational System. This situation was even more critical in the population aged between 12 and 18 years, i.e., economically active population.

To solve this issue, the Ministry of Education elaborated an educational proposal for accelerating learning, giving priority to adolescents and youths aged between 12 to 20. This way, they have recognised that adult literacy and learning are indispensible prerequisites for the reduction of poverty and the development of Angola.

The Recovery Strategy for Literacy and School Acceleration, approved in 2007, Resolution No. 9/07 of 28 February, was prepared in accordance with the provisions of the Basic Law of the Education System, Law 13/01, in the Integrated Programme for Improvement of the Education System (approved on 28 February, 2001) and in the National Action Plan on Education for All.

Other important instruments are the regulations of the National Programme for Literacy and Recovery of School Delay (provision No. 36/08, of 24 January), and the Poverty Reduction Strategy.

Housing is also a big issue in Angola. The civil war was responsible for the destruction of much of Angola's housing stock, and also the displacement of populations from their environments and traditional ways of life.

A significant part of Angola's population is displaced and living in precarious conditions in the suburbs of the main cities. To tackle this problem – which usually entails other social, health and public health problems - Angola maintains the objective of constructing a million social housing units until 2012.

According to the 2013 edition of the Integrated Housing Survey and Report on the wellbeing of Population, the national poverty index was reduced from 68% to 37% of the population in 2001. However, the poverty impact is three times greater in rural areas (58%) than in urban areas (19%). The poor are less likely to have adequate housing. Only 30% of the poor – compared with 51% of the not poor – have access to drinking water, with similar values for adequate sanitation (40% and 72%, respectively) and for electricity (14% and 57%, respectively). Only 5% of the poor have access to all three in three of these main infrastructure services, while for the not poor this proportion rises to 32%.

III.11.3.5. Gender Issues

In sub-Saharan Africa, women traditionally have fewer rights than men. They perform mostly rural or household tasks and have little representation in places of power, whether in economic, social or political organisations.

In Angola, women are guaranteed by law the right to non-discrimination, that is, the equality of treatment and non-discrimination at work, the right to an equal salary for the same work and to equal opportunities. They are prohibited of performing hazardous and dangerous works, as well as all other ones that imply effective or potential risks for their genetic function.

It is namely forbidden for women to work underground and in mines. They are also guaranteed by law a minimum rest period of twelve (12) hours between shifts (nr. 6 of article 97 of the LGT), and are not supposed to work at nights in industrial establishments without authorisation of the IGT.

Special attentions should be given to single women, widows and young women, as they belong to a vulnerable population and have higher risks of exclusion and hardship.

Women's rights were the notable area where Angola has been the best performing African nation with regards to the targets and indicators of the MDG, in Goal 3. of promoting gender equality and empowering women, though this was mostly due to the increase of women with seats in the national parliament (UNDP Millennium Development Goals Report Africa 2013).

At the project area in the city of Bom Jesus, women represent 50% of the total population. They still have unequal access to education as compared to men, even though figures improved between 2000 (68%) and 2010 (78% of women had access to education). Their condition is similar to that of women in the rest of the country. Indeed, in a semi-rural to rural area, women roles and tasks are generally limited to their household environment. As such, they are vulnerable due to their reliance on male for running the household, being the decision-maker and the person that brings an income to its family.

III.11.3.6. Healthcare System

It should be noted that we chose to individualise the Healthcare System in this chapter of the National Social and Economic Framework, as this a vital area, just as the Education System, and is one of the key aspects being considered in this environmental assessment.

The healthcare sector is one of the most critical and sensitive aspects of the Angolan territory.

Financial resources are just one part of the problem, which maybe the easiest to overcome. The lack of qualified staff and working health equipment will certainly be the most difficult problems to solve in the short to medium term.

Angola is faced with the lack of a healthcare network spanning the entire length of territory and with the lack of personnel to use current equipment, even though these remain few in quantity and are insufficient.

Investments in the healthcare sector are low in comparison to the spending on education and infrastructure. Considering the number of doctors graduating each year, the government's objective for the ratio of three doctors per 10,000 inhabitants is highly ambitious. Some healthcare indicators for 2008 were positive and, according to the authorities, malaria cases dropped 5.8%, tuberculosis 17.5% and cholera 42.7%. Based on the report - "Evaluation of the Health System in Angola 2010", it was found that the Angolan public health section employed around 67,000 persons, of which approximately 38,000 are health professionals (non administrative).

The National Sanitary Development Plan 2012-2025 (PNDS), prepared by a Multi-sectorial Committee and created by Presidential initiative through Presidential Order No. 84/11 of 27 October, is a strategic and operational instrument aimed at the realisation of the guidelines set forth in the Long Term Development Strategy, also known as "Angola 2025", and in the National Health Policy, within the scope of the National Health System reform.

According to the PNDS 2012 – 2025, the indicators suggest that there are currently 2 doctors for 10,000 inhabitants (2/10,000), nineteen nursing professionals (19/10,000), four diagnostic and therapeutic technicians (4/10,000), five hospital support workers (5/10,000) and eleven general regime workers (11/10,000).

The prevalence of HIV/AIDS is still low in Angola. The HIV epidemic in Angola has decreased 5% during the period from 2000 to 2012. The estimate for the prevalence of HIV in Angola is 1.98%. It is also estimated that the prevalence of HIV will remain stable (around 2%) until 2015. The occurrence of new infections (impact) is 0.2%, being greater in urban areas with 0.4%, than in rural areas with 0.16%. HIV transmission is predominantly heterosexual with 79.2% of the reported cases.

III.11.3.7. UXO – Unexploded Ordnance

Unexploded ordnance (UXO) is still a severe problem in Angola, as it is one of the top three countries most affected by anti-personnel landmines and unexploded ordnance worldwide (WHO, 2003). From the information collected in the ESIS, most of the area has been cleared and doesn't present a high risk in this regard. The following mapping has been done regarding UXO:

- Bairro Augusto – Has been de-mined, very low risk
- Bairro Jabondo – Hasn't been de-mined, yet no accidents have taken place, low risk
- Bairro Cafucuso – Had issues with mines before, yet was de-mined in 2013, very low risk
- Bairro Bom Jesus – Has been de-mined in the area of the agricultural project (several landmines were found), very low risk

Nevertheless, it is advised that any works in areas that haven't been de-mined yet are preceded of a de-mining campaign, and that an overall sensitising and outreach campaign is done in this regard.

III.11.3.8 Labour Laws in Angola

The two general laws existing in Angola regarding labour legislation are *the Lei Geral do Trabalho de Angola* (LGT, General Labour Law of Angola, Law 2/2000, promulgated 11 February 2000) and the *Lei 20-A/92 Direito de Negociação Colectiva* (Law for the right of Collective Negotiation), that allows for the negotiation of collective conventions and agreements, for amicable dispute resolution set forth in the Angolan Law. This Law of Collective Negotiation concerns only collective agreements and disputes and only considers as legitimate partners the syndicates and associations of syndicates or ad-hoc commissions effectively elected for the effect of these Collective Negotiations, their duties ending as soon as a Collective Work Agreement is signed.

For EPAL-EP employees, relevant to the Operational Project phase, there is a specific law (Lei 17/90, of 20 October) and public regulations (Decreto Legislativo Presidencial 3/13; Decreto Presidencial 320/11; Decreto Presidencial 102/11; Decreto Presidencial 309/10; Resolução 1/05; Despacho 1/03; Decreto 20/98), that apply to all public employees in Angola.

The LGT provides a broadly coherent and social legislative framework, coherent with human rights policies in democratic States. In practice, labour inspections and the effective defence of workers' rights can be variable, though workers are entitled to a decent salary for their work and to 22 working days of holidays per year, excluding mandatory national and local holidays (12 days in 2014).

Underage workers are only permitted if there is the written authorisation of the father, tutor, legal representative or institution in charge of them (article 11 and 282 of the LGT), or the *Inspecção Geral do Trabalho* (IGT, "General Labour Inspection", equivalent to National Employment Office). A contract should be formed and the work of underage persons is only permitted for those over the age of 14 (Article 282 of the LGT), who have to make proof of their age. For persons over the age of 16, this authorisation may be tacit, yet they must be subject to yearly physical and mental examinations to prove that they are able to perform their functions and to certify that the performance of their professional activity does not entail harm to their health and development (Article 285 of the LGT).

In the frame of the Quilonga Grande project, employees contracted directly by EPAL-EP will benefit from the relevant public employees regulations applicable in Angola. Workers indirectly employed by EPAL-EP, under sub-contracting agreements (mostly applicable during the construction phase) have also to benefit from the rights established under the Angolan Labor Law and under the PS2. As part of its social engagements, EPAL-EP will have to ensure that its contractors respect the Angolan working laws and regulations. The company will also have to implement an appropriate system of monitoring to ensure that no illegal or unethical work practices are performed by its contractors, such as the use of forced labor or underage workers.

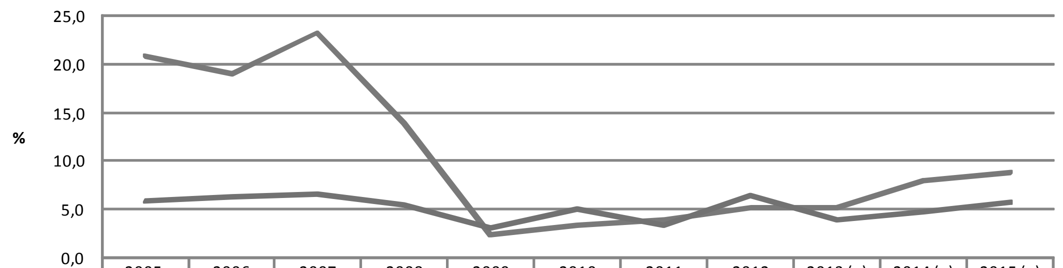
III.11.3.9. Productive and Economic Context

Angola's social and economic history has been characterised by upsets resulting from its own historical evolution. After the independence in 1975, 25 years of internal conflict followed, which hindered economic take-off and development of the country.

In the 1990's, with the end of the civil war, the Angolan economy had a period of prosperity, which was much focused on the petroleum economy. In the late 2000s, Angola was deeply struck by the collapse in the oil prices, having suffered its lowest in 2009.

Angolan economic growth was abruptly interrupted in the period prior to the global crisis, at a stage when it recorded one of the most accentuated growths in the World. In 2008, the country recorded a growth in the Real Gross Domestic Product (GDP) close to 14%, having fallen sharply to

2.4% in the following year. From 2009, the GDP has been rising and it is projected that it may grow by 8% in the current year, 2014. Figure 99 presents the evolution of the Angolan Real GDP from 2005 to 2015, with reference to the GDP values of the African continent.

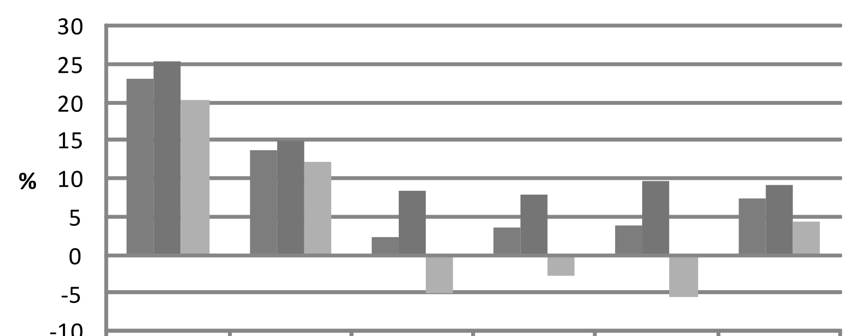


	2005	2006	2007	2008	2009	2010	2011	2012	2013 (e)	2014 (p)	2015 (p)
Angola	20,9	19,0	23,2	13,8	2,4	3,4	3,9	5,2	5,1	7,9	8,8
Africa	5,9	6,3	6,6	5,4	3,1	5,0	3,3	6,4	3,9	4,8	5,7

Figure 99 – Effective GDP Growth Rates, 2005 - 2015

(**Source:** *African Economic Outlook 2014* – OECD 2014)
e) estimates; **p)** projections

Over the last 5 years, the Angolan economy grew at an average rate of 9.2% per year. When only considering the non-petroleum economy, the average growth rate was 12.0% over the same period, which means that production in the non-petroleum economy has almost doubled in the last 5 years. The latest predictions indicate a growth of 8.8% for 2012, resulting from the combination of a growth of 9.0% for the non-petroleum economy and of 8.5% for the petroleum economy.



	2007	2008	2009	2010	2011	2012*
PIB	23,2	13,8	2,39	3,5	3,9	7,4
PIB np	25,4	15	8,31	7,8	9,7	9,1
PIB p	20,4	12,3	-5,09	-2,87	-5,6	4,3

Figure 100 – Real GDP Growth Rate (%), without Petroleum (np) (%) and with Petroleum (p) (%)

(**Source:** National Development Plan 2013 – 2017. Republic of Angola, Ministry of Planning and Territorial Development, December 2012, p. 15.)
Constant prices of 2002. * Estimated

The petroleum sector has been the major driver of the economy, and assumes the greatest weight in the national exports. Angola remains the second largest producer in Africa, with current petroleum production (2013) being 1.8 million barrels per day (bpd). With the exploration of new fields, it is estimated that petroleum production in Angola reaches 2.0 million bpd in 2016.

According to the National Development Plan 2013 – 2017 (PND 2013 – 2017) “The main reasons for the drop in petroleum production recorded during this period were the production constraints due to maintenance operations and mechanical problems, and the weak performance of gas lifting in some fields, specifically in Block 2. Due to the combination of the drop in production along with the reduction of petroleum prices (according to calculations from British Petroleum, the average Brent price dropped from USD 121/barrel, in the second quarter of 2008, to USD 45/barrel, during the same period in 2009), 2009 saw a significant reduction of the State’s fiscal revenue, which led to the contraction of the aggregate-demand block in the economy and subsequent drop in the activity levels of important sectors such as agriculture, market services and manufacturing industry” (PND 2013 – 2017, p.16).

The mining sector in Angola has a high growth potential and benefits from a Special Tax Regime that aims at attracting investments and promoting its development. Data from the National Statistics Institute show that diamonds account for 1% of Angola’s GDP and that the country is the second largest producer in Africa after Botswana, in terms of quantity. Angola is also the world’s fourth largest producer of rough diamonds.

Better quality soils and a good water supply make agriculture an important sector for Angola. Agriculture accounts for 11% of the GDP and 70% of total employment. In 2013, agricultural production grew by 8.6%, mainly due to a strong growth in the cereal production. Angola was once the fourth largest coffee producer in the world, but agriculture has been generally affected by limited competitiveness and processing infrastructures, and lack of cooperation between small-scale farmers. Despite its great agricultural potential, Angola is dependent on various foodstuffs, especially cereals (corn, rice and wheat).

The manufacturing sector has registered some annual growth, rising from 6.5% in 2012, to 8% in 2013, driven by wood, concrete and electrical materials industries. Several investments are planned for this sector, with significant creation of new jobs.

Table 36 presents a breakdown by activity sectors of the Gross Domestic Product (GDP), at current prices, during the period 2007 – 2012. This table highlights the importance of the petroleum sector in the overall Angolan economy.

Table 35 –Sectorial Gross Domestic Product, Current Prices, 2007 – 2012 (Billion Kwanzas)

PIB (Preços Correntes) Mil Milhões de Kwanzas	PERÍODO					
	2007	2008	2009	2010	2011	2012
Agricultura	351,8	405,6	596,5	729,0	886,4	749,0
Pescas e Derivados	12,6	13,9	14,5	16,9	22,1	26,5
Diamantes e Outros	80,4	66,1	53,7	71,1	89,1	85,8
Petroleo	2.537,2	3.569,4	2.661,6	3.401,0	4.640,8	4.981,0
Indústria Transformadora	241,2	303,1	363,8	464,2	584,3	726,3
Construção	224,1	318,6	449,6	601,6	750,6	914,1
Energia	3,8	5,4	7,4	9,5	11,0	13,2
Serviços Mercantis	768,8	1.104,1	1.240,4	1.555,1	1.896,0	2.344,2
Outros	326,0	375,9	454,0	548,2	669,0	790,3
PIB a custos de factores	**4.545,9**	**6.162,1**	**5.841,5**	**7.396,8**	**9.549,3**	**10.630,3**
PIB a preços de mercado	**4.636,8**	**6.316,2**	**5.988,7**	**7.584,6**	**9.780,1**	**10.876,0**

Source: MINIPLAN (from the National Bank of Angola) [Consulted on 03SET14]
http://www.bna.ao/Conteudos/Artigos/detalhe_artigo.aspx?idc=950&idsc=13862&idl=1

Table 37 presents the percent structure of the GDP by activity sectors during the same period. This table shows the importance of the petroleum sector in the overall Angolan economy, with percentages ranging from 45.6% to 57.9%. The percentage weight of Market Services is also highlighted, with values of around 20% of the GDP.

Table 36 –Sectorial Percentage Structure of the Gross Domestic Product, 2007 – 2012

Estrutura Percentual (%)	PERÍODO					
	2007	2008	2009	2010	2011	2012
Agricultura	7,7	6,6	10,2	9,9	9,3	7,0
Pescas e Derivados	0,3	0,2	0,2	0,2	0,2	0,2
Diamantes e Outros	1,8	1,1	0,9	1,0	0,8	0,8
Petroleo	55,8	57,9	45,6	46,0	48,6	46,9
Indústria Transformadora	5,3	4,9	6,2	6,3	6,1	6,8
Construção	4,9	5,2	7,7	8,1	7,9	8,6
Energia	0,1	0,1	0,1	0,1	0,1	0,1
Serviços Mercantis	16,9	17,9	21,2	21,0	19,9	22,1
Outros	7,2	6,1	7,8	7,4	7,0	7,4
PIB a custos de factores	100,0	100,0	100,0	100,0	100,0	100,0
PIB a preços de mercado	102,00	102,5	102,5	102,5	102,4	102,3

Source: MINIPLAN (from the National Bank of Angola) [Consulted on 03SET14]
http://www.bna.ao/Conteudos/Artigos/detalhe_artigo.aspx?idc=950&idsc=13862&idl=1

Finally, Table 38 presents the Real GDP Growth Rate, in percentage, of the various activity sectors, during the period of 2007 – 2012. Overall, the GDP growth rate retreated significantly, hitting its minimum value (2.4%) in 2009. Growth has been regained, but it is still below two digits.

Table 37 - Sectorial Growth Rate of the Real Gross Domestic Product (%), 2007 – 2012

Taxa de Crescimentodo PIB Real (%)	PERÍODO					
	2007	2008	2009	2010	2011	2012
Agricultura	27,4	1,8	29,0	6,0	9,2	-22,5
Pescas e Derivados	9,7	-2,4	-8,7	1,3	17,2	9,7
Diamantes e Outros	2,7	-8,2	4,6	-10,3	-0,7	0,3
Petroleo	20,4	12,3	-5,1	-2,9	-5,6	4,3
Indústria Transformadora	32,6	11,0	5,3	10,7	13,0	14,0
Construção	37,1	25,6	23,8	16,1	12,0	11,7
Energia	8,6	26,1	21,3	10,9	3,5	10,4
Serviços Mercantis	21,8	26,9	-1,5	8,7	9,5	13,4
Outros	4,5	1,9	5,9	4,7	9,6	8,3
PIB a preços de mercado	23,2	13,8	2,4	3,5	3,9	5,2

Source: MINIPLAN (from the National Bank of Angola) [Consulted on 03SET14]
http://www.bna.ao/Conteudos/Artigos/detalhe_artigo.aspx?idc=950&idsc=13862&idl=1

The Angolan economy is still highly dependent on petroleum revenue and will remain so, according to various readings. The instability that is being felt in the global energy market due to social and political events underway in several Middle Eastern countries re-launches the future role of the Gulf of Guinea – Angola included – in the world energy market.

Despite the retraction registered in the petroleum sector between 2009 and 2011, with a slight recovery in 2012, the remaining sectors have maintained a reasonable growth, with the exception of the agricultural sector that presented a fall of -22.5% in 2012.

This dynamic is encouraging when considering Angola's two priorities: employment (especially youth) and economic diversification. However, as can be seen in Table 39, the petroleum sector represents 97% of total Angolan exports.

Table 38 - Exports, Angola and Africa, 2012

	Three main export products, with their share in total exports *			Number of products that represent more than 75 percent of exports
	Product I	Product II	Product III	
Angola	Petroleum oils and oils obtained from bituminous minerals, crude (96.8%)			1
Africa	Petroleum oils and oils obtained from bituminous minerals, crude (49.2%) [49.2%]	Liquefied Natural Gas (3.9%) [14.8%]	Natural gas in gaseous state (3.1%) [9.1%]	24

Source: African Economic Outlook 2014 – OECD 2014
* the products are reported when corresponding to more than 4% of total exports.
** Data between [ ] represent the share of Africa in total world exports.

According to information provided in the official pages of the Angolan administration, the growth of activity sectors not directly related to petroleum has been strongly encouraged and supported, aimed at the improvement of infrastructure and revitalising the economic activity throughout the country.

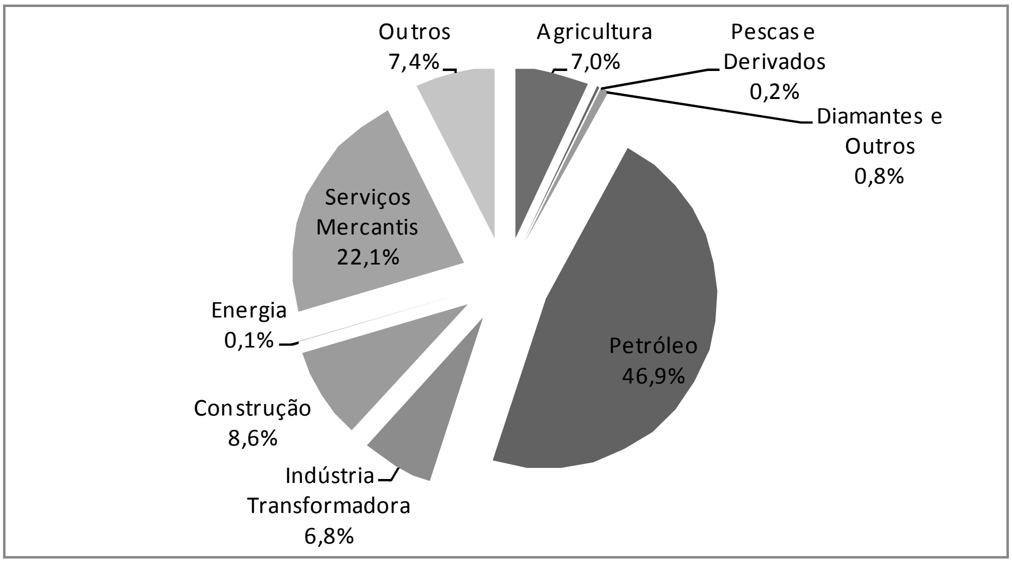


Figure 101 -– GDP per Sector (%), 2012

Source: MINIPLAN (from the National Bank of Angola) [Consulted on 03SET14]
http://www.bna.ao/Conteudos/Artigos/detalhe_artigo.aspx?idc=950&idsc=13862&idl=1

Nonetheless, Figure 101 shows that the Angolan economy is still strongly centred on petroleum, as this sole good represents about 47% of the GDP in 2012. Taking into account the percent breakdown of the GDP in the remaining sectors, Market Services represent 22.1%, Construction 8.6% and Manufacturing Industry 6.8%. On the other hand, agriculture represented 7% of the GDP in 2012, having registered a 2.3% decrease over the previous year.

In terms of employment, preliminary estimates for the year 2000 pointed towards a very high share of agriculture and fishing on the employment structure (46% of the total employment). Industrial employment, on the other hand, did not represent more than 2.3% of the total employment, for reasons already known. Other sectors that stand out are commerce (32% of the total employment), which included the informal commerce sector, and public administration (7.7% of the total employment).

The primary sector (agriculture, forestry and fisheries) is responsible for half of the total employment in Angola, but merely contributes 6.8% of the overall GDP. Although, the country was one of the main African exporters of agricultural goods, agriculture itself has still not recovered from the losses inflicted by the civil war. According to projections presented in the National Plan for 2010-11, the agricultural, fisheries and forestry sector should record an increase of 29.1% in comparison to 2009. Although considered optimistic, taking into account various obstacles, this value may actually be confirmed thanks to the high investment in agriculture in 2009. For 2010, official projections point towards a 10.7% growth in agriculture (PEA 2011).

Investment in agriculture is highly supported by international donators. Angola is one of the 15 African countries that benefit from 20 billion USD, given by the G8, for investment in agriculture, nutrition and food safety. Between 2010 and 2012, the International Fund for Agricultural Development (IFAD) will provide 50 million USD for agricultural projects in Angola. On the other hand, the Angola Development Bank (BDA) will grant special credit lines destined for agriculture, as well as credit facilities for small-scale producers (PEA 2011).

According to official estimates, manufacturing industries registered a 9% growth in 2009, and should grow by 20% in 2010. Comparing these estimates with the official data from the National Bank of Angola (Table 38), growth fell short of forecasts (10.7%) for 2010, however was 14% in 2012.

The development of industry in Angola is based on the creation of EEZ – Exclusive Economic Zones, industrial hubs and business areas to be built across the country. We highlight the Special Economic Zone of Luanda – Bengo, located in an area 8 300 ha in kilometre 30 (30 km) of the Viana Route, about 30 km from the centre of Luanda, close to the New Airport and served by a railroad. The most prominent industrial hubs in the Province of Luanda are those of Viana – South Luanda and Cacuaco – North Luanda, as well as the hubs of Icolo – Bengo and Bengo – Bengo.

Special Economic Zones like Viana (functioning since 2008), in the north of Luanda, were created to support diversification and industrial production. The country also has other industrial zones in Futila, Catumbela, Caála and Matala. The EEZ Programme is managed by the National Reconstruction Office (GRN), which directly reports to the country's president (PEA 2011).

III.11.3.10. PND 2013-2017 and Priority Clusters. The Water Cluster

The objective of the Priority Cluster creation Programme aims at "Developing sectors that allow for the creation of dynamic comparative advantages capable of sustaining Angola's position in the segment of added value chains of production." The Water Cluster is of particular interest to this environmental assessment, since it directly relates to the project which led to the development of this report.

The PND 2013 – 2017 states in Indicators and Objectives (2013 - 2017), item 3: Percentage of

Cities with Assured Energy and Water Supplies 80%, as an average value during that period (PND 2013 – 2017, p. 87). Table 40 presents the set of Objectives, Priorities of the Specific Objectives and Indicators of the Objectives, of the Priority Water Cluster.

Considering the PND 2013 – 2017, the Angolan Government defines a set of Priority Structuring Projects that contribute towards realisation of the model of economic development of the Angola Strategy 2025. Here, 9 sets of interdependent activities ("Clusters" and "Mega-clusters") are identified. These integrate among themselves while being dependent on the function of a main activity, and encompass support, complementary and basic activities. The mega-clusters are the Water, Food and Agricultural Industry, Housing, Transportation and Logistics, Mineral Resources, Petroleum and Natural Gas, Forests, Textiles, Clothing and Shoes and Tourism and Leisure (PND 2013 – 2017, p. 177).

Table 39 - Indicators and Objectives 2013 – 2017, Water

ÁGUAS	
Objectivo	**Prioridades dos Objectivos específicos**
Promover, em bases sustentáveis, o abastecimento de água potável à população e de água para uso no sector produtivo, bem como serviços adequados de saneamento de águas residuais.	1. Melhorar a qualidade do serviço de abastecimento de água tanto nas zonas urbanas como áreas suburbanas e nas zonas rurais 2. Prosseguir a construção de pequenos sistemas e pontos de abastecimento de água e saneamento comunitário, nas áreas suburbanas e rurais 3. Assegurar uma eficiente gestão na exploração dos sistemas dando continuidade a criação de entidades vocacionadas para o efeito e mediante o desenvolvimento institucional do sector 4. Aplicar um sistema de tarifas adequadas que permita a cobertura dos custos de exploração e proteja os extractos populacionais mais vulneráveis garantindo a sustentabilidade do serviço público 5. Assegurar a gestão integrada dos recursos hídricos, prosseguindo com a criação de entidades de gestão das bacias prioritárias e a elaboração dos respectivos planos directores

Indicadores dos Objectivos						
Indicadores	**Ano de Base**	**Metas**				
	2012	**2013**	**2014**	**2015**	**2016**	**2017**
1. Produção de água potável nas sedes provinciais (m3/ dia)	980.353	1.176.424	1.294.066	1.488.176	1.636.994	1.767.953
2. Número de pontos de água existentes	6.467	6.667	6.867	7.117	7.337	7.637
3. Número de chafarizes construídos	3.910	4.880	5.900	7.820	8.620	9.320
4. Número de pequenos sistemas de água	360	485	610	742	853	981
5. Número de furos de água abertos	5.807	5.984	6.161	6.383	6.578	6.844
6. Número de fontenários construídos	3.910	4.880	5.900	7.820	8.620	9.320
7. Número de cacimbas melhoradas	660	683	706	734	759	793
8. Taxa de cobertura da população servida com água (%)	56	59	62	65	75	85

Source: PND 2013 – 2017, p. 104

Still, looking at this report, it is important to highlight the Water Mega-cluster. Total amount invested is predicted to be 590.8 billion Kz (11.2% of the total), with 534.8 Kz for the "Water Supply to Province capitals and Most Populated Municipalities" (90.52%) and 56.0 Kz to the "Water for All" (9.48%) (PND 2013 – 2017, p. 178).

The National Priority Structuring Projects (PEPN) is grouped into Programmes, in which are defined the Objectives and Policy Measures and respective projects and amounts. Table 41shows the predictions for the Water sector, for both components.

Table 40 – Water Supply to Province Capitals and Most Populated Municipalities

Objectivo	Medidas de Política
Garantir a disponibilidade de água potável tanto nas zonas urbanas como áreas suburbanas de maior densidade demográfica, em condições ambientais sustentáveis.	i. Melhorar a qualidade do serviço de abastecimento de água tanto nas zonas urbanas como áreas suburbanas de maior densidade demográfica ii. Promover a criação de empresas municipais de abastecimento de água e saneamento iii. Estabelecer uma adequada política de tarifas iv. Completar a implementação dos Gabinetes de Gestão das Bacias Hidrográficas prioritárias v. Aprovar e implementar o "Plano Nacional da Água" vi. Actualizar os planos directores de abastecimento de água e saneamento de águas residuais das Cidades Capitais de Província e das Sedes Municipais vii. Assegurar a reabilitação e expansão dos Centros de Distribuição e Estações de Tratamento de Água, com vista a garantir o abastecimento a diversas áreas urbanas, peri-urbanas e rurais, incluindo o atendimentno às urbanizações que integram o Plano Nacional de Habitação

Projectos	Montante (Mil Milhões Kz)
Construção do Sistema IV do Bita	50,0
Construção do Sistema 5 Quilonga Grande	72,6
Reforço dos Sistemas de Abastecimento de Água e Saneamento de 17 Cidades capitais de Província	271,0
Construção de Novos Sistemas de Abastecimento de Água em 130 Sedes Municipais do Território Nacional	141,3

Source: PND 2013 – 2017, p. 180

As can be seen in the figure above, the construction of the System 5 Quilonga Grande, which is the subject of this report, is part of the PEPN established for the period of 2013 – 2017. Table 42 presents the planned objectives for the "Water for All" Programme.

Table 41 –Water for All

Objectivo	Medidas de Política
Completar a implementação do Programa "Água para Todos", garantindo o abastecimento de água potável a 100% da população urbana e a 80% da população rural	i. Prosseguir a construção de pontos de água e de pequenos sistemas e pontos de abastecimento de água e saneamento comunitário, nas áreas suburbanas e rurais; ii. Implementar um Programa Nacional de Monitorização da Qualidade da Água para Consumo Humano; iii. Assegurar a monitorização efectiva da qualidade da água para consumo humano, com elevado padrão, com níveis de atendimento de 70% nas zonas urbanas e 40% nas zonas rurais.

Projectos	Montante (Mil Milhões Kz)
Projecto para Melhoria do Abastecimento de água dos Meios rurais – Programa de Água para Todos	56,0

Source: PND 2013 – 2017, p. 180

Finally, the Vision under "Angola 2025" established in the PND 2013 – 2017, essentially intends to create a more "balanced, dynamic and competitive" Angolan territory in order to reinforce the economy and national development. Within the scope of the Strategic Options of the Provincial Structuring Projects we identify 390 structuring projects. Table 43 presents the summary of the distribution of priority structuring projects, by province.

Table 42 – Summary of the Priority Structuring Projects within the Territory

Âmbito Geográfico	Projectos		Investimento (10^6 Kz)	
	Nº	%	Montante	%
Bengo	8	2,07%	109.666	1,81%
Benguela	14	3,62%	428.963	7,07%
Bié	8	2,07%	38.469	0,63%
Cabinda	5	1,29%	44.448	0,73%
Cunene	9	2,33%	111.966	1,85%
Huambo	10	2,58%	145.488	2,40%
Huíla	21	5,43%	108.399	1,79%
Kuando Kubango	6	1,55%	54.603	0,90%
Kwanza Norte	9	2,33%	218.718	3,61%
Kwanza Sul	13	3,36%	466.330	7,69%
Lunda Norte	8	2,07%	73.646	1,21%
Lunda Sul	3	0,78%	15.195	0,25%
Luanda	126	32,30%	1.579.663	26,05%
Malange	19	4,91%	186.219	3,07%
Moxico	10	2,58%	118.387	1,95%
Namibe	6	1,55%	45.196	0,75%
Uíge	8	2,07%	66.793	1,10%
Zaire	20	5,17%	611.901	10,09%
Nacionais	85	21,45%	1.629.829	26,87%
Provinciais	2	0,52%	9.690	0,16%
Total	390	100,00%	6.063.570	100,00%

Source: PND 2013 – 2017, p. 156

The following chapter, with name "regional context", provides a brief characterisation of the projects planned for the Province of Luanda, with emphasis on the Water sector.

III.11.4. The Regional Context – Province of Luanda

III.11.4.1. Administrative Division and Synopsis of the Province of Luanda

The Province of Luanda, where the project is located, is the largest urban centre of Angola and occupies an area of 2 416 km^2, just over 0.19% of Angola's territorial area. Its population, based on the Population Projections of 2009 – 2015, is of 5,402 671 inhabitants, giving it a population density of 2,236 inhab/km^2.

Luanda is located in the northwestern part of Angola, with the Atlantic Ocean to the west. To the North, it borders with the province of Bengo, to the east with the province of North Kuanza and to the south with the province of South Kuanza. The province capital is Luanda, which is also one of its municipalities.

Luanda has a privileged geographical location and possesses a bay and a sandbank (Island of Luanda), extending over 14 km of beaches that allow good accessibility both by land and sea.

After the independence of Angola in 1975, the municipality of Luanda became extinct, as the city's territory was divided, first into three municipalities, and then into nine: Cazenga, Ingombota, Kilamba Kiaxi, Maianga, Rangel, Sambizanga, Samba, Viana and Cacuaco. With Law No. 29/11, of 1 September, the municipality of Luanda was restored, which led to the Ingombota, Kilamba Kiaxi, Maianga, Rangel, Sambizanga and Samba losing their municipal status.

The new Municipality of Luanda is divided into 13 Urban Districts: Golfe, Ilha do Cabo, Ingombota, Kilamba Kiaxi, Maianga, Neves Bendinha, Ngola Kiluanje, Palanca, Prenda, Rangel, Samba, Sambizanga and vila Alice. Viana and Cacuaco kept their municipal status, and are one of the seven municipalities of the Province of Luanda.

With the alteration of the Political-Administrative Division of the Provinces of Luanda and Bengo (Law No. 29/11 of the 1 September, 2011), Luanda went from nine to seven municipalities, having integrated two municipalities of the neighbouring Province of Bengo. The seven municipalities of the Province of Luanda are: Luanda, Cacuaco, Belas, Viana, Cazenga, Icolo e Bengo and Quiçama. With said Law, The Municipalities of Icolo e Bengo and Quiçama were detached from the Province of Bengo.

According to the new Administrative Division, the Municipality of Luanda coincides with the City of Luanda.

Table 44 shows the set of Provinces located in the northwest of Angola, in order to provide a better framework of the territorial and population realities of the province being studied.

Table 43 – Provinces in the Northwest of Angola, Area, Population Projection for 2013 and Administrative Division

Province	Capital	Area km² (1)	Total Population 2014 (2)	Population Density inhab/km²	Municipalities (3)	Communes (4)
Bengo	Caxito	31 370	350 706	11	6	24
Cabinda	Cabinda	7 283	435 746	60	4	7
Luanda	Luanda	2 416	5 402 671	2 236	7	47
Uige	Uige	58 696	1020156	17	16	49
Zaire	Mbanza Congo	40 129	402439	10	6	37

Sources:
(1) Social Statistics Yearbook 2009. Republic of Angola – INE, 2011.
(2) Population Projection for the Period 2009-2015. Republic of Angola – INE, February 2012.
(3) Angola in Numbers 2013, 2nd Edition. Republic of Angola – INE, October 2013.
(4) Info-Angola, Virtual Library of Angola. http://www.info-angola.ao/index.php [Consulted on 03SET14]

The Province of Luanda has several areas of interest with distinct characteristics. These are summarised below.

Ilha do Cabo, also know as Ilha de Luanda, is a shoreline composed of a 7 km long straight strip of land that separates the city of Luanda from the Atlantic Ocean, thus originating the Luanda Bay. It is linked to the city by a small isthmus that is the Fortress of São Miguel. It is mostly a leisure area and offers a variety of bars, seaside restaurants, clubs, hotels, street markets, beaches and a marina.

Alvalade, the residential borough of Luanda, contains several hotels and the Alvalade Olympic Swimming Pool. The Alvalade Olympic Swimming Pool was built in the early 70's of the 20th Century. It was recently refurbished. More than merely being a place for sporting interest, the building has a restaurant where several events such as weddings and live music shows are held.

Maianga, which was one of the nine municipalities of the new administrative division, is part of the urban area of the city of Luanda. It comprises an area of 24.7 km² and close to 319 thousand inhabitants. It is limited by the Atlantic Ocean to the west, by the now extinct municipalities of Ingombota and Rangel to the north, by the extinct municipality of Kilamba Kiaxi to the East, and by the extinct municipality of Samba to the South.

Miramar is considered as the most elitist of Luanda's boroughs. Located in one of the best boroughs of Luanda, the old cinema – Cine Miramar – still has its seats to accommodate those who pass by and decide to take a break and enjoy the view of downtown. The Alto das Cruzes Cemetery is located at the highest point of the city, in Miramar. It is one of the most famous cemeteries and many influential people of the city have been buried there.

Benfica is an extinct municipality of Samba, located south of Luanda. The Municipal Market of Samba is located in Benfica, and is also known as "Kifica". It is 300 meters long and 40 meters wide, housing more than a thousand vendors. It is open to public on Tuesday and Sunday.

Mussulo is a peninsula you can visit by car (jeep) when the tide is low, but it is usually accessed by boat. It has golden sandy beaches and visitors can enjoy deserted or entertainment areas; the island provides lodging, bars and several outdoor activities and water sports.

Figure 5 shows the simplified version of the administrative map of Angola. It covers the Northwestern part of the Angolan territory, to circumscribe the Province of Luanda and its municipalities, with respect to the bordering Province of Bengo. We point out that for the administrative limits of both provinces and respective municipalities the cartographic base used are not in agreement with the current Political and Administrative Organisation of both provinces, as laid down in Law no. 29/11 of 1 September, 2011, as detailed in the chapter on administrative characterisation of the Province.

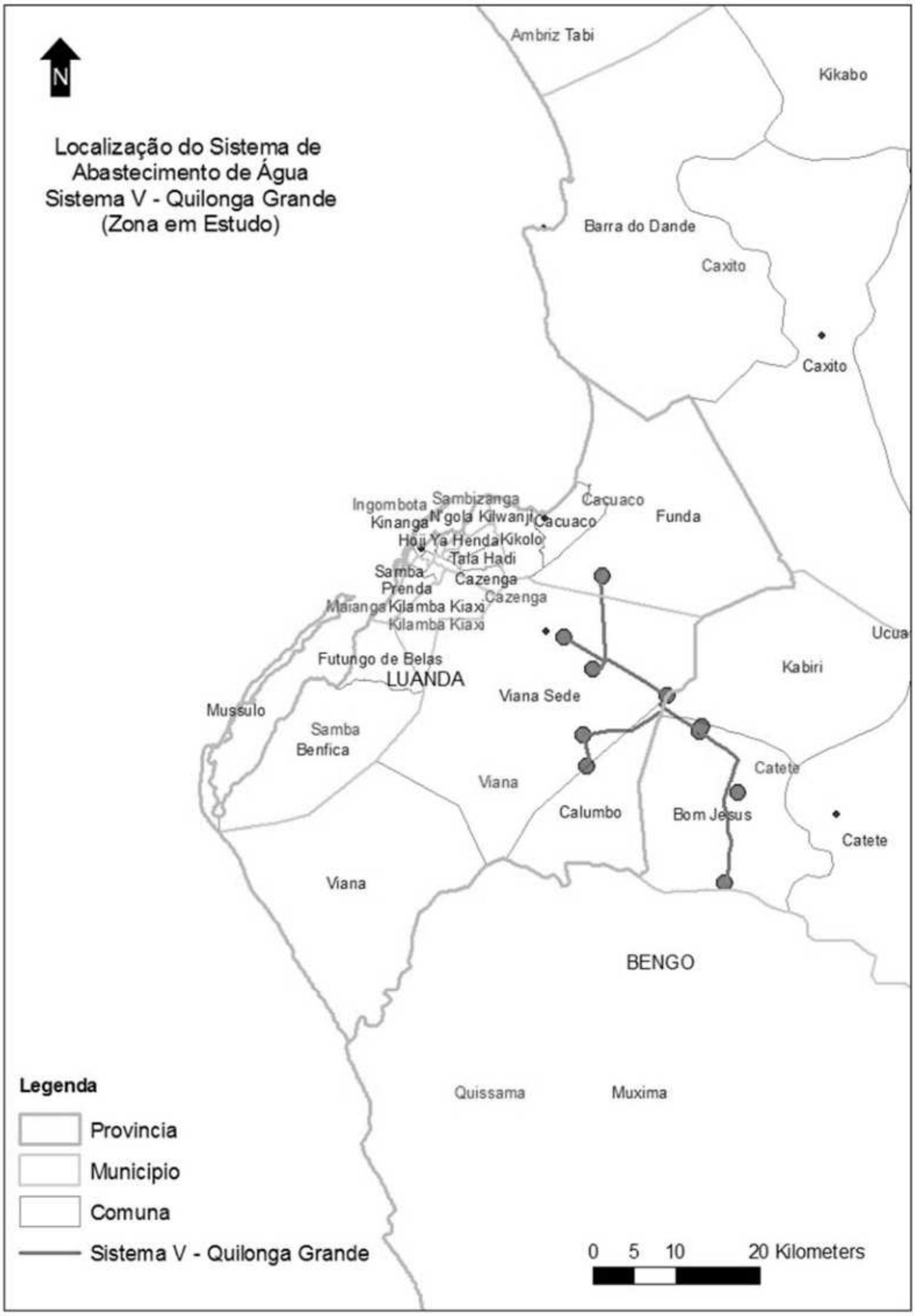


Figure 102 – Location of the Province of Luanda and Study Area

III.11.4.2. Population and Settlement

Luanda is the most populated province of the Republic of Angola, with a current population of 6 million inhabitants. Figure 103 presents the distribution of population by province and gender, showing the great heterogeneity among the 18 Provinces.

It is important to note that there is limited information on the 18 Angolan Provinces. In case of Luanda, the absence of reliable statistical information is aggravated as there are multiple and diverse estimates. Data presented in the following tables and figures should be taken cautiously. Nonetheless, these allow confirming the weight of the Province's population on the country's total and revealing the demographic evolution trend.

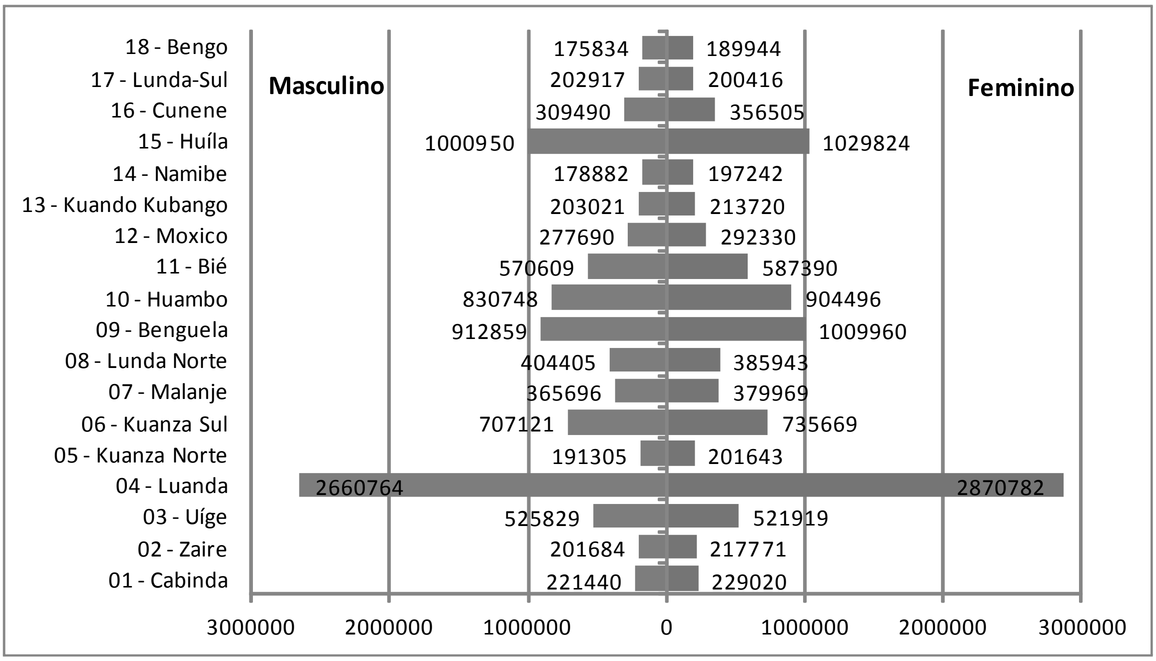


Figure 103 – Population Distribution of the Republic of Angola by Province and Gender, Projections for 2015

Like most African countries, the Republic of Angola has a majority of young population with a high birth rate. The distribution of population in the Province of Luanda has been relatively stable over time, from 2000/01 to 2008/09. The drop in the proportion of the population below 15 years of age, from 47% to 45%, was balanced by the increased in the proportion of the population between 15-64 years, from 52% to 54%, while those with aged 65 and above represented only 1%. These slight changes implied that the total dependence index dropped substantially from 94 to 87 “dependents” per 100 persons in working age (IBEP, 2008/2009 – 2013 Edition).

Figure 104– Children Playing

Families have become smaller between 2000/01 and 2008/09. Average family size has decreased from 6.4 to 5.4 persons.

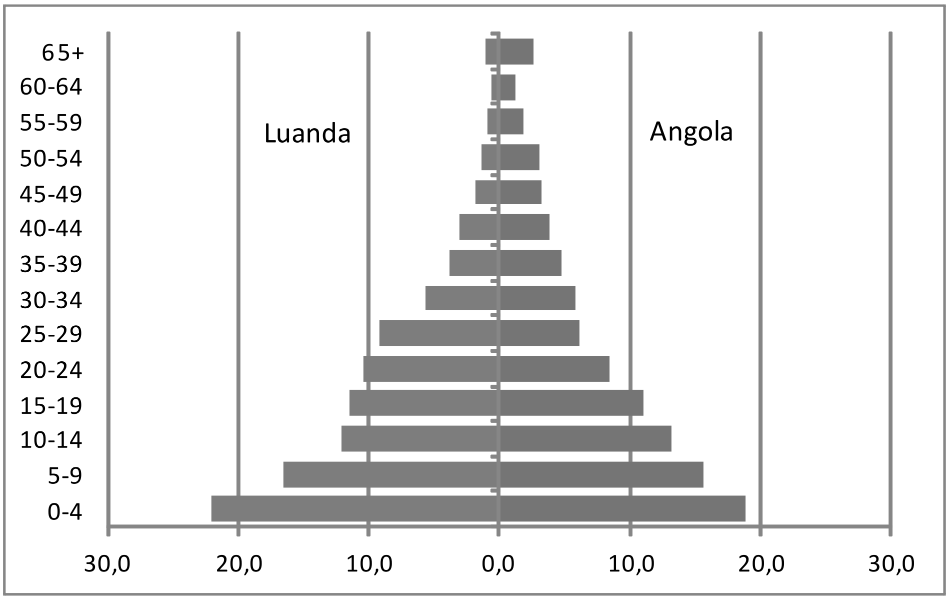


Figure 105– Population of Luanda and Angola in Five-Yearly Groups. Projection for the Period 1985 – 2010
Source: Demographic Bulletin No. 9, July 1991

III.11.4.3. Social and Habitability Condition Framework

A particularly important aspect in environmental assessments for projects of this nature is the characterisation of the current social and economic framework. This allows evaluating and predicting the impact that the project in question will have on these domains.

According to what has already been referred, the province of Luanda has many deficiencies in the social, economic and infrastructure domains, since the great growth of the resident population was not equalled by a growth of the supply of equipment and other services. The province of Luanda, like the rest of the country, has been rebuilt progressively since the end of the civil war that took place after the independence in 1975, which led to a great exodus of rural populations to the main cities of the country, and in particular towards Greater Luanda.

According to several estimates, it is predicted that the population of Luanda will reach 15 million inhabitants by 2025. This means that 54% of the Angolan population will live in the capital. The remaining 46% of the population will be distributed all over the national territory, estimated to be 27 million inhabitants by that date. The necessity of changing the structure of Luanda is evident, as it will be the only way in which the city can sustain its predicted population growth.

Luanda has low coverage rates in terms of the population being served by public water, electrical power and basic sanitation, considering the doubling of its population in just over two decades.

The Greater Luanda residential market has a considerable shortage of housing supply for the emerging Angolan middle class, mainly in the central areas of the city. On the other hand, there is an increase in the supply for the periphery residential market. Taking this into account, it is fundamental to provide these spaces with basic infrastructure, namely electricity, water and sanitation.

In terms of housing typology, the importance of houses grew from 80% to 88% of the population; the proportion of population living in apartments remained constant at 5%; and the proportion of people living in annex housing, cabanas or huts has decreased with time, but it is still significant. The population living in housing built with inappropriate materials has increased from 53% in 2000/01 to 69% in 2008/09.

Figure 106 – Wood and Tarp Houses (left) and Block House (right)

Access to appropriate drinking water sources has grown significantly from 38% to 51% of the population. The presence of more public fountains and the lesser reliance on water tanks from neighbours explains much of this improvement.

Figure 107 – Public fountain built for the people near the Bom Jesus factory

Access to the power grid has grown considerably from 61% to 84% of the population. The proportion of population with access to appropriate drinking water sources, appropriate sanitation and electricity has substantially increased from 30% to 41%.

Possession of durables has increased for all types of durable goods, particularly, stoves, ironing irons, freezers, mobile phones and satellite antennas.

III.11.4.4. Educational Framework

As regards education, the Angolan Government established the Recovery Strategy for Literacy and School Acceleration, in accordance with the provisions of the Basic Law of the Education System, Law 13/01, in the Integrated Programme for Improvement of the Education System (approved on 28th February 2001) and in the National Action Plan on Education for All.

Other important instruments are the regulations of the National Programme for Literacy and Recovery of Poor Educational Performance (provision No. 36/08, of 24 January), and the Poverty Reduction Strategy.

The Angolan educational landscape still presents many deficiencies at the infrastructural and personnel level. Education levels across the country and provinces mainly are Primary School, but the percentage of population without any education level remains high. Angola currently registers a literacy rate of 70% and illiteracy rate of 30%.

Figure 108- Bom Jesus School – 1st and 2nd Cycles

School attendance in Luanda for children in the 6-17 age group has significantly increased from 55% in 2000/01 to 71% in 2008/09. The proportion of population under 15 or more who know how to read and write has increased from 79% in 2000/01 to 87% in 2008/09. Women are still lagging behind men, but have improved considerably during the period being analysed (from 68% to 78%). The proportion of population aged 6 years or more who have never attended school has decreased substantially from 14% to 7%. It is considerably more likely for women to have never attended a school than men, but the current trend points towards this gap being reduced (IBEP, 2008/2009 – 2013 Edition).

The following tables show the data regarding the population enrolled in Primary and Secondary Education, number of schools and number of teachers for Angola and the Luanda Province. This information is based on the Social Statistics Yearbook for 2009 (2011 Edition).

Table 44 – Students enrolled in Primary School, 2008

	Kindergarten	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
Angola	470088	747230	984428	780528	544739	371097	259582
Luanda	9205	67800	97988	76081	104940	90271	77357

Source: Social Statistics Yearbook 2009, Edition – 2011, Republic of Angola, INE.

Table 45 - Students enrolled in 1st Cycle of Secondary School, 2007

	7th Grade		8th Grade		9th Grade	
	Total	H (%)	Total	H (%)	Total	H (%)
Angola	165075	58,8	121745	56,1	111912	57,5
Luanda	40981	49,4	35595	50,0	43720	52,0

Source: Social Statistics Yearbook 2009, Edition – 2011, Republic of Angola, INE.

Table 46 – Number of Teachers in Primary and Secondary School, 2008

	Total	Primary School	Secondary School	
			1st Cycle	2nd Cycle
Angola	129800	102968	19137	7695
Luanda	25850	16938	4658	4254

Source: Social Statistics Yearbook 2009, Edition – 2011, Republic of Angola, INE.

Table 47 – Number of Teachers in Primary and Secondary School, 2008

	Total	Primary School	Secondary School	
			1st Cycle	
Angola	11295	10671	460	164
Luanda	562	479	32	51

Source: Social Statistics Yearbook 2009, Edition – 2011, Republic of Angola, INE.

In terms of its higher educational offer, Luanda has a great diversity of higher education establishments and courses. Based on the information available on the "Angola Formativa" Portal (http://www.angolaformativa.com/pt/regioes/luanda/) [Consulted on 09SET14], there are 5 offerings available for Bachelor degrees, 305 for Licentiate's degrees, 12 for Post-Graduate degrees, 22 for Masters degrees, 22 for Executive, 3 for Doctorate degrees and 24 for Education degrees. Offerings are highly diverse and cover areas ranging from the social sciences, engineering, health sciences, among others, and are both public and private.

III.11.4.5. Health and Sanitary Framework

In Luanda, given the exponential growth of population and poor residential areas, the mortality rate grew from 12% in 2000/01 to 15% in 2008/09. Among people who reported having a health problem, the probabilities of visiting for a consultation grew from 68% to 73%. There are significant differences among genders, because women saw a considerable improvement (from 68% to 76%) in comparison with men (68% to 70%).

Table 49 shows the number of doctors, nurses and technicians in the public sector, per province, in 2009. The number of doctors more than tripled, rising from 849 doctors in 2005 to 2956 doctors (Angola HSA 2005).

The trend data from the report of the Ministry of Health - MINSA (MINSA 2009) show that the number of doctors has registered a steady and strong growth since 2005, with 1525 doctors in 2007 and 1899 doctors in 2008.

The number of nurses also increased significantly since 2005, from 16,037 to 29,605 (Angola HSA 2005). However, this significant variation is presumably due to the differentiated rating of nurses in the statistics of 2005 and 2009, especially considering that the number of nurses has not changed significantly since 2007: 28,848 in 2007 and 29,605 in 2008 (MINSA 2009). In 2005, there was no data available regarding the number of technicians.

The total coefficient of healthcare employees per 1000 inhabitants in Angola is close to the amount recommended by the World Health Organisation (WHO) of 2.28 workers per 1000 inhabitants (WHO 2006). However, there is a serious problem regarding irregular distribution of workers throughout the country, which is evident in Table 36, given the huge variation of healthcare workers per 1000 inhabitants in all provinces.

As for Luanda, the province under study, it appears that the situation is more favourable in comparison with the other provinces. The province has 982 doctors, which corresponds to 33.2% of total number of doctors, which corresponds to a ratio of 2.2 doctors per ten thousand inhabitants, considering estimated population. In regard to nurses, the ratio is 19.7 nurses per ten thousand inhabitants. As for technical staff, the ratio is 5.8 technicians per ten thousand inhabitants.

Table 48 – Healthcare service personnel in Angola, per Province, 2009

Province	Doctors *		Nurses		Technicians		Total	
	No.	No. per 1000 inhab.	No.	No. per 1000 inhab.	No.	No. per 1000 inhab.	No.	No. per 1000 inhab.
Bengo	87	0.41	954	4.49	99	0.47	1140	5.36
Benguela	184	00.9	2 809	1.37	3,91	0.19	3 384	1.65
Bié	106	0.18	1 468	2.45	80	0.13	1 654	2.76
Cabinda	126	0.29	1 256	2.90	278	0.64	1 660	3.83
Cunene	103	0.28	922	2.51	73	0.20	1 098	2.99
Huambo	163	0.17	1 796	1.89	343	0.36	2 302	2.42
Huila	187	0.10	2 052	1.11	495	0.27	2 734	1.48
Kuando Kubango	39	0.13	642	2.14	65	0.22	746	2.49
Kwansa Norte	115	0.46	1 051	4.20	88	0.35	1,254	5.02
Kwanza Sul	182	0.19	1 026	1.08	131	0.14	1 339	1.41
Luanda	982	0.22	8 750	1.97	2 590	0.58	12 322	2.78
Lunda Norte	94	0.16	839	1.40	89	0.15	1 022	1.70
Lunda Sul	87	0.33	753	2.90	67	0.26	907	3.49
Malange	147	0.33	1 146	2.55	82	0.18	1 375	3.06
Moxico	81	0.14	1 233	2.06	93	0.16	1 407	2.35
Namibe	103	0.56	941	5.13	257	1.40	1 301	7.10
Uíge	94	0.10	1 222	1.36	132	0.15	1 448	1.61
Zaire	76	0.38	732	3.66	82	0.41	890	4.45
Total	2 956	0.17	29 592	1.74	5 435	0.32	37 983	2.24

* Including foreign doctors **Source:** MINSA 2009

In 2007, there were 25 healthcare units for HIV-AIDS Counselling and Testing Service. These units registered a total of 7152 positive cases of HIV-AIDS, of which 188 were under 15 years of age and 6964 were of age 15 years and above (Social Statistics Yearbook 2009, Edition – 2011).

Table 49 – Healthcare Units per Province, 2005 and 2007

	Hospitals		Health Centres		Health Stations	
	2005	2007	2005	2007	2005	2007
Angola	163	185	272	454	1026	1586
Luanda	12	14	34	46	13	44

Source: Social Statistics Yearbook 2009, Edition – 2011, Republic of Angola, INE.

III.11.4.6. Employment and Production Framework

Luanda is the major financial, commercial and economic centre of Angola, housing the headquarters of the main companies of the country: Angola Telecom, Unitel, Endiama, Sonangol, Linhas Aéreas de Angola (Angolan Airlines) and Odebrecht Angola, among others. Luanda was classified, in 2011, as the most expensive city of the world, with an extremely rich population living side by side with a predominantly poor population.

On a production level, the manufacturing industry stands out (main activity of Luanda) which includes processed foods, beverages, cement and other building materials, plastic products, metals, cigarettes and footwear. Petroleum, extracted from nearby locations, is refined in the city, in facilities that were damaged several times during the Angolan civil war (1975 – 2002). Luanda has an excellent natural port, from where mainly coffee, cotton, sugar, diamonds, iron and salt is exported.

The civil construction industry is also thriving, with economic advantages for the country. This is the most developed city of Angola and is the only major economical hub of the country, but faces the reality of slums that extend Luanda to many kilometres beyond the old city.

In 2007, the first fully air-conditioned shopping mall (Belas Shopping) was inaugurated in Angola, with eight cinemas and an eating area, leisure areas and hundred stores. The reconstruction of Luanda city is evident in all aspects of the society, especially in terms of road rehabilitation and construction.

In terms of employment, the participation rate in the workforce dropped from 64% in 2000/01 to 60% in 2008/09. The age analysis shows that the participation rates have considerably dropped for the younger age groups, remained constant for people aged 35-54 years, and have generally dropped for the elderly population.

The distribution of population employed per sector of economic activity has largely remained unchanged, over both reference periods. Services remain the largest sector (80% in both years), followed by the manufacturing industry (15% in both years) and the remaining corresponds to agriculture.

The employment status of working populations has seen significant variations during the analysis period. The proportion of employees (who work for others) grew from 44% to 61% and the proportion of self-employed decreased from 54% to 39%. Most of the growth among employees (who work for others) resulted from the expansion of the private sector and a lower growth was observed in the public administration, public companies and in the cooperative sector.

In the study area, we highlight the importance of the Luanda-Bengo Special Economic Zone, approved and created through Decree No. 50/09 of 11 September. It is an economic area with several land title, economic and administrative infrastructures, appropriate for competitiveness, innovation, intensive growth of production, and job creation. http://www.zee.co.ao/index.php?option=com_content&view=article&id=78&Itemid=101

In Viana, where the Luanda-Bengo SEZ project began, development centres were built for the agro-industries, trade and services. Each industrial centre has business units in several sectors such as food and beverage, textile, agriculture, livestock, poultry, clothing and footwear. The chemical, pharmaceutical, building material, metal working and mechanical engineering, electrical material and printing industries are also contemplated.

The Luanda - Bengo SEZ includes the territories of the municipalities of Viana (27 km) and Cacuaco (Sequele) in the Province of Luanda and of the municipalities of Caxito, Dande, Icolo e Bengo (Catete and Bom Jesus), Ambriz and Nambuangongo in the Province of Bengo, in which three different centres will be implemented, with internal road infrastructures, electricity, water supply and telecommunications.

Agriculture

The primary activities are key pillars to fight poverty and food insecurity, particularly in a rural population that characterizes a significant part of the Angolan population. Agricultural activity in Angola diminished greatly after the independence of Angola in 1975, as a result of the war. This situation affected essentially the peasant sector that in many provinces was forced to leave their home areas to focus on areas that offered conditions of security, in general the peripheries of urban centres.

The situation of peace following the Luena Memorandum of Understanding, in April 2002, allowed the restoration of flow of persons and goods, allowing a very significant part of the displaced to return to their areas of origin and resume their productive activity (Extension and Rural Development Program, Republic of Angola).

Luanda is the seat of the General Directorate of Agrarian Development Institute (IDA), which has Provincial Departments in parts of the provinces of the country.

The agricultural sector of Luanda Province is characterized by a peasant subsistence agriculture, and there have been few farms of commercial type, even in colonial times. Angola is currently organized into five rural regions, and the Province of Luanda does not form part of any of them. According to this division, the five regions cover 1.364.400 Rural Families (Extension and Rural Development Program, Republic of Angola, p.6)

We will follow with a brief description of the agricultural sector in the province of Luanda, based on the report "Results of Agricultural campaign 2007/2008, of the Ministry of Agriculture, Republic of Angola (MINAGRI/JANUARY/2009).

According to MINAGRI, based on projections of INE 2007, Luanda province had an estimated population of 4.749.423, of which about 15% were rural population, representing the lowest provincial rate of rurality. Table 51 shows a set of indicators relating to the agricultural population of the 18 provinces of Angola, framing Luanda Province and others in the context of the Republic.

Table 50 - Indicators of Rural Population by Province

PROVÍNCIA	POPULAÇÃO ESTIMADA	POPULAÇÃO RURAL			POPULAÇÃO LIGADA À AGRICULTURA				
		TOTAL	%	Nº MÉD. PESSOA POR AGREGADO RURAL	TOTAL	% em Relação à Pop. Total	% em Relação à Pop. Rural	FAMILIAS CAMPONESAS	%
1	2	3	4	5	6	7	8	9	10
Cabinda	349.501	260.030	74,4	5	260.030	74	0	52.006	3
Zaire	306.123	238.775	78,0	5	238.775	78	0	47.755	3
Uige	890.821	758.980	85,5	5	876.080	98	15	175.216	9
Malanje	598.098	345.700	57,8	5	489.610	82	42	97.922	5
Kuanza-Norte	291.290	189.340	65,0	5	287.915	99	52	57.583	3
Bengo	271.942	227.345	83,6	5	227.345	84	0	45.469	2
Luanda	4.749.423	712.415	15,0	5	108.615	2	-85	21.723	1
Kuanza Sul	1.306.518	718.585	55,0	5	1.013.750	78	41	202.750	11
Benguela	1.597.295	718.785	45,0	5	877.280	55	22	175.456	9
Huambo	1.239.777	557.900	45,0	5	1.034.000	83	85	206.800	11
Bié	901.120	450.560	50,0	5	810.000	90	80	162.000	9
Huila	1.683.568	925.960	55,0	5	1.303.930	77	41	260.786	14
Namibe	289.144	160765	55,6	5	160.765	56	0	32.153	2
Cunene	507.551	329.910	65	5	329.910	65	0	65.982	4
Lunda Norte	604.977	407755	67,4	5	407.755	67	0	81.551	4
Lunda Sul	300.317	97905	32,6	5	259.235	86	165	51.847	3
Moxico	444.233	260.765		5	381.500	86	46	76.300	4
Kuando Kubango	306.215	239.765	58,5	5	239.765	78	0	47.953	3
NACIONAL	16.637.913	7.601.240	45,5	5	9.306.260	56	22	1.861.252	100

Source: (MINAGRI/JANEIRO/2009, p.8)

Table 52 shows the amounts of land prepared by the Family Agrarian Exploitations (Explorações Agrícolas Familiares - EAF) and by the Business Type Agrarian Exploitation (Explorações Agrícolas do Tipo Empresarial - EAE), relating to the agricultural year 2006/2007, a total of 3.438.120 hectares of prepared and seeded land. Once again we show values for the 18 provinces of Angola, to frame Luanda Province in the context of the others and the Republic.

From the values in Table 52, it is shown that Luanda holds only about 1.23% of the total holdings of Angolan family farms (EAF) representing 1.17% of the total and that the business type holdings (EAE) represent about 31% of total corporate holdings.

Table 51 - Distribution of cultivated areas by Province, according to the type of Land Preparation, in ha

PROVÍNCIA	Nº EAF	Nº EAE	PEDR/IDA MECANOGRO	PEDR/IDA TRACÇÃO ANIMAL	EAF "MEIOS PRÓPRIO E MANUALMENTE"	EAE "MEIOS PRÓPRIOS OU TERCEIRO	TOTAL
Cabinda	52.006	60	41	0	119.053	1.013	120.107
Zaire	47.755	67	1.228	0	41.274	587	43.089
Uige	175.216	146	1.214	0	312.423	2.790	316.427
Malanje	97.922	31	1.514	0	250.146	467	252.127
Kuanza Norte	57.583	160	1.514	0	88.315	949	90.778
Bengo	45.469	110	1.000	0	55.836	2.500	59.336
Luanda	21.723	1.146	17	0	6.500	12.789	19.306
Kuanza Sul	202.750	546	1.470	1.222	364.286	17.699	384.677
Benguela	175.456	231	2.123	11.536	138.989	7.668	160.315
Huambo	206.800	329	2.574	357.119	-97.057	22.843	285.479
Bié	162.000	172	1.645	13.142	294.634	6.082	315.502
Huila	260.786	255	2.589	245.300	145.898	28.514	422.301
Namibe	32.153	187	958	3.303	36.573	2.596	43.430
Cunene	65.982	62	1.845	113.522	74.001	433	189.801
Lunda Norte	81.551	22	35	0	87.226	685	87.945
Lunda Sul	51.847	67	40	0	60.103	1.137	61.280
Moxico	76.300	75	1.080	50	109.505	1.614	112.249
Kuando Kubango	47.953	49	1.442	28.704	80.146	367	110.659
Nacional	**1.861.252**	**3.715**	**22.328**	**773.897**	**2.167.848**	**110.733**	**3.074.806**
			1%	**25%**	**71%**	**4%**	**100%**

Source: (MINAGRI/JANEIRO/2009, p.19)

In relation to the prevailing production in Luanda, it appears that regarding grain production, the province only produces some corn, recording an aggregate output (EAF + EAE) of 8.668 tonnes (about 1,23% of the total) in the 2007-2008 agricultural campaign.

In the class of roots and tubers, cassava production in the province amounted to 21.224 tonnes (about 0.21%) in terms of aggregate output. The province also recorded a production of about 50.000 tonnes of sweet potatoes, in holdings of the business type, in the 2007-2008 agricultural campaign.

The province also has production of oilseeds and legumes (beans and peanuts), having recorded a production of 161 tons, on family holdings, in the 2007-2008 agricultural year.

In the class of vegetables, the business type holdings have higher proportions, with Luanda registering a production of 158.006 tonnes (about 5.74% of the total), inside an area of 132.10 hectares (approximately 5.6% of total), for the agricultural year 2007/2008.

There are not high incidences of forestry production in the Province of Luanda, likewise coal and dry wood.

Livestock

Livestock production in general is a socio-economic activity of great importance to the food and nutritional security, employment promotion, poverty reduction, health and prosperity of a country. The Livestock Sector in Angola has its own specific characteristics and is practiced primarily in the traditional sector and the business sector.

With about 3% of livestock the business sector has in recent years shown a remarkable growth, with the installation and/or gradual reactivation of farms, individually or collectively, the creation of Development Centres (Waku Kungo, Matala, Plateau Camabatela, Capanda, etc.), investments for production and animal industry. The same benefits mostly public-private technical assistance Angola (MINAGRI/JANUARY/2009).

The provinces with the most significant livestock are: Huila, Cunene, Benguela, Huambo and Namibe, which together account for around three million head, slightly more than 86% of the total controlled cattle, in the 2007-2008 agricultural year. In Luanda Province, there is some incidence of the livestock sector, accounting for up 236.300 heads of controlled cattle, pigs, goats and sheep, for the agricultural year of 2007/2008.

Fishing

The fishing industry in the province of Luanda, apart from the food component, is of considerable economic value, occupying important fringes of the population, which depend on fishing as a source, almost exclusively, to generate income.

The Development of the Fishing Activities and Fish Processing is essential to meet the needs of this population group, increase production levels, improve the population's fish supply, improve and operate the infrastructure and equipment to support the activity, reactivating the Luandaners shipyards, as well as the structures of the vocational training sector and improve the living conditions of the nuclei of artisanal fisheries, particularly in areas of Barra do Bengo, São Pedro da

Barra and Samba/Mussulo.

Artisanal fishing also contributes as a source of income for the population of Luanda, especially that found along the coastline and in the riverine areas of Bengo and Kwanza. The development of inland fisheries extends the municipalities of Viana, over Kwanza River, including the Cacuaco Kilunda Lagoon to the Bengo River. The fisheries sector in Luanda is at present characterized by seven major areas of activity, namely, fisheries production, processing, marketing, business maintenance, repair and shipbuilding, aquaculture and supervision. Aquaculture is one of the activities that has recently begun to earn interest, becoming implanted in Luanda with the help of big investors.

In Luanda, the main fishing port is Porto da Boa vista, but Porto Commercial and the coal pier are also used, when necessary.

Industry

In Luanda Province there has been a significant increase in the industrial sector. The "Master Plan of Angola re-industrialization" of the Ministry of Industry (Resolution No. 4/98 of 27th of March), emphasizes the need to prioritize the Province of Luanda, in order to implement measures to revive industry, since that province concentrates 75% of productive capacity. The aforesaid Plan endorses the Luanda Province Pilot Plan for Industrialization, with an area of 6.000 hectares.

The new plants will be multiplying and feeding the sector of industry in Angola, they are steadily appearing across the country, with special emphasis on the PIV - Pólo Industrial de Viana (Industrial Estate of Viana), whose capacity currently amounts to 100 units in full operation, related to metalworking, trucking, packaging, paints, varnishes and coating, building materials, cosmetics, bakeries, block factories, sofas, mattresses, furniture, pipes, soap and plastic artefacts.

For PIV - Pólo Industrial de Viana, 500 industries that signed a contract are on their way to be installed in a total area of about 3,000 hectares.

The industry linked to the agro-industrial sector in Angola has great potential since it is almost non-existent and the agricultural sector is booming.

From the range of large projects in progress, refer, for example, to the World Trade Centre Complex in Luanda, developing in an area of 1 million square metres in Viana, with 700 metres in front of the main National Highway (Road Viana/Catete), opposite Porto Seco and the railway line from Luanda, 2 km from the Expressway Benfica-Cacuaco, 10km from the future Luanda International Airport and 20km from downtown Luanda.

In addition to the new industrial development centres, in the project area there is traditional industrial activity, sawmills, cement production, brewing and soft drinks industry, bakeries and remnants of the former sugar industry, among other small craft activities.

Trade

In Luanda there coexists an informal small-scale commerce, in predominantly rural areas, with a business and quality trade in the major urban centres of Luanda, where big brands start to conquer space and market.

Tourism

The tourism sector in the province, which is mainly marked by business tourism, brings together most of the existing structures in the country and, specifically, about 60% of hotel capacity in the country.

The hotel and tourism activity is typically private; however, the creation of bases for the development of the sector is left to the State, which includes infrastructure, the enhancement of the cultural heritage of the country, as well as regulation and incentives to attract private investment to the sector.

The tourism sector is regulated by the Master Plan of Tourism of Angola 2011 - 2020, approved by the Standing Committee of the Council of Ministers on 12th of October 2011.

In 2008, according to the responsible Ministry (Ministry of Hotels and Tourism), the large scale hospitality projects of Luanda envisioned the opening of 11 new hotels with capacity equivalent to 1056 bedrooms and 873 new jobs offer. Table 530 shows the provincial distribution of hotel and similar capacity in 2009.

Table 52 - Hotel Network and Similar Operating by Province, 2009

Província	Hotéis	Pensões	Ald. Turistico	Apartho tel	Comp. Tur.	Conj. Tur.	Pousada	Alberg.	Hosped.	Estal.	Rest. Simil	Ag. V. Turismo	Total
Bengo	1	12	0	0	7	0	0	0	0	0	0	40	60
Benguela	13	42	0	2	1		2	0	44	0	207	0	311
Bié	1	33	0	0	0	0	0	0	0	0	34	0	68
Cabinda	3	13	0	0	2	0	0	0	0	2	28	0	48
Cunene	1	28	0	0	0	0	0	0	8	0	0	2	39
Huambo	4	22	0	1	0	0	0	0	5	0	43	5	80
Huila	6	15	12	0	0	0	0	0	53	0	487	12	585
Kwanza Norte	1	15	0	0	0	0	0	0	0	0	38	0	54
Kwanza Sul	14	31	0	1	1	0	0	0	0	0	102	0	149
K. Kubango	0	10	0	0	0	0	0	0	3	0	45	0	58
Luanda	48	90	14	1	0	6	0	5	119	2	815	30	1130
Lunda Norte	0	12	0	0	0	0		0	0	0	59	0	71
Lunda Sul	0	10	0	0	2	0	1	0	2	0	24	0	39
Malange	6	8	0	0	0	0	0	0	0	0	57	0	71
Moxico	3	14	0	0	0	0		0	1	0	16	2	36
Namibe	2	14	2	1	0	1	0	0	16	0	129	4	169
Uige	2	5	0	0	0	0		0	0	0	121	0	128
Zaire	6	13	1	1	0	0	0	0	9	0	26	0	56
Total	111	387	29	7	13	7	3	5	260	4	2.271	55	3.152

Source: Statical Bulletin of MINHOTUR from 2009, in MHT, May 2010
http://www.minhotur.gov.ao/VerPublicacao.aspx?id=642 [Consultation 07SET2014]

III.11.4.7. Transport and Communication Infrastructure

In terms of infrastructure, the high population growth and new entrepreneurial and productive realities of Greater Luanda have highlighted the weaknesses of the various systems and infrastructure essential for the normal functioning of a big city.

Luanda has been making an effort to provide the city with the necessary means for their growth and development consistent with the purpose of asserting the capital of the Republic of Angola within the African and global context. This chapter is a summary detailing the major categories of infrastructure, in the province standard.

The National Development Plan (Plano de Desenvolvimento Nacional - PND 2013 - to 2017) provides for the consolidation and restructuring of the airline industry, enabling the operations of companies in the industry, completing the modernization of airports and consolidating aeronautical regulation to the level of the best international standards.

It also provides for the rehabilitation of roads and railways and their integration, consolidating the public transport of passengers, finalizing the sustained revival of maritime activity at national and international level, improving maritime safety and surveillance along the Angolan coast. In the port maritime sector, the programme envisages the construction of maritime and inland terminals in the country, creating conditions of safety and security in the maritime environment.

Airport Infrastructure

The ENANA, National Company of Angola Airports, manages 18 airports and air navigation services to all airports; seven others are under the control of provincial governments, five are operated by mining companies and the Angolan Air Force uses six.

This network is complemented by a set of military airports (Lobito, Cabo Ledo, Ngage, Cahama, Changongo and Catumbela) and a set of public dirt track roads (Porto Amboim, Waco Kungo, Ambriz, Andulo, Damba, Jamba, Luau, Kangamba, Nzeto) and private (Lucapa Catoca, Gove, Nzaji).

Luanda is served by 4 de Fevereiro International Airport and the new International Airport of Luanda, whose construction started in 2007, and which is still under construction. The new airport is located in Viana, 40 kilometres from the capital; it is implanted in an area of 1,324 hectares and will have two double runways capable of landing the biggest commercial aircraft in the world. According to reports by government sources, the new airport should be completed in 2017.

Railway Infrastructure

The Angolan Railway System today integrates the INCFA - Instituto Nacional dos Caminhos de Ferro de Angola (National Institute of Railways in Angola), Regulatory Authority for the Railway Sector, Company of the Benguela Railway, EP, the Railway Company of Luanda, EP and the Railway Company of Moçâmedes, EP.

The railway from Luanda connects that city and Malange, a distance of 538 km. According to information provided in the INCFA web page, the Railroad Company of Luanda has already developed the Strategic Plan for the years 2014 - 2018, with the aim of modernizing this infrastructure

In general, the Angolan rail network needs major action for its recuperation and maintenance and the modernization of its rolling stick.

Road Infrastructure

The Core Road Network of Angola has a length of around 75,000 km, connecting between the major cities of Angola.

Most of these roads were constructed before the independence of Angola and need rehabilitation.

In Figure 109, the map of the main routes of the national road network in Angola is shown.

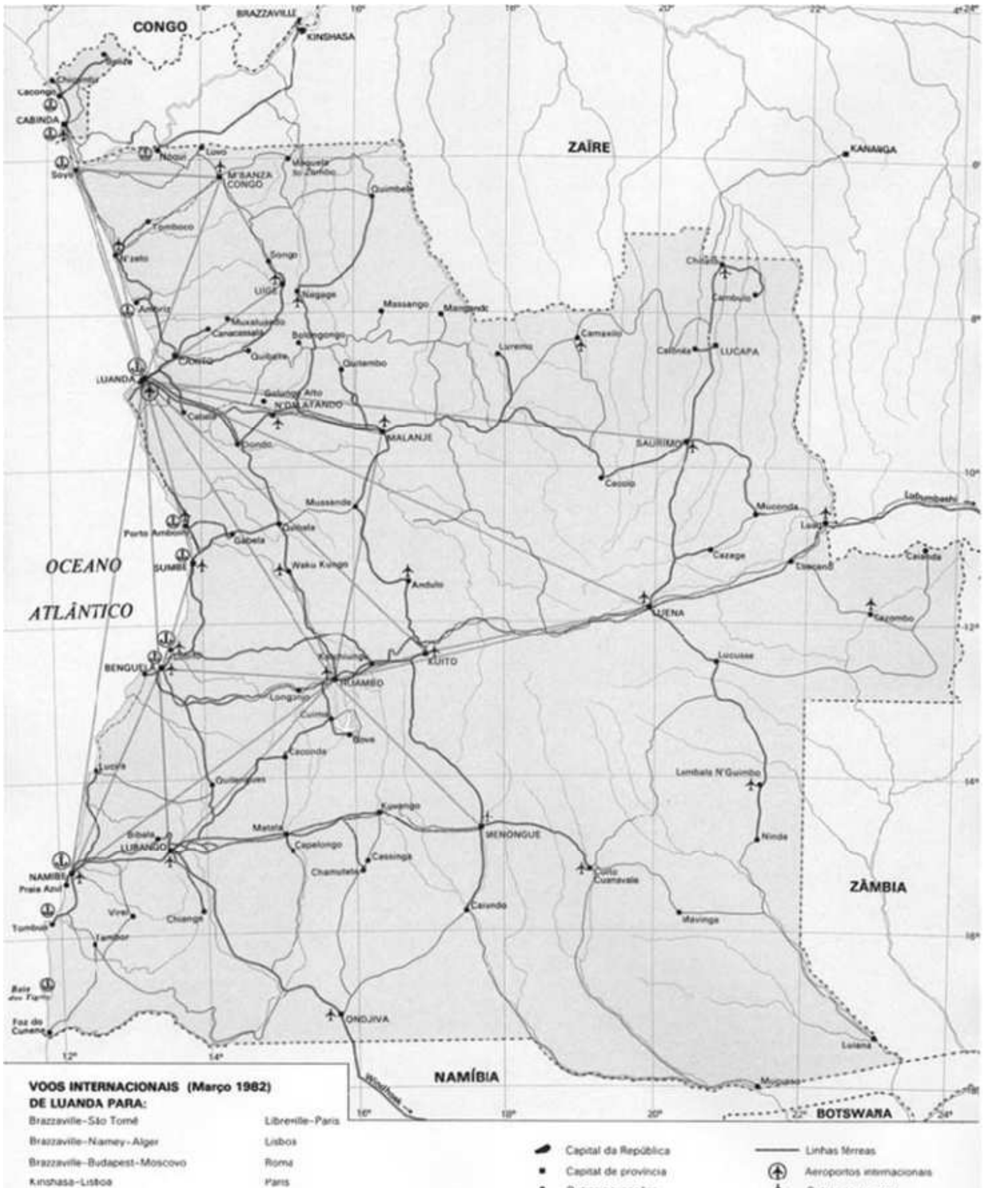


Figure 109 - Main routes of the national road network in Angola and location of airport infrastructure

The area under study, from south to north, i.e., from the point of abstraction on the Kwanza River in Bom Jesus, is served by the Bom Jesus Road, which allows access to the Bom Jesus WTP and DC , until connecting with the Road to Catete. The project follows the alignment of the Road to Catete, with junction to the New Airport DC and DC 30. Southwards of the junction for DC 30, the link to Zango III is made by rural roads, towards the west of the Road to Catete. The study area is also crossed by the Expressway, crossing the road to Catete and allows access to the PIV DC, on the west side of the Road to Catete, and towards the Cacuaco DC, on the east side of the Road to Catete.

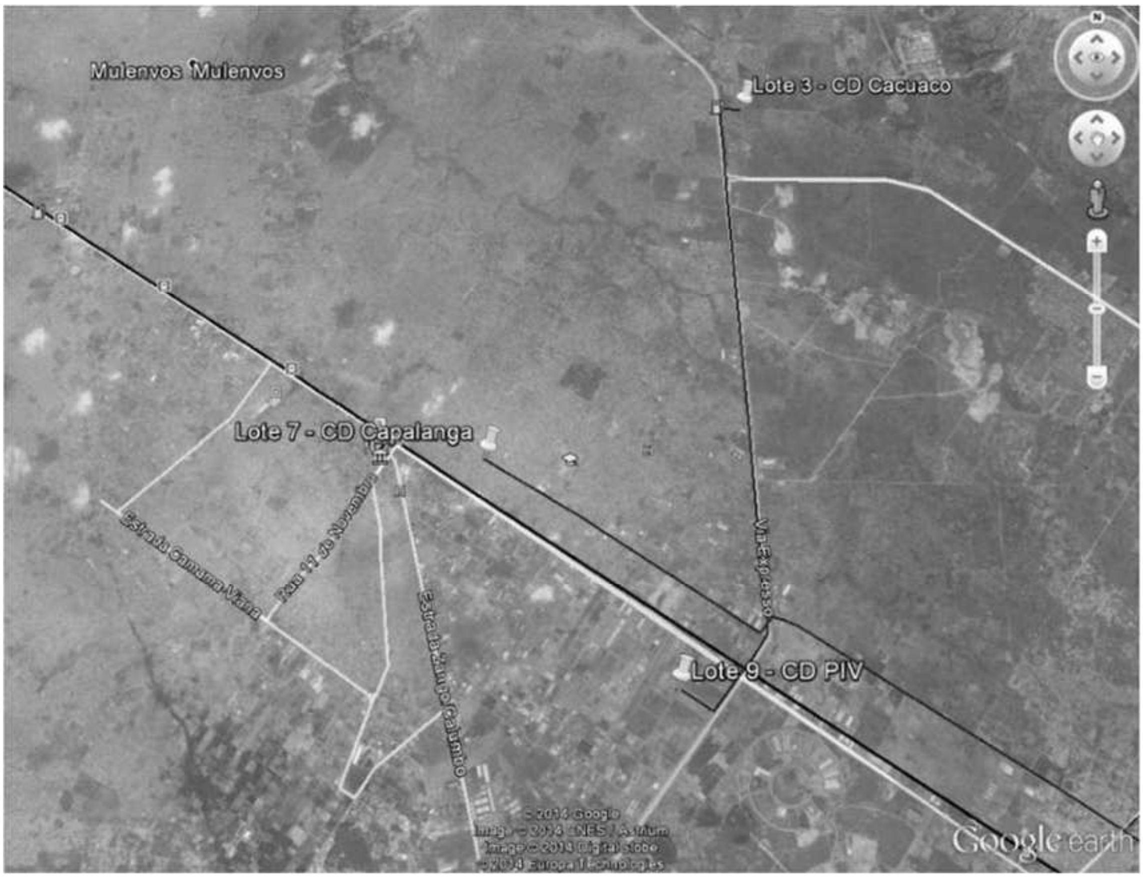


Figure 110 - Road Framework of the northern sector of the study area, crossed by the Road to Catete and the Expressway.

Figure 111 - Road Framework of the southern sector of the study area, crossed by the Bom Jesus Road.

III.11.4.8. Structuring projects in the Province of Luanda

Luanda has several ongoing projects that aim to provide the county and the city infrastructure capable and sufficient to serve a growing population and improve their living conditions.

The Provincial Development Plan 2013-2017 will provide widespread access to basic services to strengthen local services with the increased number of administrative agencies throughout the province.

126 structural projects are identified in the province of Luanda, which account for a third of the universe of such projects and 26% of the total estimated investment for the same.

Of all planned projects, 81 belong to priority clusters - including Energy and Water, Housing and Transport and Logistics.

These projects account for over three quarters of the estimated investment for the Province in structural projects.

Included in this group: creating housing units, namely the construction of about 87,000 social, developmental and economic housing units; the creation of infrastructure for water supply, electricity, sanitation and wastewater treatment; the construction of roads accessibility, heavy transport infrastructure such as the new airport and Port of Luanda (PND 2013 - 2017, p 158.).

The remaining structural projects are divided among the other clusters - with emphasis for Tourism and Leisure, where there are several investments planned for the Island of Luanda and the area of Futungo Fine.

Water is a transverse resource that constitutes an essential factor for the development of the economy in areas as diverse as are the fixation of the population (depending on their availability, quantity and quality throughout the territory), the production and export of hydropower, the support of the industrial, mining, agricultural, livestock and forestry production and the promotion of tourism, recreation and leisure.

About a third of Cluster Water and Energy PE has national and provincial geographical scope, highlighting some national referral programs as the "Water for All Programme", whose implementation should be properly staggered towards its conclusion during the period of the NDP, or the "National Program for Water and Electricity", or the construction of power transmission systems or conducting studies to determine the evolution of the cluster as the master plans of the water supply system or studies on the use of watersheds.

A significant part of these PEs still have as destination Luanda, where the living conditions of much of the population are gradually being improved.

However, the combination of different PEs provided within this cluster, should ensure sufficient water to all provincial offices and most populated cities.

In the water sector, we highlight the projects Bita and Quilonda Grande, which aim an exponential increase in the capacity of water supply in Luanda Province.

These projects are led by EPAL-EP.

The projects are aimed at the design and construction of new water supply facilities, in order to provide water in adequate quantity and quality to reduce the current shortcomings of the existing system within the identified areas (http://www.epal.gv.ao/artigo.aspx?lang=pt&id_object=1855 [Consultation 02SET14].

Based on the information available in the EPAL-EP (Public Water Company, EP) Portal, Projects Bita and Quilonga Grande addressed the following objectives:

• The Bita WTP should supply water to the southern part of Luanda, through five distribution centres, including Camama, Benfica I and II, Cabolombo and Rocha Pinto.

The first phase, that will run until 2015, envisages the construction of two intake pipes of 1.200 mm, with 18 km to Camama CD.

• The Quilonga Grande WTP should supply water to the eastern part of Luanda, through the distribution centers of Km 44, New Town 1 (Zango), New Town 2 (Zango), Cacuaco 2 (Sequele), Viana (new), Morar, new airport and Bom Jesus.

The province of Luanda has currently three distribution systems, illustrated in Figure 112.

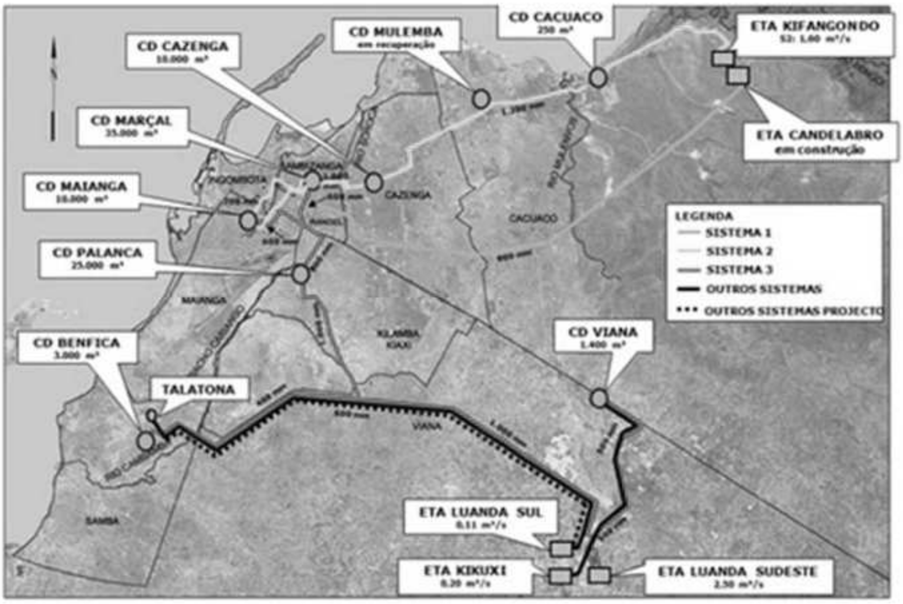


Figure 112 - Current Water Distribution Systems in the Province of Luanda

Source: EPAL-EP, http://www.epal.gv.ao/pt/sistema-de-producao-e-distribuicao
http://www.epal.gv.ao/pt/sistema-de-producao-e-distribuicao

Table 53 - Composition of Water Distribution Systems in the Province of Luanda

System 1	System 2	System 3
Kifangondo WTP intake	Kifangondo WTP intake	Cassaque intake
Candelabro WTP intake	Kifandongo WTP	Luanda Sudeste WTP
Marçal DC	Cacuaco DC Mulemba DC Cazenga DC Marçal DC Maianga DC	Viana DC Palanca DC Mainaga DC Benfica DC

Source: EPAL-EP

III.11.5. The Local Context: Territory and Population

III.11.5.1. Introduction and Methodological Notes

Although the characterization of the demographic, social and economic structures at regional level is very important, since it allows to trace and understand the patterns of regional development in the national context, the analysis at local level details the main aspects of economic life and social populations, thereby seeking to frame the potential impact of such a project.

In the environmental assessment of the water supply system - Quilonga Grande - the local dimension is particularly important, given the social and socio-cultural characteristics of local communities, as well as the needs for water supply to an area of Luanda Province already highly populated and booming.

The scarcity of data compiled with some consistency and timeliness for the municipality and commune levels had to be remedied with fieldwork developed locally, through identification of the most sensitive parts of the county, and structured and unstructured interviews to representative elements of various quarters of the society and local authorities, as mentioned previously.

Part of the site characterization will be embodied in the notes collected in several interviews carried out in the districts covered by the project, as indicated.

- Interview with Communal Administrator of the Commune Bom Jesus (Headquarters), Mr Serafim Capari, from the Municipality of Icolo and Bengo.

- Interview with Associate Administrator of the Commune Bom Jesus, Bairro Augusto, Mr. Martins André, from Municipality of Icolo and Bengo.

- Interview with Coordinator of the Commune Bom Jesus, Bairro Cafucusa, Mr. João André Camelo, from the Municipality of Icolo and Bengo.

- Interview with Communal Administrator of the Commune Bom Jesus, 1st District, Mr. Serafim Capari, from the Municipality of Icolo and Bengo.
- Interview with Coordinator of the Commune Bom Jesus, Bairro Cafucusa (close to the water capture), Mr. João André Cacualo, from the Municipality of Icolo and Bengo.
- Interview with Coordinator of the Commune Bom Jesus, Bairro Jabondo (close to the WTP), Mr. Antônio Cabeto Bumba, from the Municipality of Icolo and Bengo.

The field work related to the present descriptor were conducted by a team of two elements, the period between 27th to August 30th 2014.

Given the particularities of the implementation of the system Quilonga Grande zone, very artificialized, with several villages and settlements and in the vicinity of various equipment and business units, it was considered relevant also listen, informally, various sections of the local population.

Figure 113- Interview at Augusto District

Figure 114 – Interview at Cafucusso District

Figure 115 - Interview at Jambondo District

III.11.5.2. Framework of the Study Area

The area under study is part of the Luanda Province and covers the territory of the municipalities of Icolo e Bengo, Viana and Cacuaco.

As already mentioned in the administrative characterization of Luanda, the municipality of Icolo and Bengo, and their Communes and Districts, with the administrative reorganization of the provinces of Luanda and Bengo (Law 29/11 of September 1, 2011) , was detached from the Bengo Province and integrated into Luanda Province.

The capture of raw water from the Quilonga Grande System will be on the right bank of the Kwanza River in Bom Jesus Commune and District Cafucusa.

On the left bank of the River Qwanza is located the National Park Quiçama, which will not be covered by the project.

The area of influence of the project covers the eastern part of Luanda Province, and is confined to the municipalities of the implementation of the project.

Figure 116 shows the air framework of the study area, being superimposed the profile of the project, namely the uptake in Kwanza river, PTW Commune in Bom Jesus and the various distribution centers (DC).

Alert to the fact that the administrative boundaries of the provinces of Luanda and Bengo still do not agree with the current political-administrative division, as already suggested for Figure 102 "Location of Luanda Province and the Study Zone" .

Figure 116 - Air Framework of the Study Area and surrounding

Figure 117 shows an extract of the map (1: 100K) plotted with System 5 superimposed, so as to fit the project locally. Despite some outdated data in the map, the layout and alignment of roads and major population centers and towns maintain timeliness. As already mentioned in the chapter of road infrastructure, the insertion area of the project is served by three principals roads: Road to Catete, Bom Jesus Road and Expressway (not plotted on the map) and also by the Road Viana - Zango - Calumbo.

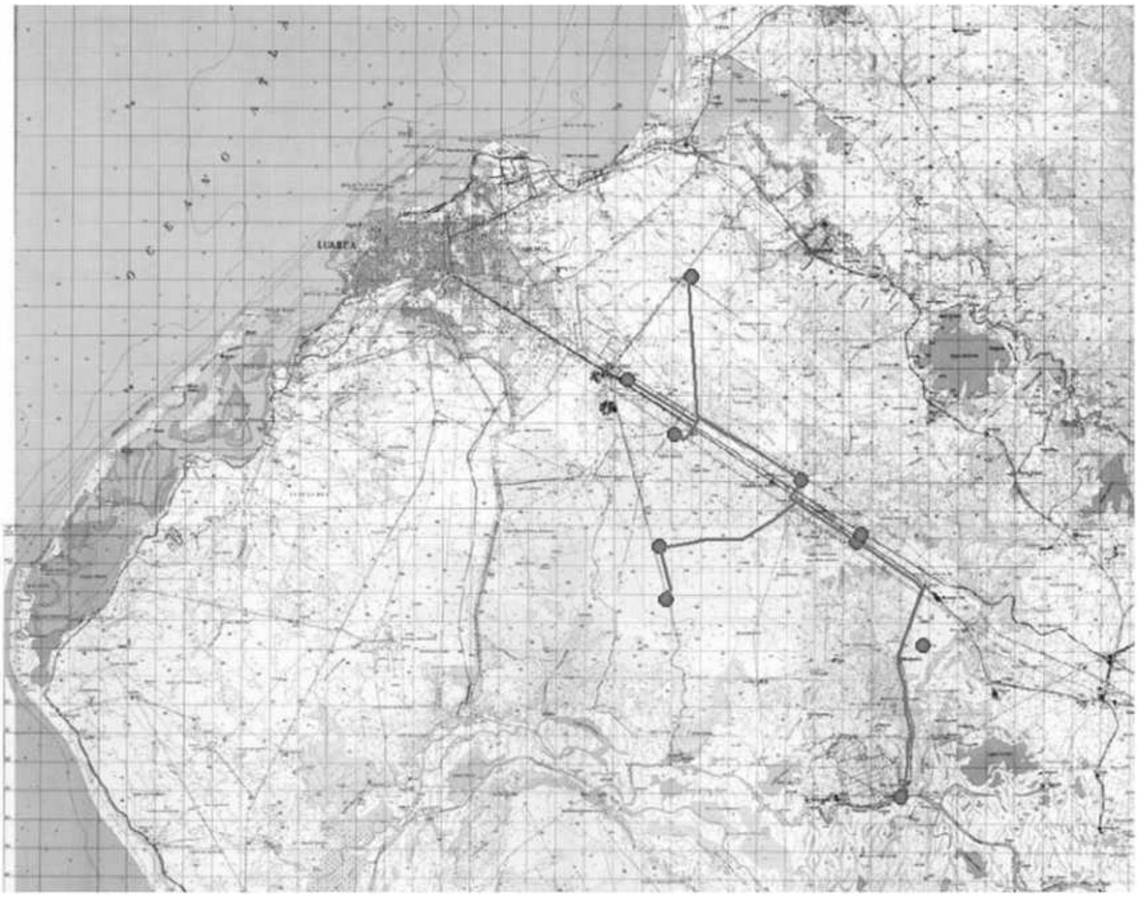


Figure 117 - Extract of map with the location of the area of implementation of the project and urban areas

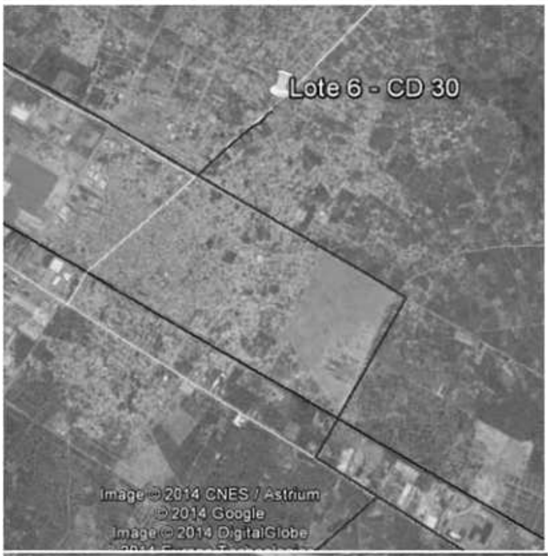
As can be seen from Figure 116 and Figure 117, despite the reduced scale, the expected area to deploy Quilonga Grande system passes through an area with heterogeneous characteristics of occupation and use, alternating between areas with some vegetation, populated areas and areas with equipment and plants.

Although the characteristics of the specific area of insertion, the choice of route of conduct, adduction for WTPs and distribution centres and other remaining elements of the system took into account the local reality in terms of use and occupation.

Figure 118 shows a set of images of aerial view that fits in more detail the main areas of implementation of the project.

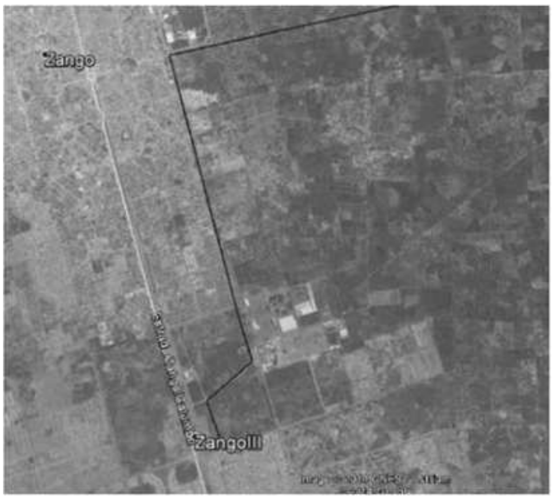

Lote 7 - CD Capalanga
© 2014 Europa Technologies
© 2014 Google
Image © 2014 DigitalGlobe


Lote 9 - CD PIV
Via Expresso
© 2014 Google


Lote 6 - CD 30
Image © 2014 CNES / Astrium
© 2014 Google
Image © 2014 DigitalGlobe


Via Expresso
Lote 3 - CD Cacuaco
Image © 2014 CNES / Astrium
© 2014 Google


Lote 5 - CD Novo Aeroporto
Lote 2 - Estação Bombagem Intermedia


Zango
ZangoIII

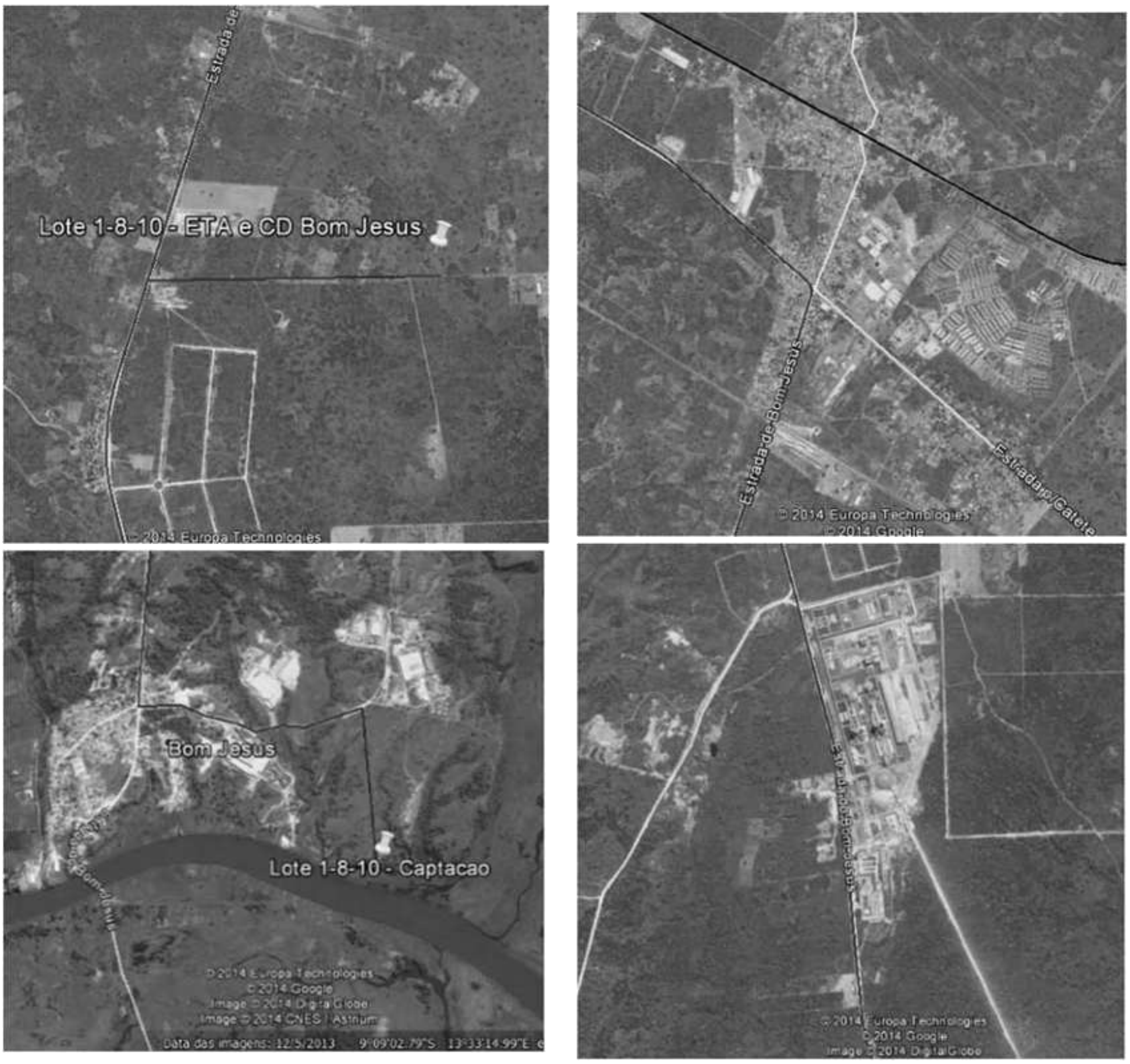


Figure 118 - Aerial view of where will be built the main components of V System - Quilonga Grande

The air environment in the area of deployment of the project is completed and detailed in the following set of images obtained during the fieldwork carried out in the last week of August.

A framework for the future intake, in Kwanza river

Uses on the bank of the Kwanza river, with boats used in artisanal fisheries

Access to the area of capture (intake)

View of the intake area upstream

View of the intake area downstream

View of the intake area for the Kissama National Park, on the left bank of the river Kwanza.

Figure 119 - A framework for future raw water intake area in Kwanza river

III.11.5.3. Population:

Composition, Ethnic Composition and Immigration

General Framework

The area under study covers counties and districts of three municipalities of Luanda Province:

Cacuaco, Viana and Icolo and Bengo.

In this administrative level, the official statistical information is very scarce, emerging quantitative references on population quantitatives in these localities in scattered sources, unofficial, with little consistency in the quality and uniformity of data and number of employees.

Regarding the Municipality of Cacuaco, we hardly got official information to the Commune and District level.

Some unofficial data indicate populations of the order of 600.000 inhabitants, with more human populated areas and other less human populated.

If we consider the Expressway as a reference, the most human populated areas are located to the west of this road and the less populated to east of the road, where CD Cacuaco will be located.

The Municipality of Cacuaco is the least covered by the project, being located just around the future distribution center (DC) of Cacuaco, in an area without human occupation.

In the city, the population growth is visible, reflected in a growing number of residential construction coupled with the main routes of communication sites.

Figure 120 - Placard indicating the City of New Cacuaco

Current traffic on the access road to the future CD Cacuaco

Site of the future CD Cacuaco, cassava field and baobabs

Figure 121 - Access road to the future CD Cacuaco

Regarding the Municipality of Viana, we also hardly got official information to the Commune and District level. Some unofficial data indicate populations of the order of million five hundred thousand inhabitants.

A significant part of this project covers the municipality, including distribution centers CD Zango 5, CD 30, CD and CD PIV and CD Kapalanga.

Of these, only CD Kapalanga is inserted in a very populated area with the district structured as a dense mesh with perpendicular paths.

In the area surrounding the CD Kapalanga some equipment is located, including a school and hotel. The site of the future CD Kapalanga is currently used by several "teams" of football that practice this modality there, despite being an informal field.

Figure 122 illustrates the land of the future CD Kapalanga and its surroundings.

Use of the land as informal field for football practice.

Use of the land as informal field for football practice

Trade in Kapalanga CD surroundings

School along CD Kapalanga

Hotel in CD Kapalanga surroundings

Figure 122 - Local and surroundings CD Kapalanga

Regarding the Zango sector, covered by the project and surrounding sector, there is also located a few houses, trade and distribution center, as the images of Figure 123 show.

Site of the future CD Zango

Trade in CD Zango surroundings

Distribution Center in CD Zango surroundings

Houses and wood logs in CD Zango surroundings

Figure 123 - Local and surroundings CD Zango

In relation to the surroundings of CD Zango, we still register the presence of some informal markets, but outside access and land of CD.

In the rest of the Viana city, still locate the CD of the Industrial Pole, of PIV, the New Airport and the CD 30.

The CD PIV and the Industrial Center located on land without residential functions within industrial estates.

The following images illustrates the location of these distribution centers.

CD PIV - Local of construction of reservoirs

The Industrial Pole CD, existing structures

Figure 124 - Local of CD PIV and the Industrial Pole CD

In the images of Figure 125, the land of the New Airport future CD are shown.

In the access to the new airport CD a primary school, a church (Apostolic), a canteen and other small activities are located, as well as the line of railway. The future New Airport CD will occupy land with cassava crop.

Exit road from Catete to the CD New Airport

Primary School in access to the new airport CD

Café with access to the DC of the New Airport

Railway track in access to the new airport CD

Disperse residues in access to the new airport CD

Location of the new airport CD with cassava crop

Figure 125 - Location of the New Airport CD

The images of Figure 126 shows the land of the future CD 30 km, which is located on the eastern boundary of the municipality of Viana, in confrontation with the Commune Kabiri, the Municipality of Catete and Bengo province.

The future CD of km 30 is located in a land without occupation, with access made by a path that goes hand in Catete Road and then runs parallel to this, in an area with some population density.

Access to the Market of km 30 from the road Catete

Disperse residues with access to the CD of km 30

Premises of the local waste disposal

High-voltage lines that pass along CD of km 30

Existing waste in the field of CD km 30

Surroundings in the field of CD km 30

School in the surroundings of the field of CD km 30

Land of the CD of km 30, with EPAL-EP board

Precarious houses made with plates, in the field of Km 30 DC

Houses made with blocks in the surroundings of the field of Km 30 DC

Figure 126 - Location of Km 30 DC

In Bom Jesus Commune, Municipality of Icolo and Bengo, a water treatment plant (WTP) is located, the intake of raw water and other significant elements of the project.

In this Commune, in the course of interviews with Local Authorities we obtained the "Report of Activities Carried Concerning the Year 2013", signed by the Communal Administrator (Pedro Serafim Catari) and dated January 15, 2014.

In addition to the report, we also obtained a document with the actual population of the settlements (Districts) of the Commune and a "List of companies headquartered in the municipality of Bom Jesus."

These three elements, together with the information obtained in the course of several interviews, are the basis of the characterization of the Commune of Bom Jesus.

In terms of the project, the Bom Jesus WTP and DC- are located in a terrain without human occupation and the access is made by a path that links to Estrada de Bom Jesus.

Following the access path to the DC and WTP a manufacturing unit is located and at the end of the path, there is a small village unit.

Next to the junction of the WTP access path with the Bom Jesus Road is located the CIF cement works.

The images of Figure 127 illustrates the site of the Bom Jesus WTP and DC and its surroundings.

Cement factory CIF

Access path to theBom Jesus DC and WTP

Site of Bom Jesus WTP and DC

Village on the limit of the access path to Bom Jesus WTP and DC

Figure 127- Bom Jesus WTP and DC sites

Since we just got more detailed and official information of the Commune of Bom Jesus, we conclude this chapter to characterize the socio-economic situation with a brief summary and a general characterization of the Commune of Bom Jesus, the municipality of Icolo and Bengo.

III.11.5.4. Commune of Bom Jesus

General Framework

The Commune of Bom Jesus is located south-east of Luanda and bordered to the north by the municipality of Cabiri, the South with the Kwanza River, east and west with Catete with Calumbo/Viana.

The Commune comprises an area of 297 km 2 and is divided into 14 villages.

According to the report of Municipal Administration, in 2010 it was estimated that the population was of 12.097 inhabitants, but this value is not accurate.

The Commune of Bom Jesus, was built as administrative post by Ordinance No. 15.975 of February 4th, 1969, published in Official Gazette No. 29 of the same year, of the Province of Luanda.

Bom Jesus is one of the five communes of the municipality of Icolo and Bengo, whose geographical position gives it the status of pole of agro-industrial development.

According to the "Report of activities Developed Concerning the Year 2013" in the Commune are only represented the MPLA and UNITA parties.

According to the Communal Administrator, in the Commune should be four Sobas, but one of them have died and have not yet named a replacement, so, there are only three.

The Great Soba lives in Bom Jesus Commune (headquarters), being responsible for the whole area of Bom Jesus and other Sobas.

Table 55 shows the distribution of the resident population by settlement, by gender and children from 0 to 11 years.

Table 54 - Distribution of Population of the Commune of Bom Jesus, by Gender and Age Group 0 - 11

Population	Population			
	Total	Men	Women	Children 0-11 years old
Km 36	815	326	489	122
Km 38	907	363	544	136
Km 44	1214	486	728	243
Coxe	151	60	91	23
Matabuleiro	468	187	281	70
Zona 3	104	42	62	15
1º Bairro	1593	956	670	398

Population	Population			
	Total	Men	Women	Children 0-11 years old
2º Bairro	1433	860	602	358
Zambela	267	107	160	40
Camuanga	597	239	358	89
Kilende	706	282	424	106
Cassenda	872	349	523	131
Canacassansa	713	285	428	108
Ngolome	257	103	154	38
TOTAL	10097	4645	5514	1877

Compiled from data provided by the Communal Administrator of Bom Jesus

Values shown the population numbers will fall far short of the current reality.

At the meeting with the Communal Administrator, a value of 20.825 residents was stated (10.391 men and 10.434 women), these data that may already be related to preliminary results of Census 2014. The population of the neighborhoods that make up the Commune is mostly young and young adult.

In general families are numerous, with an average of 7-8 per aggregate.

The languages/dialects spoken in the Commune, in addition to Portuguese, are Kimbundo and Hunbundo. Different religions are professes in the Commune, but the most significant will be the Catholic and Bom Jesus. According to oral reports, there are 17 churches in the Commune.

Catholic Church

Church of the Apostolic Faith

Baptist Church

Geová Church

Catholic Church

Church of Apostolic Faith

Baptist Church

Geová Church

Figure 128 - Churches in the area of study

Non-Governmental Organizations (NGO) World Vision and DW are present in the commune.

World Vision promotes the formation of "Social Mobillisers", about 30 people, seeking to raise awareness of basic health care, water treatment, waste, need of pit, and vaccination campaigns.

This organization provides bicycles to the mobilisers

According to oral repots in several interviews with Local Authorities, a significant proportion of the resident population (about 50%) has its ancestry from people of southern Angola, Humbundos, who were recruited by the old Sugar Factory, and the remaining 50% will have Kissama ancestry.

In the Cafucuso District, close to the water intake, it was noted that the origin of the inhabitants is "People of Malangino" which came for fishing and mining, and also the Sugar.

In the Jabondo District, close to the WTP, it was noted that residents are displaced from Malange, who went to the site in 1999.

In terms of internal migration, there are no recorded data, however, with the ongoing industrialization in the Commune, people have come from all parts of Angola.

The Local Government works in the old building of the Administrative Post of the colonial era, which consists of only one room and, according to the report, is already inadequate for the current level of service.

To the level of services provided to the population, the placement of four transformer stations (PTs), by the EDEI - Bengo, which now enable the provision of electricity to the Commune Headquarters with some regularity in about 80% of residents.

Water distribution remains problematic for people, which makes the populations continue to consume raw water.

At headquarters, Communal enterprise DW, funded by Coca-Cola, built eight standpipes, which are in the testing phase.

A generator of 15 kV was installed in the center of pumping.

The Communal Administration is building a community tank of 50.000 liters in the village of Lucumbi.

Transport is problematic in the Commune, there are many difficulties in transporting children and youth to Catete, to go to school.

To the sanitation and street cleaning level, there is a public company in the Commune since August 2013 that makes cleaning activities at headquarters, laboring with 30 employees.

The cleaning activity covers the seat of the Commune and the settlements of Matabuleiro, km 44, km 36, along Bom Jesus Road until km 30.

The Commune is served by two gas fuel supply, one at km 44, with access to Bom Jesus, and other at km 35, which at the time of fieldwork was under works.

The Commune has a field of multi-purpose football headquarters, which also serves the school.

No dates or festivities to mark, albeit a request to assign the 4th of September as the day of Bom Jesus is ongoing.

The riverside village of Kilende is sometimes affected by flooding, with temporary stiltedness of cultures.

The closest rescue and emergency services and firefighters are located in Viana.

Education

Education also faces difficulties, ranging from infrastructure, degraded schools, absenteeism of teachers, often motivated by the lack of working conditions and many of them residing outside of the Commune, especially in Luanda.

There are primary schools in the villages: km 36, km 38, Jambondo, Matabuleiro, Ngolome, Zambela, Cassenda, Lucumbi, headquarters of the Commune and km 44.

At the headquarters of the Commune and at km 44 there are schools of the 1st cycle.

Under the Programme to Combat Hunger and Poverty, a school was built in the 1st cycle at km 44.

In the "centrality" of km 44 there is another school already completed, which will be available for operation this school year (2014-2015).

Sponsored by Sonangol and its affiliates is under construction at the headquarters Communal a school with seven classrooms that have conditions for the 2nd cycle, according to the Communal Report.

In terms of school population, according to statistics from five schools, were enrolled 3.793 students distributed in education cycles, and 3168 (83.5%) of the Primary and 625 (16.5%) of the 1st Cycle of Secondary School.

Regarding educational attainment, a total of 34 classrooms, 6617 students (69%) had school performance.

The school facilities, in addition to a deficit in the number of schools and number of rooms, need generally works.

Some of the locations where classes are taught currently are unable to do so, namely the school Jambondo, who works in a school made of plates.

Still regards education, the school at km 36 is small to the large number of children and would need another school in the Bemba sector, once that is distant 8 km from the village headquarters.

In the village of Canacassassa there is no school itself and the classes are given in the rubble of an unfinished structure.

At Lucumbi, a school is also required, since children are currently studying in a structure that was a refectory of the Ministry of Agriculture.

School in Bom Jesus headquarters, with 1st and 2nd cycle

School at km 36, Primary Education and 1st cycle. It is located next to the access to the Airport CD

Construction of new school in Bom Jesus headquarters (work has called off)

School in substandard facilities (plates) in Jambondo

Figure 129- Schools in the Municipality of Bom Jesus

Health

The Commune has a Health Center and Two Medical Stations, located respectively in Communal headquarters in Zambela and km 44.

The facilities of the health centers have some degradation, with plans to build a new Medical Center, a work under the direct responsibility of the Provincial Government of Luanda.

In the 1st half of 2013, 2.515 children were vaccinated, with technicians to commit themselves to fulfill the Vaccination Plan.

The Health Center of Zambela need urgent rehabilitation and equipping and works only with a doctor twice a week.

There are no estimates of infected population or population suffering from pandemics, however it was said there was lot of problems with alcohol.

Figure 130 - Site of the future Medical Center, along km 38

Economic and Business Activities

The Commune of Bom Jesus has seen a very significant growth at the business and productive levels, and over fifty companies are headquartered at the Commune.

Its location and the existence of roads that traverse along the Commune - Bom Jesus Road and Catete Road - in a direct connection to the center of Luanda have attracted and fixed several companies.

Near the future site of capture of raw water in the Kwanza River, several plants of Coca-Cola and Cuca-Nocal are located, in Bairro Cafucuso.

On the Bom Jesus Road, near the Bom Jesus WTP and DC is located the CIF cement works in Bairro Jabondo.

On the Catete Road, from the junction of Highway Bom Jesus many companies from various industries are located, as is illustrated by the following pictures.

Cuca Factory - Nocal, Neighborhood Cafucuso, Bom Jesus

Coca Factory - Nocal, Neighborhood Cafucuso, Bom Jesus

Building materials company at km 38.

Informal market at km 44, near the junction of Highway Bom Jesus with road Catete

Trade in CD Zango access surroundings

Industrial unit, close to access to the km 30 CD

Figure 131 - Diversity of economic activities in the area of the project

A significant part of the population has a rural way of life and their main source of livelihood is taken from the land, the river and the next existing lagoons surrounding the project. The rural population practices a predominantly subsistence agriculture, but agricultural surpluses are sold in informal markets along the two roads that structure the villages. Livestock production occurs in smaller scale and artisanal fisheries occupies about 40% of the local population.

Example of goats grazing along garbage all over the floor

Maize crop

Using of tractor plowing on

Pnestock in canal irrigation, the irrigated fields of the old sugar factory

Agricultural fields with drip irrigation

Agriculture and pest control field

Figure 132 - Agriculture

In the Commune of Bom Jesus there is some hotel offer, featuring the Commune of 5 residential and pensions.

III.11.5.5. Public Consultation

A full public consultation at the time of this report production has not yet been conducted. Indeed, Angolan laws pertaining to environmental and social risk assessment and permitting system state that public consultation have to be conducted in the frame of impact assessment only after the ESIS report has been finalized. Besides, these consultations can only be done by the appropriate national authorities. . Therefore formal public consultations will have to be arranged and conducted by EPAL-EP and the Ministry of the Environment of Angola, after the ESIS report has been approved by the Ministry of the Environment.

However, for the preparation and elaboration of the ESIS, several individuals in open, group meetings have been interviewed and there have been limited consultations regarding the project. Also, several meetings were held with local authorities in several neighbourhoods within Bom Jesus (Augusto, Sede, Cafucuso and Jabondo), those that will be directly affected by the project. Most of the persons who were interviewed had not heard about the Project at the time when the meetings were conducted. During these meetings, baseline socio-economic information was collected on issues such as demographics, social organisation and access to basic infrastructures, public services or cultural assets. Besides, the project has been presented to respondents, and their opinions, fears and expectations have also been gathered and registered. Stakeholders expressed their concerns and expectations over mainly two topics:

- Employment of local youth: it is expected that the project empowers local youths by employing them during the construction activities. Indeed, stakeholders mentioned that the numerous existing industrial projects in the Bom Jesus area didn’t resort to hiring local people, especially young unemployed workers. They therefore expect that the Quilonga Grande project will not reproduce this, as it would greatly limit the positive impacts it could have on the local communities.
- Improved access to water: stakeholders reminded that the access to water in the various neighbourhoods was very limited. They therefore strongly expect that the project, which aims at improving access to water by developing new infrastructures, will also benefit the people that will be the most directly impacted by it. As an example, stakeholders mentioned the electric transmission line that crosses Bom Jesus but didn’t improve access to energy for the Project Affected People and the Bom Jesus population as a whole.

Due to these limited stakeholder’s consultations, a more detailed stakeholder engagement plan is drafted below, and will have to be formalised in the ESMP once the ESIS has been submitted to the Angolan environmental authorities and other stakeholders.

- Local authorities: Bom Jesus' communal administrator, and neighbourhood/"Bairro" coordinators;
- Local public services: schools and health centre's representatives;
- Local associations: women's groups (OMA - Organização da Mulher Angolana), youth groups, cooperatives;
- Community representatives: traditional leaders (soba's), religious leaders;
- NGOs: World Vision, DW (does the management of the water fountains);
- Industries: Coca-Cola, Cuca-Nocal, CIF (Cement Company)
- Project Affected People (PAP): households, individuals and business-owners. Special attention is to be given to vulnerable people, who should also attend the public consultation.

Following the stakeholder consultations, the Environmental and Social Management Plan (ESMP) should be appropriately updated.

Besides this, a Grievance Mechanism should be drafted in order to efficiently deal with potential community complaints that could be generated by the project. Special attention should be given to certain periods or seasons of the year when the activities of the Project should be minimised, changed or even stopped, to prevent major disruptions to the local populations and ecosystems. An example of this is fishing (best fishing months are from May to July, when family and other people coming from other regions), period during which the disruption to one of the local population's main source of nutrients and income (40% in the Bom Jesus Sede neighbourhood come from fishing, as seen in the interviews) should be minimised near the abstraction/intake area.

III.11.5.6. Sensitivity of Local Power and Population on the Project

As indicated in interviews, the people are not aware of the project, in general.

Regarding the Administrator, he thinks the project could bring several advantages to the Commune, to increase employment, construction and funding levels and broaden the distribution of drinking water in the Commune. Currently only in the 1st quarter and the 2nd quarter there are standpipes. As main problems, the Administrator noted that local youths are not employed by the existing industry and noted, too, that the power lines cross the Commune and do not leave them any benefit.

III.11.5.7 Vulnerable Groups and Persons

The World Bank defines vulnerable groups as those who are "excluded" or "weak" and liable to serious hardship and poverty because they are unable to take advantage of opportunities or have limited resilience in case of shock. Vulnerable persons are usually defined as single or young mothers, unemployed youth and persons belonging to poor households, with disabilities, the sick, the elderly or children.

This ESIS hasn't identified in detail the presence and living conditions of vulnerable populations in the area directly affected by the Project, However, it is anticipated that poor households, sick or disabled people, elders and children, and single women such as widows are part of the population in Bom Jesus Town, and may be affected by the Project. Specific mitigation measures will therefore have to be prepared to take account of these populations' views during the public consultation process, and ensure their concerns and issues are being taken care of during the implementation of mitigation measures.

50% of the population of Bom Jesus Sede are ancestors from Kissama, the location of the National Park across the Kwanza River. The remaining are of Humbundu origin (southern Angola). Also, from the Cafucuso and Jabondo districts, most of the population is from. These people are not indigenous people, and no other groups of indigenous people people have been identified in the Project area.

III.11.5.8. Stakeholder Engagement

Stakeholder engagement is a long-term process of sharing information and knowledge, seeking to understand the concerns of others and building relationships based on collaboration and partnership. It requires the building of trust through open dialogue and the delivery of commitments. Project stakeholders have been identified in order to understand the individuals or organisations that will be affected by or may influence the Project or related activities either positively or negatively. There are primary and secondary stakeholders and the ones identified for this Project were:

Primary Stakeholders	Secondary Stakeholders
Project Participants (management and employees)	**Angola National Government**
Community leaders	**Local Government**
Local community members	**Special interest groups**
Vulnerable sub-groups (eg youth, disabled persons, women)	**Churches and other religious organisations**
Potential suppliers and contractors	**Non-Governmental Organisations (NGO)**
Local businesses/cooperatives (e.g. fishing)	**Community-based organisations**
	Universities/academics
	Training centres
	Water suppliers
	Trade associations, industrial bodies, etc.
	Labour unions
	Political parties
	Financial community
	International, national, regional and local media

Areas that have to have special attention taken care to are the specific stakeholder's reactions and the disclosure of information to the remaining stakeholders, regarding:

Physical Environment; Biodiversity; Environmental Quality; In-migration; Integration of workers; Cultural heritage; Recreation and amenities; Health; Employment; Skills and education; Agriculture; Fishing; Local businesses; Local economic development; Infrastructure, Utilities and Services; Transport/Traffic.

II.11.6. Forecasting in the Absence of the Project

In the absence of the project the reinforcement of the drinking water supply of Luanda would not be done, delaying the expected dependent on social and economic development of the water.

On the other hand, the expected population growth accentuate the shortages of a vital resource for the daily lives of people, for health, for the improvement and development of economic activities already in place, and the development of other activities provided in local planning, regional and national.

It is therefore considered that the absence of the project would lead to deterioration in the quality of life of populations, health conditions and social and economic development, interrupting an effort by governments in the pursuit of improving the living conditions of the population and progress the region of Luanda and also the country.

It is also considered that the positive impacts identified, as job creation, during the construction and exploitation, the economic activities associated with maintaining the system and also the investments and economic dynamics that the project contemplates, would not be achieved.

III.12 HERITAGE

III.12.1. Introduction

This descriptor intends to cover the entire area of influence of project Sistema V - Quilonga Grande.

The works of survey and archaeological prospection aimed anticipate any constraints of the archaeological point of view and property, for the various areas of deployment of project structures.

The aim is, complement with an asset valuation of the project in question, verifying the existence or absence of equity and/or archaeological occurrences with historical or archaeological value, which may be affected by the project execution.

III.12.2. Methodology

The outlined work included conducting an exhaustive survey and archaeological heritage, referring to the influence of the project area and advocating measures to minimize proposing to the Owner of Work to safeguard and recording of evidence with historical and archaeological interest, that may be nearby or even in the layout of the infrastructure project.

To achieve the objectives, the following general methodology of work was implemented:

• Historical and archaeological general and specific research about the evolution of human occupation in the area of intervention, including general compilation of data available in publications, reports, databases;

• Characterization of the territory, including visits to selected areas to affect, in order to verify their scientific potential;

• Definition, based on all the information previously collected, a general frame of reference of archaeological potential, including the respective mapping of areas of archaeological sensitivity and higher risk;

• Archaeological prospection in all areas of influence of the contract job;

• Propose mitigating measures for each identified case;

• Photographic record of each zone of influence of the various contract jobs;

Cartographic location;

• Definition of methodologies for the archaeological record to be applied in respect of the valuation attributed to different levels of complexity considered;

• Setting standards of performance of archaeology and interinstitutional relations team for the correct management of archaeological work;

• Description, materialized in proper cartography, of the prospected areas and associated conditions of soil visibility through a simplified classification that includes the following classes: null, poor/low, medium fair and good;

• Registration, general file, sites or structures of archaeological, architectural and ethnographic interest.

For each instance we created a record inventory of cultural heritage;

• Brief Assessment of identified heritage events and ranking of their scientific importance and heritage;

• Proposal for mitigation measures to be implemented in the equity occurrences that have been identified and are the subject of any allocation for project implementation.

The literature survey consisted of referred authors consulted, as well as the collection of oral information to local populations.

When carrying out systematic surveys on the area of project implementation, with particular focus at this stage, to the marked area and areas to be used for land deposits and deployment of shipyards.

When a site is located within the area of employment, its photographic record, cartographic location and filling out a fact sheet of siege are made.

Whenever possible we tried to contact with the local population, in order to obtain information from the local microtoponímia.

III.12.3. Characterization of Present Situation

History Survey

In 1575, the Portuguese captain Paulo Dias de Novais, landing on the Cape Island, established the first nucleus of Portuguese settlers: about 700 people, of whom 350 men of arms, religious, merchants and civil servants.

A year later (1576), recognizing that not be the proper place, ran ashore and founded the village of São Paulo da Assunção de Luanda, and laid the foundation stone for the edification of the church dedicated to St. Sebastian, where today is located the Museum of the Armed Forces.

Thirty years later, with the increase of the European population and the number of buildings, the village of São Paulo da Assunção de Luanda became a city, extending to the border of San Miguel off the old Hospital Maria Pia (currently Josina Machel). In the Iberic Union. in 1618, Fortaleza de São Pedro da Barra was built.

The city became the administrative center of Angola since 1627. In 1634 Fortaleza de São Miguel de Luanda was built.

The town was conquered and came under the rule of the Dutch West India Company from 1641 to 1648, when it was restored to the Portuguese Crown by an expedition sent from the Captaincy of Rio de Janeiro, in Brazil, by Salvador Correia de Sá e Benevides.

From 1550 to 1850, Luanda was a major center of the slave trade to Brazil.

While only a fifth of its imports were sourced from Portugal, the other four-fifths were with Brazil.

The equilibrium in the trade balance was maintained with the extensive smuggling of slaves.

The city was limited to military, administrative and redistribution functions.

The industry was virtually nonexistent and little public education evolved.

In 1847, including public buildings, the town had 144 houses with first floor, 275 ranch houses and 1058 huts.

In 1889, Governor Brito Capelo opened an aqueduct which supplied the city of previously scarce drinking water, paving the way for the great growth of Luanda.

Luanda in 1872 received the nickname of "Paris of Africa".

Luanda is the largest and most densely populated city of Angola.

Initially designed for a population of around 500.000 inhabitants, is today a overpopulated city.

According to recent studies, there are over five million inhabitants currently living in Luanda.

The city of Luanda is composed of seven municipalities:

Cazenga, Ingombota, Kilamba Kiaxi, Viana, Rangel, Samba and Sambizanga.

The central zone of Luanda is divided into two parts, the Baixa de Luanda (the old city) and Cidade Alta (the new city).

The Baixa de Luanda is situated next to the harbor.

The coastline is marked by the Luanda Bay, formed by the continental coastal protection through the Ilha de Luanda and Mussulo Bay, south of the main urban center, formed by sandbanks of Mussulo.

Current survey

Through the work of gathering information on the ground as well as the bibliographic level, was not detected heritage or archaeological features in the area of influence of the project execution.

III.12.4 Forecasting in the Absence of the Project

According to the outcome of the work, we find that the allocations of the assets are zero, despite the high probability of new data arising at the work of mechanical excavation to the opening of ditches and earthworks for the implementation of project structures.

IV. Impact Identification and Evaluation

This chapter deals the forecast and evaluation of the environmental impact factors at various stages of the project.

The methodology used is based on the presentation of the classification of the detected impacts as previously described, and an analysis is presented of the resulting impacts which are a result of the following: the Construction Phase and the Use Phase. Following this and whenever considered necessary, measures to minimize the negative effects for all the descriptors will be taken into consideration, as well as the potential of positive impacts. The evaluation of the impacts was carried out without alternative locations for the project being taken into account.

The quantification of the Environmental Impacts is made by comparing the difference between the future situation both with, and without the project. This comparison is made for each environmental descriptor, by analysing their development over time either with, or without the Project in question (See Figure 133).

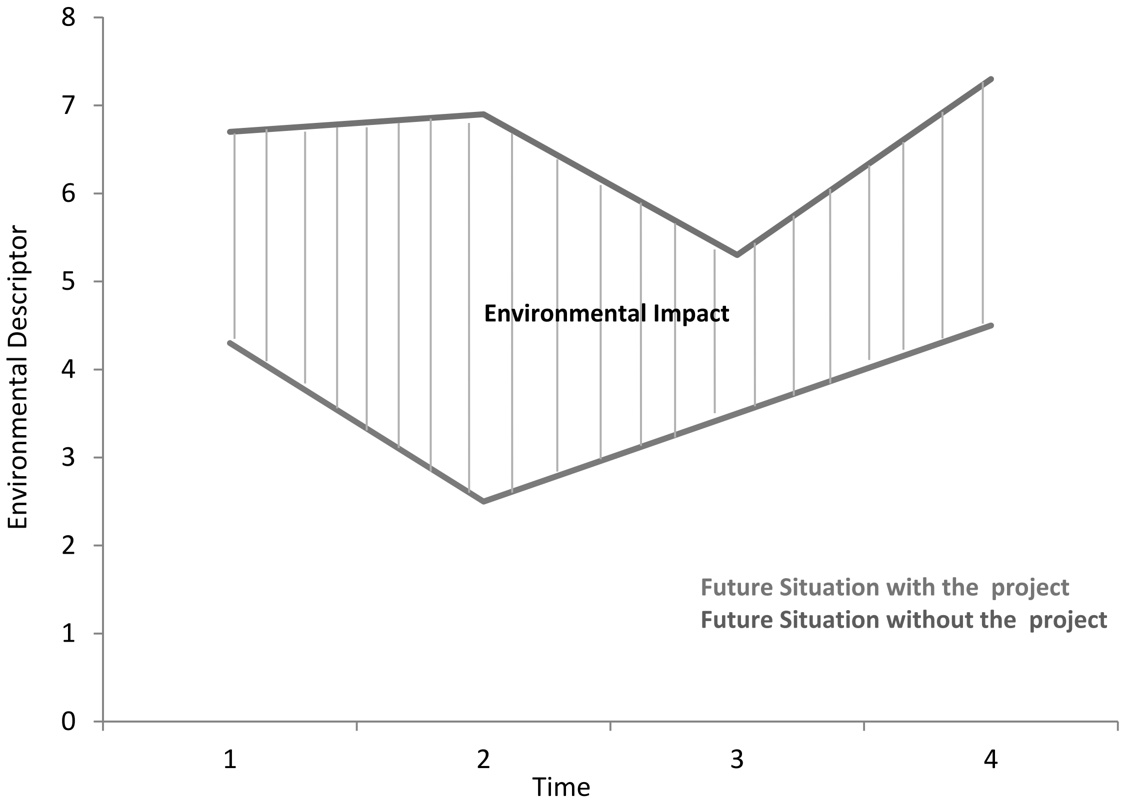


Figure 133 - Schematic representation of the evolution of the environmental descriptors over time for the future situation either with or without the project being undertaken

The interpretation of the impact does not derive solely from the type of pollutant element or disturbing element of the established natural balance, but also the characteristics of the environment in which the project is undertaken, including its self-purifying capacity and the recoverability of the host environment and knowledge of the socio-economic and bio-geophysical characteristics of the area.

IV.1. CLIMATE

The typology of this Project does not provoke measurable changes (impacts) in climate parameters such as temperature, rainfall, relative humidity or wind, either in the construction or in the operational phase.

However, as the cumulative effects of human activities on climate variables are nowadays a reality, in many cases it is often not possible to spatially limit the origin or effect; the foreseeable impacts are listed but they are almost certainly expected to be of considerably reduced magnitude.

IV.1.1. Construction Phase

In the construction phase there may be changes in temperature and humidity at ground level, which may provoke, on a very reduced scale, an increase in temperature at ground level and a decrease in moisture due to the removal of ground vegetation (the sections and / or areas where this applies) and dust emissions during construction.

The stripping and consequent removal of ground cover vegetation may result in decreased evapotranspiration and lack of the protective effect of the vegetation in relation to direct sunlight, thereby increasing the temperature and "drying" of the environment at ground level. However, as the vegetation of the areas where this will take place is mostly inchoate, its removal will have minimally significant impacts.

The emission of dust into the atmosphere (mainly during the excavation of ditches and / or stripping ground cover) will decrease the humidity and increase the temperature at ground level. The combination of both parameters simultaneously will result in a greater effect, in turn being responsible for an increase of the forecast effects.

In conclusion, impacts on climate during the construction phase can be classified as: negative, of reduced magnitude, indirect, likely, temporary, with immediate effect on the local geography and reversible.

IV.1.2. Use Phase

During the use phase, the occurrence of environmental impacts is related to the production and emission of greenhouse effect gases primarily resulting from the operation of generators.

In conclusion, impacts on climate during the use phase can be classified as: negative, of reduced magnitude, indirect, unlikely, temporary, with long term effect on the local geography and reversible.

IV.1.3. Cumulative Impacts

The urban growth in the province of Luanda, which has been evidenced in recent decades, suggests increasing pressure on the climate. The progressive occupation of more or less natural areas for the construction of buildings and of roads will significantly increase the negative environmental impacts verified in this descriptor.

It is considered that this project is not a source of negative climate impacts, and therefore should not be included in the summation of impacting activities for the region of Luanda.

IV.2. Geology

Carrying out the Project will undoubtedly have an effect on the geology of the WTP construction sites, distribution centres, and water mains pipelines, either by excavation or by necessary waterproofing (coverage) of hitherto exposed geological material.

The significance of these impacts will be reduced mainly because outcropping lithologies (mainly Pleistocene sands) are quite common in the region of Luanda and geological scars proliferate scars as a result of excavating aggregates, some of which are in quite close proximity to the areas of the project undertaking (such as those inventoried as Geo21, Geo28, or Geo30 in the Baseline chapter).

IV.2.1. Construction and Use Phase

The main impacts which are likely to be caused in the geological medium are related to geomorphological and geotechnical issues. However, the Project does not foresee landfill and / or excavations of such a scale would give rise to any significant impacts.

Furthermore, the lack of classified geological heritage or potential classification in the Project areas or its nearby surroundings, does not add any impact to this descriptor.

In conclusion, it should be noted that the greater part of the Project includes the area corresponding to the KON5 block (with an area of 1024 km2), of the landside portion of the Kwanza basin (with an area of 25000 km2) area. The comparison of the area which will undergo changes with the area of the block shows a large difference of magnitude; consequently this impact is considered as: negative, of reduced magnitude, indirect, unlikely, permanent with long-term occurrence regarding the local geography and reversible.

IV.2.2. Cumulative Impacts

It is considered that this project is not the source of negative impacts on the geology, and therefore will not be part of the summation of impacting activities for the region of Luanda.

What contributes to this assumption is the fact that, in the vicinity of the road connecting Bom Jesus to Luanda – at Km. 44 Catete there is about 1 square kilometre of cuttings, several meters deep and which have not undergone any landscaping.

IV.3. Water Resources

Implementation of the Project will undoubtedly affect water resources, since the project is based on the abstraction of water from the Kwanza River, in order to supply to the populations with water.

The environmental impact assessment for the water resources descriptor will be broken down by Project phases, since there will be different impacts in the two phases (construction phase and operation phase).

IV.3.1. Construction Phase

During this phase, the actions which potentially impact on the surface and/or subterranean water resources either quantitatively or qualitatively are outlined as follows:

- Setting up, maintenance and dismantling of construction sites – taking into consideration the duration of the works, the type of equipment used on the sites and the operations carried out there, as well as the permeable nature of the vast majority of the underlying geological formations with the possibility of contaminating the groundwater. Consequently this impact is considered: negative, of low or high magnitude (depending on the nature and duration of accidental spillage), direct, likely, temporary, with long-term occurrence regarding the local geography, and reversible (as long as there is timely detection and rectification);
- Washing and disinfecting the pipelines / Waterproofing of materials with bitumen based paint –- These operations require the use of substances that should not come into contact with the water so as not to contaminate it. This impact is classified as: negative, of reduced to moderate magnitude, direct, unlikely (taking into consideration that the probability is directly related to the competence of the operator), temporary, with long-term occurrence (considering the distance of the water masses), geographically local, and reversible (as long as there is timely detection, and the migration of pollutants is effectively checked);

- Surveying of bituminous surfaces - In this process, the component most likely to cause any impact on the water quality relates to the laying of bituminous pavement fragments, and includes the selection of appropriate (or inappropriate) locations for their deposit sites. It is therefore considered that the impact is: negative, from reduced to high magnitude (depending on the selected location), direct, likely, permanent, with long-term occurrence, geographically local, and reversible (as long as it is detected and corrected);

- Earthworks (stripping and trenching) - Stripping operations in Pleistocene sandy soils may initially increase the rate of groundwater infiltration. Moreover, the water balance may also be affected by the eventual increase in surface runoff. However it is considered that, given the nature of the vegetation cover and reduced slopes occurring in almost all the areas of intervention, these changes will be very minor. This impact is therefore classified as: negative, of low magnitude (given the areas involved), direct, unlikely, permanent, with long-term occurrence, geographically local, and irreversible;
- Construction of large concrete structures and/or other buildings - These buildings contribute to soil sealing, with the immediate effect of lowering the rate of recharging groundwater formations, and the increase of surface runoff water (with consequent increase in the velocity of water and erosive power). Therefore, this impact is classified as: negative, of low magnitude (given the areas involved), direct, unlikely, permanent, with long-term occurrence, geographically local, and irreversible;
- Earth removal and landfill - This operation runs the risk of transporting contaminated soils to unsuitable landfill sites over highly permeable geological formations, with a high risk of groundwater contamination. This impact is therefore considered to be: negative, of reduced to moderate magnitude (depending on the selected site and the degree of contamination of the soils), direct, likely, permanent, with long-term occurrence, geographically local, and reversible (as long as it is detected and corrected);
- Water consumption - Given the duration and scope of the works, water consumption is expected to be significant (for industrial and domestic purposes). However, as the Kwanza River, (which has a high volume of available water) is expected to be the source of this water, this impact is classified as: negative, of reduced magnitude, direct, certain, temporary, immediate, geographically local, and irreversible;

- Excavations and intersection of groundwater levels - The Project does not foresee the need for very deep excavations and as groundwater levels usually occur at a depth of several dozen metres, it is not considered that there will be any significant increase in the vulnerability of the water table, as the unsaturated zone will remain relatively thick, thereby enabling the retention and lessening the effect of many of the pollutants. This impact is classified as: negative, of reduced magnitude, indirect, unlikely, temporary, immediate, geographically local, and irreversible.

IV.3.2. Operational Phase

The quantities of water extracted from the Kwanza River are estimated to have a maximum value of 9 m^3/s (when the three treatment channels are in full operation). This will assist in revealing the most significant impacts in quantitative terms of the water resources.

According to the data consulted in http://english.cwe.cn/, the average flow of the Kwanza River is 836 m^3/s, and the mean annual runoff is estimated at 26.3 million m^3.

However, Hamududu (2012) considers the average monthly flows, registered in Capanda (the dam being more than 200 km upstream of the integral abstraction of this Project), to be as follows, values are shown in Table 56.

Table 55– Average monthly flow (in Capanda) in m^3/s

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	ANNUAL
220	341	541	867	1106	1279	1243	824	451	322	262	213	639

Thus, considering these values as representative of the reality of the Kwanza River in the vicinity of Bom Jesus, in September there is a maximum allocation of available water from the Kwanza river (the worst case scenario in environmental terms), which corresponds to 4.2 % of availability. In the most favourable month, i.e. in March, that allocation is only 0.7% of water availability.

This impact is therefore considered to be: negative, of reduced magnitude, direct, certain, permanent, immediate, geographically regional, and irreversible.

The positive impact is highly significant when taking into account the large number of inhabitants of Luanda, who will have piped water, in such quantities and qualities as will be addressed at the level of socio-economic impacts.

As a positive, albeit relatively insignificant impact in terms of water quality, there is the fact that, with the implementation of the Project, a decrease is expected in the tanker truck traffic from the "*girafas*" (water columns or stand pipes) installed in Bom Jesus, thus decreasing the risk of road accidents and possible water contamination.

Water quality issues during the operational phase and the associated potential impacts are outlined as follows:

- Vertical axis pumps located on the Kwanza Riverbed;
- Generators installed in case of possible electrical power outages;
- Storage and use of water disinfection products (e.g. Chlorine gas);
- Storage prior to use of products such as aluminium sulphate, polymers, and possibly milk of lime;
- The final destination of the sludge;
- The final destination of UV lamps (which contain mercury, although in reduced quantities);
- Waste water from the installations (Distribution Centres and WTP);
- Diesel oil tanks.

Thus, the impacts related to any accidental spills of oils, fuels and/or other lubricants are classified as: negative, of reduced the high magnitude (depending on the nature and duration of accidental spillage), direct, likely, temporary, immediate, geographically local, and reversible (as long as readily detected and corrected).

The storage and handling of waste water disinfection products, as well as storage and handling of aluminium sulphate, polymers, milk of lime and other chemicals will be carried out, in line with current legislation and/or international hygiene and safety standards. Therefore, it is considered that impact associated with the storage and handling of these chemicals is classified as: negative, of reduced magnitude, direct unlikely, temporary immediate, geographically local, and reversible.

IV.3.3. Cumulative Impacts

The main cumulative impacts relate to requests (extractions) for water from the Kwanza River. As described in the "Baseline", captation points proliferate along the right bank of the Kwanza

River. The number of active captation points and the volumes of water extracted is yet unknown to the ESIS team.

IV.4. SOUND ENVIRONMENT

IV.4.1. Baseline Measurements

With regard to the construction phase, the impact assessment was based on the planned construction activities for the Project, and estimates of noise associated with them, taking distance into consideration.

Based on the position and the activities, an assessment was made of the duly identified main receptor areas taking the IFC limits as a reference. The impact assessment was based on these criteria.

With regards to the Operational Phase, the evaluation of the acoustic impact was based on acoustic modelling of the Project, namely the area of the installation of the equipment and its surroundings.

For the purposes of modelling the industrial sources (equipment), and given the lack of data on sound power and design of the facility, using sample data from other facilities of the same type was considered for the case of the WTP, and data from catalogues for pumps of similar capacity to those to be used in the case of the DCs.

Furthermore, an estimate was made of the heavy traffic associated with the installation, notably the estimated volume of material to be moved (sludge).

Therefore, modelling of two phases was carried out corresponding to the different start-up stages of the Project; namely the start-up of a 3 m^3/s line (Phase 1) and the start-up of the second line, for a final production of 6 m^3/s.

The values obtained by the model are then added, in terms of energy, to the reference values obtained, and in this way the resulting noise levels are estimated.

Given the existing uncertainty regarding the evolution of existing residual noise levels associated with surrounding sources, it was decided to maintain the phases of plant operation reference values.

Based on the results obtained from this calculation, an assessment of compliance with the limits set by the IFC was performed, the assessment of impacts to the Sound Environment descriptor is based on these finding and on the results obtained at each point.

IV.4.1.1 Construction Phase.

The main actions which may impact on the noise environment in this phase are the activities of clearing, stripping, and mainly excavation and earthmoving. The movement of machinery and equipment and the installation of the yard are also considered, although less relevant. It has to be also taken into account that while some of these operations occur for a limited period at each site, others will affect the whole area for almost the entire duration of construction.

Note that the sound waves generated by building operations are typically described as having hemi-spherical geometry. Therefore, two kinds of noise source are considered i.e. line and point source, wherein the propagation of sound waves is hemi-spherical or semi-cylindrical, respectively. The radius of the sphere or the base of the cylinder being considered the source of noise and described according to the following expressions:

- Sound level 1 – Sound level 2 = 20 log (r2 /r1) (for point source);
- Sound level 1 – Sound level 2 = 10 log (r2 /r1) (for linear source).

This means that, for example, by doubling the distance from the sound source, the sound pressure level decreases 6 dB (A) for point sources and 3 dB (A) for linear sources. This approximation is a simple way of estimating the noise levels during Construction Phase.

The estimated sound levels L_{Aeq} for construction operations and equipment are shown below.

Table 56 - Estimated sound levels for construction operations and equipment

Activities / operations	LAeq dB(A)		
	Up to 50 m	100 m	500 m
Earthmoving and excavation	72-75 (30 m)	62-65	46
Aggregate crushing	73-81 (50 m)	67-75	50-56
Tarmacadam Roller	70-75 (20 m)	56-61	45-48
Vibrating tarmacadam roller	80 (20 m)	66	50
Pneumatic jack-hammer	80-84 (20 m)	66-70	50-54

The above values refer to propagation in open space (line of sight). However they must still be considered and added to the decaying sound energy with the distance from the source taking into account attenuating values, such as wind speed and direction and the presence of natural obstacles (trees, type of terrain, etc.).

Of the activities listed, the most relevant are earthmoving and excavation, the remainder being more localized activities from the point of view of both time and space.

Given the lower time expression and its temporary character, it is not considered appropriate to evaluate these sources based on IFC references.

Accordingly, the Portuguese legislation was considered as a reference; namely Decree-Law No. 9/2007 which defines the exposure limits for temporary noisy activities, such as those undertaken during the construction phase, i.e. 60 dB (A) and 55dB (A) for the evening and night periods respectively.

This legislation does not consider the existence of applicable limits in daytime.

In this situation, the noise disturbance that may occur occasionally and for a limited duration can be estimated, taking into consideration the distances of the residential settlements from the areas of activity.

The works and installation of the planned main water pipelines laid alongside existing roads where there tends to be greater urban density are particularly noteworthy. Due to their proximity, these locations are subject to significant noise levels, albeit for limited durations.

The intervention areas with longer duration, particularly next to the captation and WTP, are located in areas at distances greater than 500 m from housing settlements and therefore no significant impact is expected during the construction phase.

With regard to the Distribution Centres, it is considered that the Cacuaco and Zango are also located in areas remote from the settlements, at distances of more than 500m, and no significant impact in the construction is expected.

With regard to the other Distribution Centres, the foregoing applies with respect to the installation of the pipeline, where occasional short term impacts may occur, which are related to the construction activities.

It is therefore considered that the noise generated during the Construction Phase activities will have a negative impact, of low to moderate magnitude, direct impact, and temporary, of immediate occurrence with the start of activities, geographically localized and reversible.

IV.4.1.2. Operational Phase

With regard to the operational phase of the project, it is considered that there are two main noise sources associated with the operation of the units; namely the noise associated with the equipment to be installed and the noise associated with the movement of heavy vehicles transporting production materials (chemicals, filter sand etc.) and removing sludge and residues.

It is considered to be the same with regard to road traffic, mainly affecting the area around the WTP and the captation zone, distribution being by the closest main roads, namely the Bom Jesus and Viana highways.

Taking into account the high level of traffic circulating on these roads, it is considered that the traffic associated with the Quilonga system will, predictably, have a reduced impact, which is not relevant, given the sound levels already present.

The volume of traffic that was considered in the simulation was estimated based on projected requirements for transporting sludge, waste residues and materials. The model was based on a daily circulation of 10 heavy goods vehicles during daytime hours, 4 during the evening and 2 during the night, either from the WTP or the captation area, the traffic using the various roadways in the area.

For the operation of the facility, there is still no data available for the project regarding the sound power levels of the equipment to be installed, its location, installation conditions of and operation.

Therefore, some simplifications and estimates were made regarding the emission data of the facility in order to ensure that an adequate simulation could be made from existing data.

Consequently, given the uncertainty of the exact location of the equipment and structures, all the equipment of the WTP was considered as an emission source point with a sound power equivalent to the sum of all the various equipment to be installed.

Regarding the captation and Distribution Centres, due to their smaller size and the smaller amount of equipment, they were also modelled as point sources.

With regard to the equipment itself, as yet, there are no technical data sheets with the respective sound power available, therefore an estimated $L_A w$ was assumed for the main equipment emissions taken from acoustic data for equivalent equipment; namely water pumps, based on a calculation of the proportion of electric power (KW) of each device.

For these purposes, the emission data of different pumps manufactured by KSB used in water supply networks have been used.

Therefore the main equipment for the water and air lines planned for Plot 1 was identified. The equipment was identified as having a forecasted higher noise contribution, being the eventual main sound power of the facility.

The main ones to be identified, and then considered for the calculation, were pumps, centrifuges, blowers, and compressors, which considering their size and electric power will be the main elements at the level of acoustic impact.

For the purposes of the captation and Distribution Centres, a sound power value was assumed, which is equivalent to the water pumps planned for the Water Treatment Plant for the flow defined in the design project.

The digital terrain model was drawn up based on the elevations data provided by the Consortium for Spatial Information (CGIAR-CSI), namely the SRTM 90m Digital Elevation Database v4.1, the 5 metre spaced contour lines having been developed from these elements.

The prediction of the noise levels in the project horizon year was carried out using acoustic mapping software, modelling the Project and surrounding receptors, as well as the respective distribution routes for traffic involved in the operation.

The modelling was carried out using Brüel & Kjær's Noise Predictor Mapping Software Type 7810, version 6.2. The calculating algorithm being based on ISO 9613-2: 1996.

For the purpose of evaluating the estimated noise levels for the Design Project, the same receptors were considered as indicated in the characterization of the Baseline, with small adjustments at points R1, R5, R7, R8, R9 and R10 so as to locate the point next to the closest settlement to the emission source, the Baseline being maintained.

The data obtained by the model were summated in terms of energy to the Baseline values, in order to obtain the predicted values of environmental noise:

$$L_{environmental} = 10 \times \log_{10}\left[10^{\frac{L_{Residual}}{10}} + 10^{\frac{L_{Project}}{10}}\right]$$

Taking the simulations into account, the following results were obtained:

Table 57 – Estimated noise levels for the two phases of the Project

Points	Residual Noise		Particular Noise (Noise associated with the Project)				Environmental Noise			
			Phase 1		Phase 2		Phase 1		Phase 2	
	Ln	Lden	Ln	Lden	Ln	Lden	Ln	Lden	Ln	Lden
R1A	33	43	22	29	25	32	33	43	34	43
R5A	71	81	28	34	31	37	71	81	71	81
R5B	71	81	30	37	33	40	71	81	71	81
R6	64	74	7	14	10	16	64	74	64	74
R7A	36	46	12	18	15	21	36	46	36	46
R8A	48	58	43	50	46	53	49	59	50	59
R9A	45	55	32	38	35	41	45	55	45	55
R10A	57	67	25	31	28	34	57	67	57	67
R11	49	59	50	56	53	59	53	61	54	62
R12	50	60	12	18	14	21	50	60	50	60
R14	55	65	11	18	13	20	55	65	55	65

Table 58 - Calculation of increments relative to the reference values

Points	Environmental Noise				Recorded increment relative to residual noise			
	Phase 1		Phase 2		Phase 1		Phase 2	
	Ln	Lden	Ln	Lden	Ln	Lden	Ln	Lden
R1A	33	43	34	43	0	0	1	0
R5A	71	81	71	81	0	0	0	0
R5B	71	81	71	81	0	0	0	0
R6	64	74	64	74	0	0	0	0
R7A	36	46	36	46	0	0	0	0
R8A	49	59	50	59	1	1	2	1
R9A	45	55	45	55	0	0	0	0

Points	Environmental Noise				Recorded increment relative to residual noise			
	Phase 1		Phase 2		Phase 1		Phase 2	
	Ln	Lden	Ln	Lden	Ln	Lden	Ln	Lden
R10A	57	67	57	67	0	0	0	0
R11	53	61	54	62	4	2	5	3
R12	50	60	50	60	0	0	0	0
R14	55	65	55	65	0	0	0	0

By analysing the data obtained it can be verified, that given the remoteness of the main structures of the surrounding settlements' receptors, the impact introduced by the Project in both phases is nil or very low. Effectively, the levels of the majority of noise emission points associated with the Project are significantly lower than those already existing in the "Baseline", and therefore do not contribute to an increase in noise level. This situation is mainly due to noise abatement associated with acoustic waves propagating in space. Given the existing distances between the Project structures (WTP, Captation and Distribution Centres) in relation to the main neighbouring settlements, being greater than 500m, the incident sound level in these settlements is negligible, the predominant source of residual noise contribution being already present.

The exception to this situation is point R11, associated with the Kapalanga Distribution Centre (Plot 7). This Distribution Centre is located within a dense urban area, in close proximity to dwellings; therefore it is the most sensitive situation of the Project regarding noise level.

Effectively, this point is already not in conformity with the limits established by the IFC guidelines for residential areas, having been already exposed to sound levels resulting in slight disturbance.

According to estimates, the introduction of this Distribution Centre may lead to an increase of 5 dB (A) during daytime hours, and 3 dB (A) on the Lden indicator, (Phase 2), thus exceeding the IFC recommendation regarding the increase of sound levels compared to the "Baseline"; namely 3 dB (A), therefore it is considered necessary to address this location under the chapter on the definition of minimization measures.

It is therefore considered that the noise generated during the Operational Phase activities will have a negative qualification, of reduced magnitude, direct, certain, permanent, immediate occurrence with the start of operations, of a local dimension, and reversible.

To allow a more comprehensive view of the modelling undertaken and planned acoustic dispersion, noise maps, focused on major emission points (WTP, Distribution Centres and Captation) have been developed, namely for the second phase of operation (after implementation of the two production lines).

The respective noise maps for the Lden and Ln indicators are shown below.

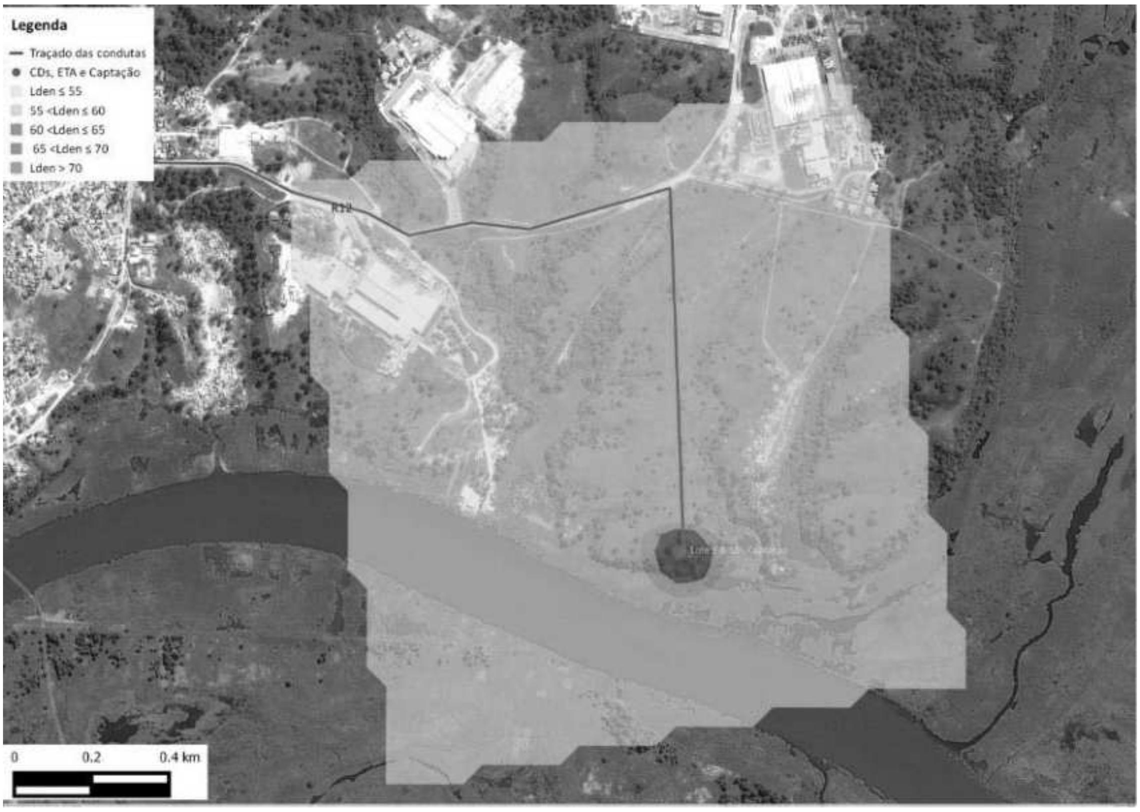


Figure 134 - Noise Map – Phase 2 of Operation - Capture - Lden Indicator

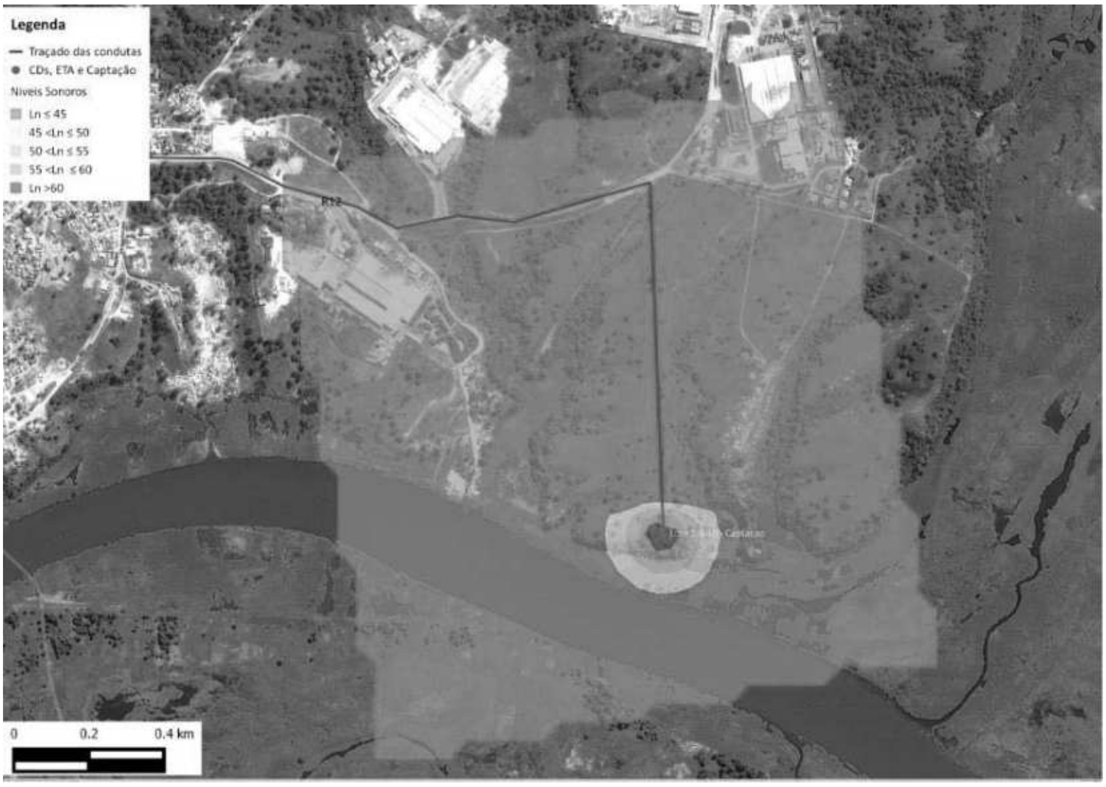


Figure 135 - Noise Map – Phase 2 of Operation - Capture - Ln Indicator

Figure 136 – Noise Map – Phase 2 of Operation – WTP and Bom Jesus DC - Lden Indicator

Figure 137 – Noise Map – Phase 2 of Operation – WTP and Bom Jesus DC - Ln Indicator

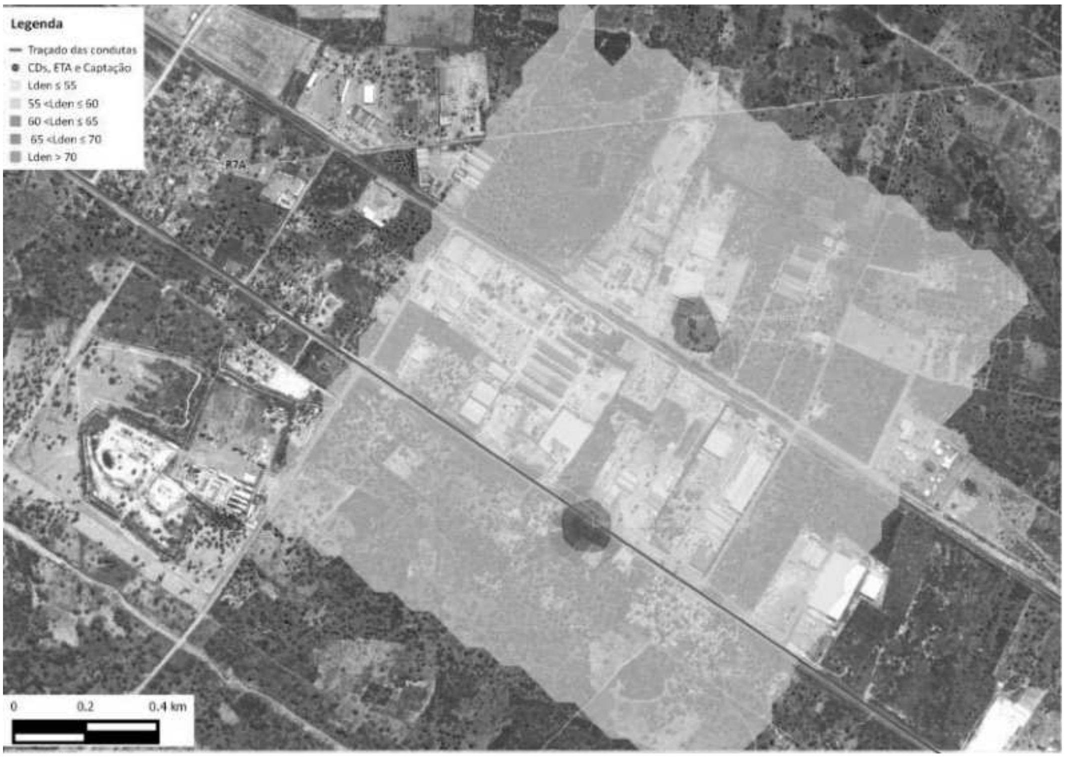


Figure 138 – Noise map – Phase 2 of Operation –New Airport DC and Intermediate Pumping Station - Lden Indicator

Figure 139 – Noise Map – Phase 2 of Operation - New Airport DC and Intermediate Pumping Station - Ln Indicator

Figure 140 – Noise Map– Phase 2 of Operation – DC at Km 30 – Lden Indicator

Figure 141 – Noise Map – Phase 2 of Operation – DC at Km 30 - Ln Indicator

Figure 142 – Noise map – Phase 2 of Operation – PIV DC - Lden Indicator

Figure 143 – Noise Map – Phase 2 of Operation– PIV DC - Ln Indicator

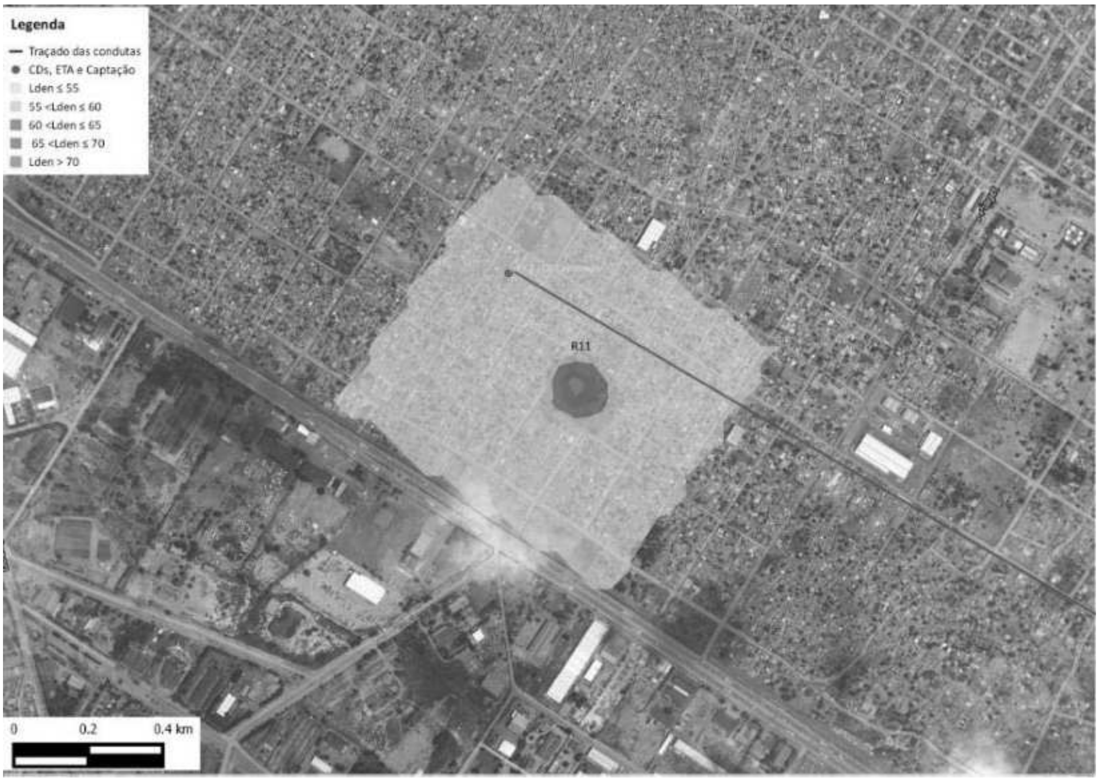


Figure 144 – Noise Map – Phase 2 of Operation - Kapalanga DC - Lden Indicator

Figure 145 – Noise Map – Phase 2 of Operation - Kapalanga DC - Ln Indicator

Figure 146 – Noise Map – Phase 2 of Operation – Cacuaco DC - Lden Indicator

Figure 147 – Noise Map – Phase 2 of Operation – Cacuaco DC - Ln Indicator

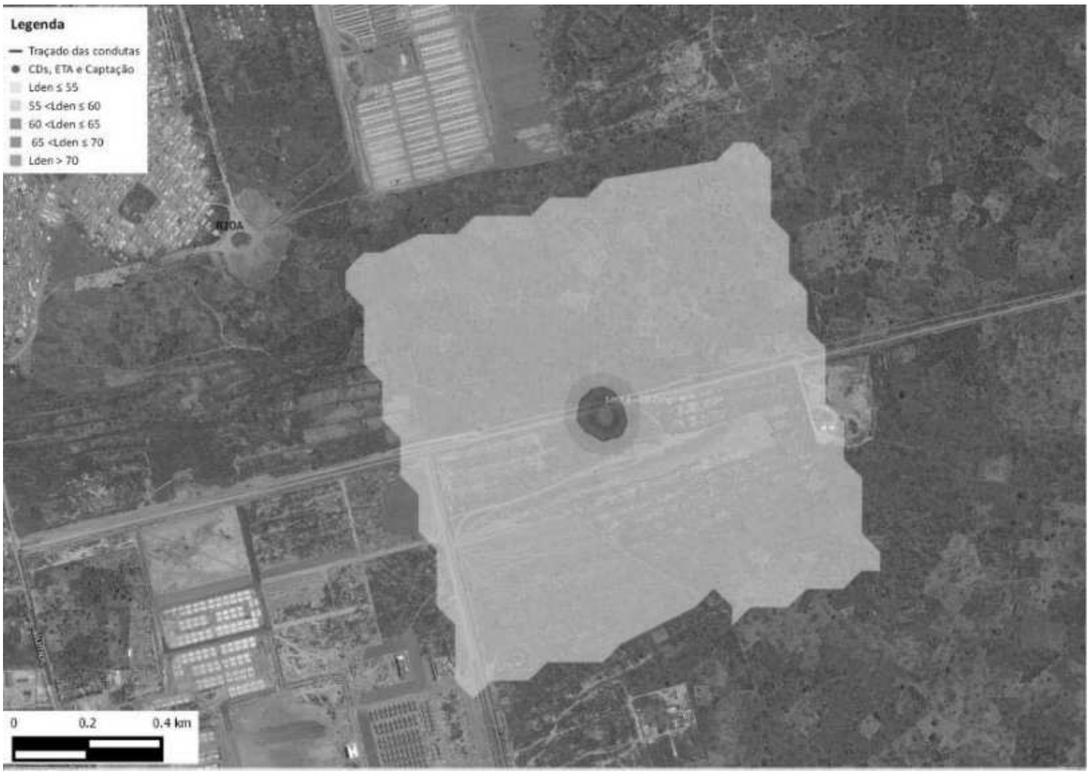


Figure 148 – Noise Map – Phase 2 of Operation – Zango 5 DC - Lden Indicator

Figure 149 – Noise Map– Phase 2 of Operation - Zango 5 DC - Ln Indicator

IV.4.2. Cumulative Impacts

Following on from the above, and regarding the evolution of the "Baseline" in the absence of the Project, the entire region of deployment of the Quilonga system is undergoing extensive development, with the emergence of several industrial centres and units, as well as being the site of the future international airport.

These sources will accumulate with those already existing in the locale, with special emphasis on roads increased heavy goods vehicle traffic, and will become predominant sources in multiple locations.

However, as identified above, with the exception of points R1, R8 and R11, the increases in noise level introduced by the Project are nil, as the noise emissions of the Project, next to the nearest receptors, is negligible compared to the existing values. Even at these points, only point R11 registers an increment which can be considered relevant.

Therefore, although there will be a combination of the project with several surrounding sources (industrial, highways, etc.), it cannot be considered that there will be a cumulative impact because, next to the closest receptors, the noise emissions associated with the Project will make no contribution to the present noise level.

IV.5. WASTE RESIDUES

To enable proper management of waste residues inherent to the phases of the Project and make a proper assessment of the resultant impacts on the environment it is imperative that there is a clear identification of the different waste residue flows, which includes information regarding their typology, what level of danger they present, and the most suitable possible final destinations for them.

Therefore, depending on the phases of the Project it is to be expected that there will be different types of waste residues depending on the activities.

IV.5.1. Construction and Operational Phase

In summary, the major waste residue generating activities during the construction phase will be:

- Setting up and dismantling of construction sites;
- Cleaning and removal of existing waste residues in the area in question;
- Deforestation and stripping;
- Demolition of structures / existing housing;
- Earthworks and landscaping;
- Excavations and earthmoving;
- Waterproofing and sealing of the soil;
- Concreting;
- Maintenance of equipment;
- Sundry civil construction works;
- Installation of electrical and communications systems.

During the Construction Phase it is foreseen that the waste residues produced will, in the majority of cases, not be hazardous, and will be categorised as special waste residues and solid industrial waste.

Once in the operational phase actions such as maintenance and operation of offices and infrastructure will be carried out for the WTP, Water Captation, Sludge Treatment Plant, Distribution Centres and all of the extension of the water supply pipelines. During the operational phase, the waste residues generated will of the domestic/ household type (solid industrial waste) and industrial (special waste residues category).

For a better analysis of the impacts associated with the production of waste residues, the main waste residues are identified, and are classified in accordance with the Angolan Waste Residue List (LAR) in Annex X, DP no. 190/12, August 24th, as shown in Table 60.

Table 59 – Predicted waste residues during the activities of the Construction and Operational Phases of the Project

Project Phase	Waste residue	Angolan List of Residues (LAR)
Construction	Diverse plastics	17 02 03
	Timber from construction /demolition	17 02 01
	Mixed rubble comprising concrete, bricks, slabs, tiles and ceramic materials not covered in 17 01 06*	17 01 07
	Uncontaminated rocks and soils (stripped topsoil, excavated earth)	17 05 04
	Contaminated soils and rocks (Earth from contaminated excavations)	17 05 03
	Sundry pipes	17 09 04
	Brickwork (bricks)	17 01 02
	Slabs and ceramic materials	17 01 03
	Concrete residue	17 01 01
	Mixed metals	17 04 07
	Bituminous mixtures containing tar	17 03 01*
	Metals	20 01 40
	Residues from paints, adhesives, glues and resins containing hazardous substances	20 01 27*
	Electrical waste and obsolete electronics	20 01 36
	Paper and cardboard packaging	15 01 01
	Plastic packaging	15 01 02

Project Phase	Waste residue	Angolan List of Residues (LAR)
	Metal packaging	15 01 04
	Mixed packaging	15 01 06
	Sundry contaminated packaging containers (paints, thinners, oils)	15 01 10*
	Oil contaminated waste	15 02 02*
Operation (Maintenance of equipment)	Used oil filters	16 01 07*
	Metals	20 01 40
	Used motor oils	13 02 08*
	Remains of fuel (diesel and fuel oil)	13 07 01*
	Oil contaminated waste	15 02 02*
Operation (Functioning of the System)	Biodegradable waste residues from kitchens and canteens	20 01 08
	Paper and cardboard	20 01 01
	Glass	20 01 02
	Sundry plastics	20 01 39
	Green residues, from garden maintenance	20 02 01
	Electrical appliances and obsolete electronics	20 01 36
	Sundry lamps	20 01 21*
	Solid urban waste	20 03 01
	Empty ink cartridge and toner packaging	15 01 10*
	Residues from A/C equipment maintenance	14 06 02*
	Residues from generator maintenance (hazardous and NON hazardous)	16 01 99 16 01 21*
	Residues from pumping systems maintenance	16 01 99
	Diesel and other combustibles (fuel) residues	13 07 03*
	Septic tank sludges	20 03 04
	Coarse Bar Screening residues (WTP)	19 09 01
	Water clarification sludges (WTP)	19 09 02
	Other WTP sludges	19 09 99

Key:
(*) – Hazardous waste

Negative impacts inherent to the increased production of waste residues, either during the Construction Phase or the Operational Phase of the Project are to be expected.

During the Construction Phase the majority of the waste residues will be the result of construction and demolition operations and classified as non-hazardous.

During the Operational Phase, the production of hazardous waste residues is to be expected, such as empty chemical packaging, especially as the result of maintenance of equipment and machinery and the use of chemicals in the WTP, the Sludge Treatment Plant, and in the Distribution Centres. These waste residues require specific packaging, transportation, and final destination, due to their composition and risk of spillage and/or contamination of soil and water.

Also at this stage, sludge resulting from the treatment of water will be produced which result in impacts, not so much by their type, but mainly by the amount generated. The volume estimated in the Preliminary Project is 97 m^3/dte which will involve the daily use of trucks to transport this waste residue to its final destination.

However, the implementation of a suitable integrated waste management system in both phases, will not only result in the reduction of waste residues, as it will promote internal reuse and recycling, but also a reduction in the environmental impacts that may be caused by its improper handling, packaging and final destination.

In both phases, the production of waste residues may provoke impacts associated with soil contamination. These will be of a negative nature, indirect, likely, temporary, immediate and medium-term, and reversible. Their magnitude varies between low and moderate, respectively for non-hazardous and hazardous waste residues.

IV.5.2. Cumulative Impacts

With the implementation of the Project, and consequent production of waste residues associated with its activities, a cumulative effect will occur due to:

- The increase in the consumption of resources;
- Impacts on soil, the landscape and water resources inherent to landfill;
- Impact on the population's quality of life, by the emission of dust, gases, and noise resulting from the transport of waste residues from the production site (WTP) and the final destination, as yet to be defined.

IV.6. AIR QUALITY

IV.6.1. Construction Phase

The construction phase involves carrying out earthmoving, excavation, levelling, the circulation of heavy vehicles and equipment operation, all of which will contribute to an increase in the concentration of dust and gas in areas surrounding the site yards and on access roads to them.

The receptors most affected at this stage will be mostly all the villages located to the West and Southwest of the emission sources, as this is the direction of the prevailing winds in the region.

The environmental impacts generated will be negative, moderate, direct, certain, temporary, immediate, local, of reduced to moderate magnitude, and reversible.

IV.6.2. Operational Phase

During the Operational Phase the air quality will mainly be affected by emissions of combustion gases originating from the circulation of employees' vehicles and the transport of waste residues from Coarse Bar Screening and sludge generated in the Water Treatment Plant to the final destination, and also the operation of emergency generators.

With regard to light and heavy traffic, particularly on roads that connect to the Water Treatment Plant, there is expected to be an increase in emissions of combustion gases and dust. These sources are diffuse in nature and as such, contribute to the degradation of the air quality in general and not just in the area of the Project infrastructures.

The environmental impacts for this phase regarding air quality are negative, of reduced magnitude, certain, direct, immediate, reversible, local and temporary.

IV.6.3. Cumulative Impacts

The operation of traffic routes and the resulting change in air quality due to burning fossil fuels and resuspension of particles are cumulative effects with regard to the current situation.

These effects will be verified at the level of public health, since the increase of atmospheric emissions will affect the most vulnerable groups in particular, such as asthmatics, the elderly, and children, especially those living in close proximity to traffic routes.

As previously mentioned, the spread of dust during the Construction and Operational Phases will have a cumulative effect on the climate, as it contributes to the degradation of air quality, and also to the occurrence of phenomena such as smog and the greenhouse effect .

The transport and entrainment of dust to surface water sources will be one of the factors that will influence the quality of water, particularly during the Construction Phase. The presence of suspended solids contributes to the increase in turbidity and changes in the physico-chemical properties as well as limiting the passage of light.

IV.7. SOILS, SOIL USES AND PLANNING

In assessing the impacts, qualitative methods were used to estimate the magnitude of the effect during Construction and Operational Phases of the Project.

In this evaluation not only was the value of the soils taken into consideration, but also the characteristics of the Project and major activities planned for each of the phases that may affect these resources; namely, earth-moving, earthworks and levelling.

The implementation of the Project occurs on different types of soil, with the largest area of soil affected, being mainly characterised by human intervention and presence and of no agricultural value.

The fact that a significant number of kilometres of pipelines are next to (running parallel to) highways, the impacts on these descriptors are significantly reduced.

Finally, due to the absence of any current Territory Planning legal instruments, no such impacts of this character will be evaluated.

IV.7.1. Construction Phase

Earthworks and levelling are the actions of this Project phase with the greatest impact regarding the soils, they lead to soil compaction and are responsible for erosion. The magnitude of this impact will depend on the volume of the earthworks (excavation and embankments) as well as the suitability of soils which are affected.

This impact is considered to be negative, of reduced magnitude, direct, certain, temporary, immediate, locally geographic, and reversible (in the case of trenches for the laying of water mains pipes).

The circulation of vehicles, machinery and people, combined with the depositing of construction materials, can cause soil compaction and make it impermeable. The movement of the workforce and machinery at the work site involves risks of soil pollution which can be minimalized, (such as possible spillage of oil and / or fuel).

The environmental impacts for the Construction Phase are therefore considered to be: negative, of reduced magnitude, direct, certain, temporary, immediate, locally geographic, and reversible.

IV.7.2. Operational Phase

During the Operational Phase, due to the relatively modest area of deployment and the strategic importance of the project, the impacts are considered to be negligible.

For example, it should be noted that the whole stretch of buried pipelines which are laid parallel to the highways does not prevent the continued use of the soils that covers them.

IV.7.3. Cumulative Impacts

There are not considered to be any cumulative impacts that justify an assessment and characterization.

IV.8. ECOLOGICAL FACTORS

The level of importance of these impacts was estimated from the degree that the faunal and floristic communities would be affected, taking their conservation relevance into account. Therefore, the value and functionality of the different biotopes was considered, as well as the importance of the area for species of fauna and flora with special bio-geographical status or unfavourable conservation status.

The impacts on wildlife were also predicted based on the inventory of species observed in the area, considering the nature of their preferred habitat, their mobility, dispersal capacity and their conservation status according to the International Union for Conservation of Nature (IUCN).

It is considered that the main impacts of the Construction Phase are the result of clearing groundcover, deforestation, stripping, and earthworks, earthmoving and landscaping. This being followed by road laying, the construction of buildings and other structures planned in the Project, and especially water captation and the Treatment Station that will be associated with it.

For the Construction/ Actuality Phase of the Project the main impacts on the local flora and fauna will be directly related to the volume of water taken from the Kwanza River. The pipes will be underground and most buildings will be located in highly populated areas and of no ecological relevance.

Considering the type of project, the investment associated with it and its proposed continued existence over decades, it was not considered necessary in this study to consider the impacts associated with non-commissioning and dismantling.

IV.8.1. Construction Phase

During this phase, and as previously mentioned, there will be impacts arising from earthmoving and earthworks and clearing of vegetation, namely removing groundcover, deforestation, and stripping. It is considered that these impacts will be negative and direct due to the direct destruction of floristic species (and indirectly due to the depositing of dust with the consequent deterioration of plant health), and the direct loss of habitat which will cause the exclusion of wildlife of a moderate magnitude given its existing specific richness in the area of the project undertaking. This impact will be certain in terms of likelihood and its occurrence will be immediate, and on a local geographic scale, as the affected area is directly within the footprint of the project and not to the same degree on the adjacent areas (overall area study). It is considered that this impact, with the exception of areas where permanent structures will be built, will be temporary and partially reversible through landscape restoration of the disturbed areas.

The construction of buildings and the creation of impermeable areas will have a negative impact, namely through the loss of habitat and creating a fragmentation effect. With a direct effect and a certain probability, this impact will be of a reduced magnitude, given the existing biodiversity in the area of the proposed buildings. This impact will be permanent and irreversible, of immediate occurrence, and on a local scale.

Regarding water captation and its respective pipelines, only the impacts of the construction and the physical presence of the structures will be considered in the present descriptor as the potential impacts on aquatic communities will be dependent on maintaining the river flow as analysed under the “Water Resources” descriptor.

During the Construction Phase of the Abstraction Plant in particular, there will be impacts on the aquatic ecosystem of the River Kwanza and its northern bank. These impacts will be temporary and reversible, but during construction, an Environmental Management Plan should be established containing measures to minimize impact on the aquatic and riparian ecosystem.

Hence, the largest impacts associated with these structures relate mainly to the captation area of the river. This impact will be direct and negative, but of a reduced magnitude, as there is no riparian gallery which has to be sectioned. There will be a certain, permanent, and irreversible impact, with immediate occurrence on a local scale.

The detailed design of the distribution pipeline route should take into account the presence of flora and fauna, and avoid sensitive sites such as mature trees and other significant natural habitat and should take account of possible fragmentation of passage routes for wildlife.

IV.8.2. Operational Phase

During the Operational Phase of the Project, the main impacts will mainly result from human presence and associated activities. Increased vehicular traffic, in addition to the risk of animal-vehicle collisions, will also lead to driving the local fauna away due to artificial lighting of the installations and the noise generated by them. This impact although of a reduced magnitude is negative, indirect, likely and permanent. The occurrence of this impact should occur at a local scale in the medium term, and may be reversible given the relative tolerance of many species to human presence and the possibility of implementing specific mitigation measures.

During the Operational Phase of the Abstraction Plant, provision for planned and accidental releases of chemicals or contaminated water should be contained within an Environmental Management System for the facility, in order to protect the aquatic and terrestrial environment.

IV.8.3. Cumulative Impacts

As previously mentioned, the primary cumulative impact centres on the many existing water captation points on the Kwanza River which may give rise to future problems of water flow and consequent ecological problems, inducing for example, drought in marshy areas during periods of very low water availability.

In spite of this, the creation of this captation may also provide an opportunity to contribute to the partial conservation of the wetlands area to the East of the Bom Jesus, through the control of new captation points, or waterworks on the Kwanza River, as well as the expansion of the Bom Jesus Highway to the East, South of the current Cement Works.

IV.9. LANDSCAPE

IV.9.1. Construction Phase

The Project will be developed in landscape units B and C. In unit B (moderate quality and fragility) there will be water captation and the pumping system, the pipelines connecting to the Water Treatment Plant, the Cacuaco Distribution Centre and some sections of the Capalanga and Cacuaco area pipeline system. All other infrastructure, such as the Water Treatment Plant, Distribution Centres and supply pipelines between the Distribution Centres will be built in unit C (reduced quality and high fragility). The fact that all the water pipelines will be buried is a positive aspect that will reduce the visual impact of these infrastructures.

In this phase the impacts on the landscape consist of:

- Decreased visual quality due to stripping and levelling of the land, with the consequent removal of vegetation which gives chromatic texture;
- Increased fragility of the landscape resulting from excavations and the installation of foreign elements, such as the construction yards and all mobile and fixed equipment that will give rise to the increase of visual impacts around the of works / construction site areas;
- Changing the natural contours of the landscape through excavations and earthworks;

Therefore, the overall impacts on the landscape will be negative, direct, certain, and of reduced magnitude. The duration will be temporary, local and immediate to the start of works.

The impacts inherent in changing the topography of the land manifest the characteristics itemised above, with the exception that they will be irreversible and the duration will be permanent.

IV.9.2. Operational Phase

At this stage of the Project, the impacts on the landscape may be due to the presence of foreign elements in the natural landscape, such as the captation installations, the Water Treatment Plant and Distribution Centres. Regarding the latter, the elements which cause the greatest impact are the reservoirs and water towers due to their height (between 35 and 55m), despite being grouped in areas with a lesser visual quality, given the strong urban pressure for housing and mainly industrial installations.

Lighting Impacts. There will be limited artificial lighting for both the Water Abstraction Plant and the Water Treatment Plant, though mitigation recommendations in this regard are set out in the following Section. Both intake and treatment plants will operate continuously 24h/d, 7d/wk. However, at night, since the plant is fully automated, artificial lighting will be limited to working areas such as the car park and buildings such as reception and control room.

The Water Abstraction Plant will be designed to minimize landscape impacts and to retain as much of the original landscape character as possible, including retention of mature baobab trees. Additionally, new landscaping will reflect native species and be harmonious with the surrounding natural landscape.

Similarly, the Water Treatment Plant will replace the existing agricultural landscape with a more formal landscape but this will also be sympathetic to reflect native species and be harmonious with the surrounding natural landscape.

It should be noted that the areas of implementation of the Project and its surroundings already have elements that cause visual impacts that reduce the quality of the natural landscape.

The impact of decreased visual quality due to the installation of buildings and equipment will be negative, certain, and direct, permanent, of low magnitude, reversible, with a spatial dimension ranging from local to regional. In the assessment regarding duration and reversibility, it is proposed, that the end of the useful life scenario of the infrastructure calls for the restoration of the local landscape and the removal of all buildings.

IV.9.3. Cumulative Impacts

The whole area of the Project development presents elements that will impact on the landscape to such an extent that cumulative impacts are to be expected with the implementation of the Project and the introduction of new foreign elements in the natural landscape.

IV.10. SOCIO-ECONOMY

IV.10.1. General Considerations

The Project which is covered by this study will cause impacts on the population and economic activities, some of which will be considered positive and some negative, related to the phases of the project. The degree of significance of the impacts was estimated from the degree of negative or positive impact on local populations and activities in general.

The positive impacts are related to increasing the availability of potable water to support social and economic development of the Luanda region, particularly in the Eastern part of the province, through the implementation of a captation plant drawing untreated water from the Kwanza River, of a Water Treatment Plant with a maximum capacity of 9 m3/s (6m3/s in the initial phase), and its respective of pumping and connection network to the different Distribution Centres. The realization of this project meets the objectives and targets set by the Government of the Republic of Angola, aimed at meeting the needs and expectations of the population and interested economic parties, covering a very wide range of activities related to providing a public water supply to the population and other economic activities in general.

In addition to the jobs created during the Construction Phase, also of great importance are the resulting dynamics for industry and commerce associated with civil construction such as the production of materials, equipment, machinery, and the production of chemicals, among others. The provision of service is also one of the activities that is expected to register a significant increase as it will play an important role in the modernization of procedures, and thus improve the competitiveness of the system.

The negative impacts of a socio-economic nature are also varied, and are mainly related to the loss of land tenure, with potential effects on buildings, and on population mobility, with the possible interruption of road traffic or traffic disruption and general disturbance for the population during the construction phase.

Both positive and negative impacts have a differentiated impact during the Construction and the Operational Phases of the Project.

Because it is both a rural and urban area, the construction of water supply networks will be responsible for a set of changes in the everyday lives of the population and agricultural activities, especially to the resident populations in the immediate vicinity of the works and in the economic activities around these areas. The effects will be essentially negative during the Construction Phase, and in some cases will persist after the proposed works are completed.

Land and informal housing security are a serious concern in Angola, and certainly forced evictions have occurred in the country, mainly in urban areas of the capital. The possibility for forced evictions in context of this Project have been assessed, being directly relevant to IFC PS5. Our understanding is that there will be no requirement for forced evictions for this project, as land purchases or commissioning seem to have already been performed, so no Resettlement Action Plan (RAP) is required.

As a component of the ESMP, if any forced evictions are required then these need to be documented and a process of compensation activated. In addition, any change in river or land use affecting local communities including fishing, farming, other commercial activities or recreation needs to be documented.

Interviews conducted with local population make specific requests for local compensations; it is recommended in the ESMP that these requests are taken into account on a case by case basis in providing appropriate compensation.

The following subchapters deal with Population Awareness regarding the Project and are the results of contacts which were made, and the identification of the main impacts to be expected due to the construction of the Project, as well as the magnitude of the effect.

IV.10.2. Population Awareness Regarding the Project

In order to identify the awareness of the population regarding the Project, meetings were held with various entities of the area to be developed.

In addition to researching this awareness, the meetings were intended to publicize various aspects of the Project, such as where the pipelines would cross, and also to collect information related to the territory, and the everyday lives of the population, and the main economic activities of those involved.

Of the contacts that were made, it became apparent that the representatives of the people were unaware of the Project in its entirety.

In summary, although a significant part of the population and its representatives do not know about the Project, the contacts that were made allowed public attention to be focused on some aspects of the Project, which gave rise to a process that is intended to be participatory within the remit of this Environmental Impact Study. At the same time, information about the Project, (although summarised), allows the contacted parties to inform the public. In this way, the Project will gain acceptance from the population who consequently are more likely to put up with the inconveniences that the development phase of the works will entail.

IV.10.3. Construction Phase

One of the main positive impacts of the Project is the value of the investment. This is a positive impact of high magnitude, certain, immediate and temporary (during the civil construction phase of buildings associated with the Water Treatment Plant, Reservoirs, Pumping Stations and Pipelines, and in the final stage of the installation of various equipment - total duration 3.5 years), benefiting the economy as a whole, and reflecting on local, regional and national levels. This impact extends to the international level due to the procurement of equipment that is not available in Angola from external sources.

Construction of the Project will imply the creation of jobs (for Plot 2, employment for 90 workers is planned for the Construction Phase, however, estimates are not yet available vacancies for Plots 1, 8, and10), which will have a positive effect locally if the workforce is contracted from the population of the Icolo, Bengo, Viana and Cacuaco municipalities which are close to the study area in question. This impact may be considered to be positive, of medium magnitude, likely, immediate and temporary (lasting 3.5 years). Even if the workforce is contracted from outside the localities traversed by the pipelines, it will also be a positive impact, but benefiting the population of other locales, thus increasing the spatial extent of positive impact.

One of the major things that affects the population is the occupation of the property by the water supply pipeline infrastructures, construction of the Captation Facility, the Water Treatment Plant, and the Potable Water Treatment Plant and by the supporting construction equipment with emphasis on the construction sites. This occupation is negative, certain, of reduced to moderate magnitude, significant, irreversible, permanent for most infrastructures, and temporary in the case of building yards and service roads to be used during the Construction Phase. The effect is progressive depending on how the work fronts advance, but ceases as the work progresses.

Another significant affect will be the barriers created by the trenches and the safety and security fences which will reduce or limit population mobility. This is a significant negative impact, which is certain, of high magnitude, variable, reversible and local, as during the construction phase it will be progressive.

Only one makeshift dwelling in corrugated sheet was identified, located in the vicinity the grounds of Distribution Centre 30 km, which will impact on it, it is expected to be significant, certain, of reduced magnitude, permanent, irreversible and also at the local level, although able to be minimised.

The land around the site of the Cacuaco Distribution Centre has a field of cassava and baobab trees, which implies a negative impact, it is expected to be significant, certain, of reduced magnitude, permanent, and partially reversible and also local, although able to be minimised.

The land around the site of the New Airport Distribution Centre has a field of cassava which implies a negative impact; it is expected to be significant, certain, of reduced magnitude, permanent, and partially reversible and also local, although able to be minimised.

The significance of some of the disturbances referred to may be minimised and the magnitude reduced if the users of the thoroughfares where the pipelines are to be installed are forewarned of any constraints to the use of roads and lanes, either by temporary narrowing of the roadways, or by speed restrictions due to construction.

In the present case, the compulsory purchase plans are not yet completed so it is not possible to accurately assess to what degree the buildings or economic activities will be affected. However, the manner in which the property owners are approached, and the different forms of acquisition of land for the construction of infrastructure and pipelines, will be carried out in such a way as to provide fair compensation for the ensuing losses arising from them.

At a later stage of the Project (the Project is in the Preliminary phase), when the complete historical records of the compulsory purchase proceedings are known (amicable or litigious), any complaints regarding the possible impact on the population resulting from the acquisition or leasing of land can be more reliably identified.

The proximity of work fronts to some localities or scattered dwellings may affect the population by causing disturbances as a result of noise, dust, and provoke traffic disruption and pedestrian mobility issues.

It is a negative impact, (especially the possible interruption of traffic circulation) of low importance, temporary, reversible, possibly being more prejudicial along the roadways where the pipeline runs alongside, particularly in Plot 2 - Potable water transmission network of to the Distribution Centres, impinging on the Bom Jesus Highway, the Catete Bairro de Zango Highway, and the Expressway:

The extent, scale and duration of the works require the permanence of workers in the area during the construction period, which is estimated at about three and a half years. This implies that accommodation will be required in the various establishments in the municipalities crossed by pipelines, and also the need for canteen facilities. This is considered to be a positive impact on the commercial activities of the municipalities involved, and categorised as not significant, likely, temporary, and on a local level. It is anticipated that in most cases the worksite facilities will be used to preparing meals.

During the Construction Phase there will be an increase in local trade in building materials, resulting in a positive impact of moderate magnitude given the size of the works, likely, immediate, temporary, reversible and significant for the commercial activities of region, especially in the municipalities affected if the materials are purchased in the region.

Excavations at the Water Treatment Plant sites and the foundations of the reservoirs and associated adduction may require the use of explosives which may disturb the resident population in the vicinity of the works, especially in places and dwellings in close proximity to the waterways as previously mentioned. It is a negative impact, of low significance, likely, of reduced magnitude, sporadic, temporary, reversible and at a local level.

Furthermore, during the Construction Phase, there is a very strong possibility that construction companies based in the municipalities and communities traversed by the works will be awarded contracts. The realization of this eventuality would lead to a positive impact of high magnitude, certain, temporary, significant for employment and economic activity in general, at the local level.

The circulation of heavy plant and vehicles required for the undertaking of the Project will have a detrimental effect on some roads and streets in the vicinity of the works, and access may be disrupted affecting the normal use of these roads by local populations. This impact is negative, of reduced magnitude, likely, will occur during the construction phase; will be reversible and relatively negligible locally.

Despite the existence of protection fencing around the trenches for the pipeline and the construction of the captation facilities of the Water Treatment Plant and the Potable Water Treatment Plant, there is a potential risk of harm to the population, resulting in a negative impact, unlikely, negligible, temporary, reversible and at a local level.

IV.10.4. Operational Phase

The reinforcement of the drinking water supply to the eastern region of Luanda, will contribute to improving the quality of life of the population and ensure a higher level of drinking water service satisfaction. With this mind, the aim of bolstering the water supply is considered, in this study, to have a positive socio-economic impact, very significant, certain, irreversible and at a regional level, with indirect consequences resulting in the increase of profitability of economic activities dependent on water supply, thereby benefiting economic parties and the population in general.

It is worth noting that the greater availability of water will lead to the vitalisation and creation of economic activities with the consequent investment associated with them. This is a positive impact, certain, significant, of high magnitude, and benefiting the regional economy.

In the regional context, the indirect positive impact of the possibility of attracting investment for economic activity in general should also be noted, as this will have a significant positive impact on the creation of new businesses or the expansion of existing ones it. This will boost the economy, and in turn contribute to population settlement and to social stability, which is a positive impact, indirect, certain, and permanent on a regional level.

As noted previously, other sectors will also benefit from the operation of the project, such as industry, commerce and services related to the water sector, and in particular where the water treatment will require significant amounts of reagents (5750.807 tonnes per year for the Water Treatment Plant process and 76.409 tonnes per year for the sewage treatment process). In fact, the bolstering of the water supply contributes to the creation or stimulation of industrial companies related to the production of materials, equipment and machinery, repair of machinery and equipment, the production of chemicals such as reagents, power distribution (annual energy consumption of 78,788,986 kWh per year) and oils and lubricants among other sundries.

The provision of service is also one of the activities that will register a significant growth given that it will play an important role in the modernization of procedures and operation of the captation, treatment, and water supply system, thereby improving overall competitiveness.

Therefore, the industrial, trade, and service sectors will all register a positive impact, indirect, certain, of moderate magnitude, permanent, irreversible and on a regional level..

The jobs created by the businesses that will be created and the vitalisation of the various sectors constitutes a positive impact, significant, certain, irreversible, of low to moderate magnitude local and on a regional level.

Along with the aforementioned benefits, what should also be highlighted is the expected improvement in the professional qualification of human resources through programmes and measures aimed at valorising the regional human resources. This qualification is a positive impact, certain, significant, of moderate magnitude, and on a local and regional level.

It is noted that the costs of operation and maintenance of the supply system, involving the acquisition of various materials (such as raw materials and lubricants) and the provision of various services including cleaning the captation and Water Treatment Plant facilities will benefit the local economy, with positive repercussions on the population and local economic activities. It is a positive impact, certain, of low magnitude and significance, permanent, and on a local level if these activities are contracted to companies residing in the municipalities of the study area.

At this phase, in addition to the employment generated to ensure the operation of the system, especially the Water treatment Plant (the number is not yet established), there will also be jobs created related to maintenance, however, these numbers cannot be estimated in this phase of the study. It is a positive impact, certain, of low magnitude, not significant and on a local level.

In the Operational Phase there will be practically no disturbance of the population or their activities during the water supply Operational Phase.

The bolstering of the water supply to the Luanda region contributes towards the objectives and targets established in the various Angolan Plans, Programmes and Strategies of both regional and national scope, namely:

- **MPLA Government Programme 2012 – 2017,** having as it targets:
  - 100% coverage in urban areas and 80% in rural areas;
- **Angola 2025. A country with a future. Long term development strategy**
  - Aims to guarantee the supply of potable water to at least 80% of the Angolan population, reducing by half the population without access to potable water by 2015;
- **"Water for Everyone" Programme (2007)**
  - Access to potable water for Angolan rural communities and by 2017 supply at least 80% of the population in rural areas
- **National Development Plan (PND) 2013 – 2017. Ministry of Planning and Territorial Development, December 2012,** the targets of which are:
  - Increase the production of potable water in provincial centres (from 980,353 m^3 per day in 2012 to 1,767,953m^3 per day in 2017).
  - Increase the coverage of the population provided with water (from 56% in 2012 to 85% in 2017).
- **Investment in the Electric and Water Sectors Programme, until 2016. Ministry of Power and Waters**, the targets of which are:
  - Renovation and expansion of the water supply systems, with the aim of reaching a coverage of 100 % in urban areas and 80 % in peri-urban and rural areas;
  - Increase the supply of water in peri-urban and rural areas (minimum consumption per-capita of approximately 40 litres per day in standpipe supply situations and 70 litres per day supply for domestic connections devoid of internal network);

  - Among the developing Structuring Projects emphasis is given to bolstering the Municipal Water Supply and Sanitation Services to 78 Municipalities.

- **Power and Water Sector Action Plan 2013 - 2017. Ministry of Power and Water. April, 2013**

In **Luanda** several renovation, expansion, and construction projects are underway on the water supply systems and infrastructures such as:

- Stabilising and increasing the levels of water produced;

- Increasing the distribution coverage to the population;

- Improving and expanding the distribution network;

- Constructing new Water Treatment Plants (Bita and **Quilonga**).

Consequently, the contribution of the system which is the subject of this study, with regard to achieving the goals indicated in the documents referred to, has a positive impact, certain, of high magnitude, and of a local, regional and national level.

IV.10.5. Cumulative Impacts

Of the cumulative impacts of the Project, greater demands on the road network for access to the New City of Cacuaco area have been identified, which coincides with the access road to the future Cacuaco Distribution Centre (Figure 120 and Figure 121).).

This increased demand translates into increased traffic and the consequent emission of dust, combustion gases and noise, thus exacerbating the disturbance of the resident population who use the highway and live in the vicinity.

Also noteworthy is the increased danger to pedestrians and traffic in general, increasing the risk of accidents on this access road to the New City of Cacuaco.

IV.11. PATRIMONY

IV.11.1. Construction Phase

During the construction phase, there are no foreseeable impacts to buildings of historical significance. For the planned earthmoving phase, it is recommended that archaeological monitoring should be implemented as a way to minimize impacts on any archaeological remains that may be in the subsoil and are not visible on the ground surface.

IV.11.2. Operational Phase

For the Operational Phase, there are no foreseeable impacts to buildings of historical significance. However, it is recommended that there is a reanalysis of the Operational Phase on the basis of data obtained through archaeological monitoring during the Construction Phase. Thereby making possible the identification of any archaeological remains that may come to light during the mechanical excavation process.

IV.11.3. Cumulative Impacts

No cumulative effects were identified in the present project.

IV.12. COMPILATION OF IMPACTS

The compilation of the impacts identified for each of the descriptors and their classification is presented in the table on the following pages.

Table 60– Compilation Table of the Project Environmental Impacts

Activity		Environmental Descriptor	Description	Effects	Evaluation
Construction Phases	Deforestation and Stripping	Ecology	Deforestation and Stripping	Effect of driving away fauna	-, D,C,T, Im, L, Rs
		Air quality	Removal of ground cover (trees and vegetation)	Alteration of air quality due to atmospheric emissions (particles)	-, D, P, T, L, Im, Rs
				Reduction of capacity to capture atmospheric CO_2	-, D, C, Pt, L, Im, Rs
		Environmental noise	Deforestation, destruction of arboreal growth and stripping	Increase in incident noise levels on the surrounding sensitive receptors Effect of driving away fauna	-, D, C, T, Im, L, Rs
		Landscape	Removal of ground cover	Destruction of the natural landscape	-, D, C, Pt, L, Im, Is
		Geology and soils	Removal of topsoils	Reduction in the quantity of the most fertile soils.	-, D, P, Pt, L, Im, Is
		Socio-Economy	Cassava cultivation in the Project terrain (Cacuaco and new airport DCs)	Disruption of agricultural crops	-, D, C, L, Im, Rs
		Water resources	Removal of topsoils	Alterations of water infiltration properties	+, D, P, T, L, Im, Rs (with the exception of waterproofed areas)
				Alterations of surface run-off conditions	-, D, C, T, L, Im, Rs
	Foundations	Water resources	Excavation of foundations	Alteration of the depth of the water table (with induced lowering)	-, D, I, T, L, Im, Rs
		Socio-Economy	Digging trenches and erecting safety fences	The effect of a physical barrier, resulting in the reduced or limited mobility of the population	-, D, C, T, L, Im Rs
			Excavation of foundations with the possible use of explosives	Disturbing the population in the close vicinity of the work fronts where explosives are used	-, D, P, T, L, Rs
		Geology and soils	Excavation of foundations	Provoking changes in agricultural soils	-, D, P, T, L, Im, Rs (partially)
	Levelling (Earthworks)	Ecology	Earthworks	Immediate destruction of vegetation Loss of habitat	- D, C, T, Im; L, Rs
		Heritage	Excavation/Levelling	Possible effects on the Archaeological Heritage in the subsoil	- D, P, Pt, L, Im, Is
		Noise	Earthworks and excavations	Increase in the incident noise levels on the surrounding sensitive receptors Effect of driving away fauna	-, D, C, T, Im, L, Rs
		Air quality	Earthmoving and circulation of heavy vehicles	Atmospheric emissions of greenhouse effect gases and particles	- , D, C, T,L, Im, Rs
		landscape	Levelling	Alterations of the contours of the natural landscape	-, D, C, Pt, R, Im, Is
		Socio- Economy	Makeshift dwellings in the Project terrain (DC km30)	Rehousing	-, D, C, P, L, Im, Is
		Water resources	Earthmoving	Contamination of surface water by entrainment of fine particles	-, D, P, T, L, Im, Rs
	Movement of equipment	Air quality	Emission of dust and combustion gases	Alterations in air quality due to the emission of greenhouse effect gases (combustion) and particles	- ,D, C, T,L, Im, Rs
		Socio-economy	Circulation of heavy vehicles in the service of the works	Degradation of roadways and highways, with disruption of their normal use by the local population	-, D, P, T, L, Im a MP, Rs
	Contracting labour force	Socio-economy	Creation of jobs	Increase in the rate of employment for the population, reduced unemployment, improvement of socio-economics of the employed population	+, D, P, Im, T, R, Rs
			Awarding of construction contracts to companies based in the municipalities	Growth in the civil construction sector with favourable repercussions in local and regional employment	+, i, P, , T, R, Rs

Activity		Environmental Descriptor	Description	Effects	Evaluation
			Influx of workers, for an estimated period of three and a half years	Increase in demand for accommodation and canteen facilities	+, i, P, T, L e Rs
	Civil Construction Works	Landscape	Construction of high-rise buildings Introduction of foreign elements in the natural landscape	Alteration of the natural landscape, due to the introduction of foreign elements	-, D,C, T, R, Im, Rs
		Ecology	Building of permanent installations and impermeable areas	Loss and fragmentation of the habitat	- D,C,Pt, Im, L, Is
			Captation of water	Increase in disturbances in riverside areas	- D,C, Pt
		Environmental noise	Building of permanent installations and impermeable areas	Increase in incident noise levels on the surrounding sensitive receptors Effect of driving away fauna	- D, C, T,Im, L, Rs
		Waste residues	Production of waste residues from packaging and maintenance of equipment and Municipal Solid Waste	Soil contamination	-, i, P, T, L, Im, Rs
		Air quality	Atmospheric emissions (CH_4 and other gases)	Alteration of air quality (decomposition emissions, CH_4 and other gases)	-, D, C, T, L, Im, Rs
		Water resources	Washing and disinfecting of the pipelines / waterproofing materials with bitumen based paints	Water contamination	-, D, I, L, Im, Rs
		Socio-Economy	Building of permanent installations and occupation of property (site yards)	Occupation of property and alteration/unuseability	-, D, C, Pt (for permanent structures) and T(site yards), Is
			Disruption of daily life in inhabited areas close to work fronts	Effect on the population due to the inconvenience caused by noise, dust, traffic disruption locally or nationally	-, i, P, T, L, Rs, Im
			Local business of construction materials	Increase in sales of construction materials locally	+, i, P, T, Im, R, Rs
Operational Phase	Functioning of the System	Professional Socio-Economy	Bolstering the potable water supply to the Eastern region of Luanda human consumption	Improvement of the quality of life of the population, and a greater level of satisfaction of the individual and collective needs for potable water	+, D, C, P, R, Is
			Bolstering the availability of water for the business sector	Possibility of stimulating economic activities and investment in sectors with specific water requirements	+, i, C, P, R, Is
			Sales of products and services for water treatment	Improving the sectors of activities related to the sale and provision of services for water treatment	+, i, C, P, R, Is
			Creation of businesses in the sales sector of products for water treatment services and maintenance	Increase in the supply of labour to meet the growing demands	+, i, C, Pt, R, Is
			Professional Training and Qualification	Improvement in professional qualification of human resources, by way of regional valorisation programmes and measures	+, i, C, Pt, L, L e R, Is
			Provision of maintenance and cleaning services for the system installations contracted locally	Increase in the supply of labour to meet the growing demands	+, i, C, Pt, L, Is
			Governmental Programmes and Strategies	The bolstering of the water supply contributes towards achieving the targets defined by the Government	+, i, C, Pt, R a N, Is
		Landscape	Presence of infrastructures	Degradation of the quality of the landscape by foreign elements in the natural environment	-, D, C,T, L, Im, Rs
		Waste residues	Production of non-hazardous waste residues	Contamination of the soil and water resources	- , i, P, T, L a R, MP, Rs
			Production of hazardous waste residues		- , i, P, T, L a R,MP, Rs
		Air quality	Emission of particles and greenhouse effect gases to atmosphere	Alteration of air quality	- ,D, C, T, L , Im, Rs
		Ecology	Circulation of vehicular traffic Artificial illumination Noise	Effect of driving away fauna	- ,i, P, Pt, MP,L, Rs
		Environmental noise	Circulation of vehicular traffic Operation of equipment	Increase in the incident noise levels on the surrounding sensitive receptors Effect of driving away fauna	- , D, C, Pt, Im, L, Rs

Activity	Environmental Descriptor	Description	Effects	Evaluation
	Soils	Dumping of sludges resulting water treatment in the water Treatment Plant	Contamination of the soils	-, D, P, Pt, L, LP, Is
	Water resources	Captation of water from the Kwanza River	Decreased water availability from the Kwanza River	-, D, C, Pt, R, Im, Is
Phase of construction and operation	Socio-economy	High value of the investment	Benefits the economy in general, with positive repercussions at local, regional, national and international levels	+, D, C, Im, T, TF,Rs

Impact Assessment Key:

Qualification	(+) positive; (-) negative; (o) - Nil		
Magnitude	**High**	**moderate**	**reduced**
Incidence:	**D-** direct, **i-** indirect		
Probability or degree of certainty	**C -** certain**, P –** probable/likely,		
Duration	**T-** temporary**, Pt -** permanent, **I** – improbable/unlikely		
Spatial dimension	**L -** Local**, R** - Regional **N-** National **TF-** Transfrontier		
Occurrence	**Im –** Immediate**, MP –** Medium Term**, – LP –** Long Term		
Reversibility	**Rs –** Reversible**; Is -** Irreversible		

V. Minimization and Empowerment Measures

After assessing the environmental impacts associated with the construction and exploration of the project, it is important to identify the most effective mitigating measures to reduce them, as well as the enhancer measures to reinforce the positive effects of the development, maximizing their benefits.

The approach will be made for each phase of the project, according to the environmental descriptor, which also proposes a series of minimizing measures of general and specific nature.

The general measures are applicable to a broad set of descriptors, which should be applied generically to the various phases of the project and the different descriptors.

V.1. CONSTRUCTION PHASE

V.1.1 Climate

Measures to minimize this descriptor are not considered, since minimally significant effects were not identified. However, implementation of measures to minimize dust emissions such as spraying is recommended, since their effects may have an influence, albeit minimal, in climate.

V.1.2 Geology

M1 - Whenever landfill is necessary, materials from the excavation should be used, thus minimizing the amount of surplus land (to carry out the intervention areas).

V.1.3 Water Resources

M1 - The accidental hydrocarbon (oil) spills, oils and/or other lubricants should be minimized through proper and safe storage of these substances and a handling by qualified personnel sensitized to environmental issues.

M2 - The previous measure should be complemented by the construction of soil sealing operations for oil changes and fuel supplies, as well as for the storage of chemicals.

M3 - In shipyards, domestic sewage and industrial wastewater should not be forwarded to the surrounding water environment without being guaranteed a minimum quality under Law (Emission Limits Values listed in Annex VI of Presidential Decree 261/11 of 6th of October).

M4 - If excavation materials with traces of contamination occur, they must be stored in confined spaces, thus avoiding contamination of surface and groundwater.

M5 - A temporary drainage system should be constructed, at the surrounding of the shipyards and at the surrounding area to be intervened for the construction of the WTP. This system, if appropriate, should include decantation basins.

M6 - Where there are fuel tanks on site, underlying retention basin with adequate volume retention of leaks by accident or incident should be built.

M7 - certified companies shall collect the lubricating oils and materials.

M8 - A program of continuous optimization should be implemented on the WTP, with a view to substantially reducing water waste.

V.1.4 Acoustic Environment

During the construction phase, it is proposed to implement the following measures:

M1 - meet current IFC indications regarding noise levels and increments incidents compared to baseline situation;

M2 - adopt measures to minimize the increase in noise levels on construction sites and adjacent to the work areas, such as:

- streamline the movement of vehicles and work support machinery;
- ensure the maintenance and periodic overhaul of all vehicles and all work support machinery;
- possess class level certification of the sound power emitted by all the work support machinery;
- soundproofing the work support machinery that generates more noise, using for example silencers with internal combustion systems or air pressure on machinery (e.g., compressors, drills, cranes);
- organize all vehicles and all the machinery to support the work that operate outdoors, in order to reduce the source noise generation and targeting the largest possible distance between the facades of buildings located adjacent to the work areas;
- select and utilize, where possible, vehicles and machinery designed to support the work for preventing and controlling the generation of noise;
- select, whenever possible, techniques and construction processes that generate less noise;

- set an appropriate time for work, with the limitation of execution or frequency of construction activities that generate high noise (e.g., movement of heavy vehicles that support work, jobs that resort to the use of noisy machinery to support work) only during the day (from 8 to 20 hours) and on weekdays;
- warn (written, apologising the annoyance generated and explaining why) the resident population and existing adjacent to the work areas, if recourse to techniques and construction processes that generate high noise;

M3 - adopt measures to protect individual workers more exposed to noise during construction activities;

M4 - insulate and isolate properly, if appropriate, areas located in open space where they develop construction activities that generate high noise through its boundaries with the deployment of acoustic panels;

M5 - introduce, where necessary and where appropriate, additional acoustic measures and/or check the protection already implemented, justified based on the results of monitoring to develop and to minimize the increase in noise levels on construction sites and in areas adjacent to the work (especially with sensitive uses).

V.1.5 Waste

M1 - Develop and implement a Waste Management Plan (the art.º7 of the RGR) in compliance with legal requirements in this regard, always aiming at the correct identification and classification of waste according to the LAR;

M2 - Temporary packaging of the waste in a dockyard in a sealed, waterproof and easy to access area;

M3 - Installation of containers for waste separation, depending on its type, to facilitate the delivery for Valuation operations (recycling, reuse), instead, the Landfill (Disposal);

M4 - Conducting campaign (s) awareness / training on workers to correct separation of waste on the premises and knowledge of best practices in waste management;

M5 - routing the waste to appropriate(s) and authorized destination(s), by operators also authorized thereto, in compliance with all legal requirements;

M6 - The waste such as lubricants, oils, fuels and other waste deemed hazardous must be handled cautiously, to avoid spillage;

M7 - Storage in appropriate place of aggregate waste resulting from land clearing and soil stripping, for future recovery of the project area;

M8 - At the end of the work the entire area allocated to the yard and their local environment should be clean and all waste collected that may still exist on the site;

V.1.6 Air Quality

M1 - Cover the loads of particulate material such as land, to avoid the dispersion of particles during transportation;

M2 - Moisten, in periods of dry weather, the stacks of particulate matter, in order to prevent dust resuspension;

M3 - Implement a maintenance plan and periodic review of fixed and mobile equipment, in order to maintain normal operating conditions and minimize emissions of air pollutants;

M4 - Whenever the crossing of inhabited areas is unavoidable, lorries should operate at moderate speeds to minimize the emission of dust and gas.

M5 - Promote the optimization of routes of movement of machines, to prevent excessive emissions;

M6 - The areas of mobilized bare soil, where there is passage and/or working of heavy vehicles during dry weather periods, should be watered regularly;

V.1.7 Soil, Land Use and Planning

M1 - The accidental hydrocarbon (oil) spills, oils and/or other lubricants should be minimized through proper and safe storage of these substances and a handling by qualified personnel sensitized to environmental issues.

M2 - The previous measure, should be complemented by the construction of soil sealing operations for oil changes and fuel supplies, as well as for the storage of chemicals.

M4 - If excavation materials with traces of contamination occur, they must be stored in confined spaces, thus avoiding contamination of soil.

M4 - In order to decrease the degree of soil compaction caused by the movement of machinery and heavy vehicles, accesses must be properly planned, thus avoiding cluttered circulations and restricting the minimum area to be affected.

M5 - certified companies shall collect the lubricating oils and materials.

M6 - The works of excavations and embankments should be started as soon as the soil is clean, thus avoiding the repetition of actions on the same areas.

V.1.8 Ecological Factors

M1 - Promote actions of environmental training/awareness of the different intervening parts in the execution of construction works, focused on good environmental practices and the application of the set minimization measures.

M2 - Find parks and yards of materials within the intervention area and in ecologically degraded sites and reduced slope, duly sealed, never near watercourses.

M3 - Limit the actions of clearing, deforestation and blasting areas strictly necessary for the performance of the contract, which must be properly marked.

M4 - Proceed to stripping topsoil and its storage in ''pargas'' for future use in landscaping, prior to the execution of the works of earthmoving.

M5 - Developing a Landscape Plan Integration (LIP) in the dockyard areas and subject to earthworks, comprising unpacking, aeration and soil renaturalisation completing the planting of native plant species.

M6 - Establishment of a specific Landscape Integration Plan (LIP) for the Acquisition and associated buildings, through the planting of native plant species, reducing the visual intrusion of this from the river.

M7 - Promote the use of surplus land in modeling land and environmental recovery in the area of implementation of the project, aimed at reducing the dump volume.

M8 - Do not use ecologically sensitive areas, in bed or full agricultural suitability for running dumps.

M9 - If it is necessary to use land loan, must be assured that the place of origin of the same there are no exotic/weed species.

M10 - Set vehicular circulation circuits and machines that were allocated to contracts that favor the use of existing accesses.

M11 - Rationally promote the irrigation of temporary accesses, especially in dry weather periods and strong wind, to prevent the deposition of powder materials on the vegetation.

M12 - Search the timing of activities generating higher perturbation does not coincide with the most critical in terms of reproduction of fauna period after the onset of the rainy season affecting the months of November to March.

M13 - set a limit of 30 km/ in temporary bouts of work seeking to reduce the incidence of wildlife roadkill and dust disturbance with consequent deposition on vegetation.

M14 - In the PIP, planting native vegetation and feature of the original biotope should be ensured, particularly the species identified in this study, when recovering from targeted areas.

M15- Copies of Baobab *(Adansonia digitata)* and other larger species that do not overlap directly with the implementation of structures shall be maintained and properly marked as such so that does not happen cut of brush when land clearing, thus fostering a more rapid landscape restoration of the area.

M16 - For the execution of water pipes to capture the different distribution centers, a route which follows the verges of roads, in order to minimize the allocation of vegetation by excavation and trenching should be used. Once the layout is coincident with the conduit paths, the area from the surrounding vegetation should be marked by preventing the stepping of the vehicle.

M17 - As part of a Construction Environmental Management Plan (CEMP), include the provision for protection of the aquatic and terrestrial natural environment which will include the specific provisions recommended by Ecovisao.

V.1.9 Landscape

M1 - Landscaping recovery of all areas of the dockyard and accesses created during the construction phase, with replacement of the initial land use;

M2 - All waste must be packaged in appropriate containers, and later sent to authorized undertakings in order to reduce their visual display;

M3 - Prior to the work of land clearing and stripping the delimitation of the area of intervention should be make, in order not to make unnecessary interventions in outdoor areas, thus avoiding the allocation of vegetation that are interesting to preserve;

M4 - Conducting periodic watering in the main routes of trucks movement in order to reduce dust and minimize the effects on the landscape;

M5 - Ensure that all temporary landscape impacts during Construction Phase are made good before the Operational Phase, including removal of all construction equipment, waste, stockpiles material and obstructions (see also Waste Management Plan).

M6 - For the Water Abstraction and Treatment Plants produce a Landscape Management Plan for the Construction and Operational Phases which will minimize landscape impacts and to retain as much of the original landscape character as possible, including retention of mature baobab trees. Additionally, new landscaping will reflect native species and be harmonious with the surrounding natural landscape. The Plan should contain measures for maintaining and developing the living landscape and to monitor its implementation through regular review.

M7 - Although the extensive primary and secondary pipeline infrastructure required for the project is intended to be buried, there may be arise visual and landscape impacts, especially if security fences are erected to protect the pipeline route. At the stage of detailed project planning of the exact pipeline route, landscape and visual impact should be taken into account, and mitigations employed as necessary to minimize impact. All pipe burial should be made good after the pipeline is laid, and the former landscape value restored as fully as possible.

M8 – As much native vegetation to be retained as possible, and especially mature baobab trees.

M9 – Plant species selected for landscaping should be selected to mitigate for loss of native vegetation during construction, and should be species native to Angola and be of local provenance to the Luanda Region.

V.1.10 Socio-Economics

M1 - Promote actions of environmental training/awareness of the different intervening parts in the execution of construction works, focused on good environmental practices and the application of the set minimization measures.

M2 - Find parks and yards of material along the intervention areas and in locations easily accessible, properly sealed and safety signs properly placed.

M3 - The expropriating owners should be advised of the date they start work.

M4 - In order to minimize potential allocations, interventions should be phased, making the conclusion of the works progressively. This is particularly important along the way where the pipes will be installed, so that you can resume normal daily life of the people, since the progressively covering the ditches of the pipelines as soon as they are installed will limit spatially the allocation of mobility and will also limit interventions temporally.

M5 - Any temporary interruption of roads, paths and roads should be kept to the minimum possible period, priority should be given to reestablishment of passages and secured provisional connections, thus limiting the inconvenience to the local population.

M6 - The works, if possible, should be limited to daytime, so as to avoid disturbing the resting period of the inhabitants of the buildings in the vicinity of the works ,particularly along the routes used for installation of pipelines.

M7 - The possible use of explosives in open ditches of the pipelines and foundations at the site of capture and WTP should be done using microretarders to reduce the magnitude of the impact on the population, and warning signs should be used.

M8 - In order to minimize inconvenience during the construction phase and identified in the chapter of prediction of environmental impacts, the works should be properly identified, being careful to point out the presence of heavy vehicles used to works on roads to use, by appropriate signs indicating, where possible, the period for which the work will run.

M9 - Indications should be given to the staff assigned to work, towards full compliance of traffic rules, and limiting the beeps in the locations and/or crossed neighborhoods. The movement of vehicles assigned to work with the average headlights on during the day should also be recommended. This will reduce the possibility of accidents occurring in the localities traversed, and in the ways of communication that are used, limiting, at the same time, the disruption of daily life of the inhabitants of these localities and places.

M10 - In the vicinity and accesses of some Distribution Centers are schools, particularly in Kapalanga DC, in the New Airport DC and km 30 DC, so that security measures should be redoubled in traffic, opening ditches and other works that may threaten the safety of children in particular, and the population in general.

M11 - In order to prevent accidents due to fall of persons, especially children or animals to the ditches, the continuity of seals along the paths of service as well as in the passages of restatements of streets should be ensured.

M12 - The promotion of some public sessions advertizing the Project to the Communes would beneficial, because they would keep the population informed about the interventions, constituting an important step to better assimilation and acceptance of the Project by the population.

M13 - Realizing that is likely that the poor housing made of sheet of the km 30 DC will be affected, it is considered important that the process of acquisition of housing is initially earlier, or any other buildings, even if not intended for habitation and that can be compromised in normal use.

M14 - Realizing that the two cassava plantations and baobabs on the ground of the New Airport DC and Cacuaco DC will probably be affected, timely knowledge of the expected start of the work should be given to those who exploit the land, to see the possibility of reconciliation of work with the cycle of harvesting.

M15 - The project should promote the provision of drinking water to the population in the area surrounding the capture and WTP, which are not covered by any distribution center.

M16 – Utilise the preliminary and final results of the Angola Census 2014, as soon as they are released, to update, complement and modify the analysis done in this ESIS. This will allow for better characterising the baseline assessment of affected communities.

M17 - Following the Stakeholder and Public consultations, update accordingly the Environmental and Social Management Plan (ESMP).

M18 – A feedback mechanism should be created, so that any issues raised from PAP of vulnerable groups are properly identified and addressed. Special attention should be given to vulnerable persons as appropriate.

M19 – A feedback procedure should be drafted and made available at local community centres and service points.

M20 – A grievance mechanism should be drafted and implemented, in order to efficiently deal with potential community complaints that could be generated by the project, mindful of gender-based mitigation measures to be developed whenever necessary.

M21 – Any potential conflicts with or previously unidentified sensitive or indigenous communities should be assessed and addressed according to the IFC performance standards.

M22 – Even though there are no foreseen evictions, if any do take place, they should be done in a civil manner, providing proper compensation to the PAP and resettling them, where and when appropriate.

M23 – Any works or intervention in areas that haven't been previously demined should be preceded of a demining campaign and a sensitising and outreach campaign should be done in the areas of intervention of the Project.

M24 - The results of this ESIS and a Non-Technical Summary of it should be widely made available to the general public and all the stakeholders identified in the Project.

V.1.11 Heritage

M1 - In light of the work of excavation and earthmoving provided, we advocate the implementation of archaeological monitoring, applicable exclusively to the works of opening ditches and earthworks, required for the implementation of linear and nonlinear structures of the project. The results of the works of archaeological monitoring will have to be poured into the final report to be delivered to the Owner of Work. The archaeologist must have five years or more of proved experience in coordination of public works.

M2 - Definition of a monitoring plan/archaeological monitoring phases for earthmoving, in areas not intervened in this implementation project.

M3 – Utilise the preliminary and final results of the Angola Census 2014, as soon as they are released, to complement and modify the analysis done in this ESIS. This may allow to better target any communities that haven't been interviewed/consulted.

M4 – There is a baobab tree in the Bairro Augusto neighbourhood next to which women wait for their husbands when they go fishing (interview with Bom Jesus's Assistant Communal Administrato). It is strongly advised that this tree is mapped and preserved.

M5 – Chance Find Procedure, whereby if an object or artifact is discovered during excavations, excavtaions will cease and a nominated and qualified person will be contacted and their counsel sought.

V.2 EXPLORATION PHASE

V.2.1 Geology

M1 - Ensuring the existence of a waste management system that ensures the correct routing of the same to duly licensed and/or authorized areas to receive the type of waste generated by the normal operation of the drinking water supply system.

V.2.2 Water Resources

M1 - Leakage monitoring network should be implemented in the extensive network of adduction, for the rapid identification and correction of any significant loss of water.

M2 - It should be ensured proper operation of wastewater treatment, with maintenance and periodic monitoring systems.

V.2.3 Acoustic Environment

M1 - Setting speed limits of 50 km/h within the premises of the project, minimizing the associated circulating road traffic emissions.

M2 - Performing actions to raise awareness among drivers pertaining to the unit vehicles, especially heavy vehicles, to reduce the speed of traffic on the public roads leading to the project, in order to reduce the impacts in these pathways and the sound emission of these vehicles

M3 - Throughout the construction of new roads or improvements of roads, for creating accessibility to the project, the use of porous pavement, with characteristics of sound absorption is recommended.

M4 - Carrying out maintenance and periodic review of all equipment to perform the installations, as well as all vehicles and machinery allocated to industrial units.

M5 - With a view to the proper monitoring of the evolution of the sound environment throughout the development of the project, it is proposed to comply with the monitoring plan defined, in order to timely identify any instance of noncompliance, and the definition of new measures to minimize accordingly.

M6 - performing an acoustic containment of the equipment of Kapalanga DC through its proper encapsulation, this confinement which should ensure minimal noise reduction of 5 dB (A), so as to avoid any acoustic increment compared to baseline. In the case of technical failure of the acoustic enclosure, the installation of elements for reducing noise propagating between the unit and surrounding the respective receivers is recommended, such as acoustic absorption or other barrier that ensures this reduction.

V.2.4 Waste

M1 - Feasibility study for the construction of a landfill for disposal of sludge resulting from the treatment process WTP, given that it is a waste that will be produced throughout the lifetime of System 5 - Quilonga Grande. This solution can be used for the deposition of industrial waste produced by plants growing in the area of insertion of the project, particularly in the Exclusive Economic Zone (EEZ), and to minimize the impact of transport to the Mulenvos Landfill;

M2 - Development of a Waste Management Plan (WMP) in compliance with the legislation in force;

M3 - Creating a park for temporary waste storage, with sealed soil, spill containment system and installation of containers marked with the name and LAR of the waste;

M4 - Sending waste to authorized destinations and Valuation operations at the expense of disposal;

M5 - Implement practices to reduce waste production and internal reuse of the same, such as, for example, the composting of green waste and land maintenance garden areas;
M6 - The waste such as lubricants, oils, fuels and other waste deemed hazardous must be handled and packed cautiously, to avoid spillage;
M7 - Awareness and periodic training of employees of the intake, WTP and Sludge Treatment and Distribution Centers Station for proper sorting and packaging waste;

V.2.5 Air Quality

M1 - Opt for energy-efficient equipment, i.e., with low fuel consumption and emission rates;

M2 - Ensure periodic maintenance of all fixed and mobile devices, in particular the generator groups;

M3 - As a compensatory measure, the road section of Bom Jesus that makes the connection between the water intake the WTP should be paved or improved and should be cleaned regularly and the verges, in order to reduce the resuspension of particles;

M4 - Circulation of vehicles that transport sludge at low speeds in order to reduce the spread of dust and the emission of pollutants resulting from fuel combustion;

V.2.6 Ecological Factors

M1 - Reduce artificial lighting of the enterprise, the capture of the lights of discrete presence and placed in strategic locations from a standpoint of rational energy management, but also to minimize the light pollution of the surrounding areas.
M2 - Mechanisms of environmental awareness of the employees of the future complex supply should be created, noting that the ecological importance of the region should promote nature conservation;
M3 - For the Operational Phase, establish an Environmental Management System for built facilities and pipeline route, which should include the protection of the aquatic and terrestrial environment by preventing and minimizing polluting or damaging activities, whilst also providing ecological enhancements through landscaping and wider community initiatives.
M4 - an awareness campaign should be made, for example through leaflets and public actions in local communities of Bom Jesus, which promote the circulation at low speed of motor boats in the Kwanza river, and that concern the conservation importance of the African Manatee by correcting the existing misinformation.
M5 - It is further proposed that as Measure of Compensatory of the verified impacts on biodiversity in the region is subject to industrial expansion for the lagoon/marshland area at east of Bom Jesus, as well as the proliferation of water intakes in the area. This measure will also serve to protect the water quality capture from Quilonga Grande itself and riverside area of the North Quiçama National Park.

V.2.7 Landscape

M1 - The landscape design for the intervention areas, in particular of the intake, WTP, using the planting of native species to restore the natural quality of the landscape and create a zone of visual "cushioning";

M2 - Paintings of the water towers of all Distribution Centres with colours/shades that predominate in the landscape, in order to reduce the visual impact of a structure of high dimension.

M3 - Ensure that lighting at the Water Abstraction and Treatment Plants is minimized and is designed to reduce light pollution at night.

V.2.8 Socio-Economics

M1 – Utilise the preliminary and final results of the Angola Census 2014, as soon as they are released, to complement and modify the analysis done in this ESIS. This will allow filling most of the gaps in them and changing any forecasts or analysis. It may be of particular influence in identifying target future employees and recruitment campaigns.

M2 - A separate water supply distribution line as well as fountains should be supplied to the local neighbourhoods directly impacted by the project.

M3 – Disruption to fishing activities should be minimized from May to July near the intake area during yearly maintenance activities, for the peak of the fishing season.

M4 – A grievance mechanism should be drafted in order to efficiently deal with potential community complaints that could potentially be generated by the project.

M5 – There should be a follow-up and progress report to the recommendations produced in this ESIS, or else the likelihood of the recommendations being implemented is greatly reduced.

M6 – Assess the impacts and results of mitigation and enhancement measures during the construction phase and verify is there is the need to change or implement any measures.

M7 – Impact mitigation and enhancement measures that are undertaken by the Client on the operational phase should also be communicated to all the stakeholders in the Project.

V.2.9 Heritage

M1 - Utilise the preliminary and final results of the Angola Census 2014, as soon as they are released, to complement and modify the analysis done in this ESIS. Any significant chances or new data identified should be incorporated in a revision of this ESIS, addressed and its impacts mitigated or enhanced.

M2 – Assess the impacts and results of mitigation and enhancement measures during the construction phase and verify is there is the need to change or implement any measure.

VI. Monitoring Plans

The integration and analysis of information collected in the monitoring of various environmental parameters will, in future, achieve objectives that fall within a policy for preventing and reducing the negative impacts caused by the development of the various project activities.

In this sense, the underlying realization of a Monitoring Plan objectives are, in order of priority and importance, the following:

- Evaluate and confirm the impact of the exploitation of the Supply System on the parameters monitored, both in terms of the predictions made in the ESIS, as in compliance with the legislation in force;
- Check the efficiency of the measures taken to minimize impacts;
- Assess the eventual need for application of new mitigation measures in relation to some environmental aspects (if the one proposed initially is not sufficient);

With the implementation in the field of PM is intended, in a systematic way, to ensure the continued collection of information on the evolution of certain environmental variables, including Water Resources, Ecological Factors, Noise, Waste, i.e., the variables that most important assume the level of incidence of impacts on the project at hand.

The results of Monitoring Plans should be computerized in a database, which enables the monitoring of the evolution of the parameters over time.

VI.1. WATER RESOURCES

Regarding Water Quality component is proposed for the Exploration Phase of Supply the following system-monitoring plan:

ENVIRONMENTAL DESCRIPTOR	PARAMETERS TO BE ASSESSED	SAMPLING SITE	SAMPLING FREQUENCY AND PERIOD
Surface water quality	Electrical conductivity; pH; TSS or turbidity, Color, Odor, Water temperature, BOD_5, COD, Sulphates, Nitrates, Aluminium, Ammonia Nitrogen, Total Iron, Total Manganese, Total Cadmium, Arsenic, Total Mercury, Nickel, Lead Cyanide	Water sampling	Quarterly

ENVIRONMENTAL DESCRIPTOR	PARAMETERS TO BE ASSESSED	SAMPLING SITE	SAMPLING FREQUENCY AND PERIOD
Surface water quality	Electrical conductivity; pH; TSS or turbidity, Color, Odor, Water temperature, BOD_5, COD, Sulphates, Nitrates, Aluminium, Ammonia Nitrogen, Total Iron, Total Manganese, Total Cadmium, Arsenic, Total Mercury, Nickel, Lead Cyanide	Place of discharge of liquid eluents WTP	Quarterly

VI.2. ECOLOGICAL FACTORS

At this stage and given that the data available on the project is still at the preliminary study stage (Preliminary Draft), also existing project details to be adjusted for the main conclusions/recommendations of this Environmental Impact Study; it is recommended the execution of a revaluation of land relative to this descriptor, after the start of the work, allowing assessment of the effectiveness of mitigation measures proposed and the definition of new work for the stage, or exploitation, if this happen to be applicable.

VI.3. NOISE

VI.3.1. Introduction

During the construction and operation of the project is expected to occur environmental impacts, from the noise environment descriptor, generated by activities associated with each phase level.

The main actions which may impact this descriptor, in the construction phase, are land clearing, stripping, excavating and earthmoving. The movement of machinery and equipment as well as installation of the dockyard can also be regarded as activities that could cause impacts.

With regards to the exploitation phase, the operation of all equipment associated with the units to install, as well as the circulation of the draft affects vehicles, are also likely to introduce noise impacts on the environment of the surrounding populations.

Thus, a Mo nitoring program of Sound Environment should be implemented, in order to verify the compliance of the project with IFC proposed requirements and ensure the monitoring and control of environmental impacts expected at the descriptor level soundstage.

VI.3.2. Objectives

The implementation of this Monitoring Plan lies in the need to check the sound levels in the area where the project fits, as well as the assessment of discomfort in your surroundings, in the phases of construction and operation.

Given the stated objectives, the Monitoring Plan shall:

- allow to evaluate and confirm the effectiveness of measures to minimize the negative impacts foreseen;
- detect the existence of anomalies compared to the IFC benchmarks considered;
- equate the need to implement other measures and corrective actions,
- verify predictions made of the sound environment and evolution,
- get additional information, to be used in the reassessment of the impacts and the redefinition of mitigating measures proposed.

It is intended, therefore, in this monitoring plan, to identify monitoring locations, sampling frequency, set the necessary means, among other elements, that allow assessment of the noise environment in the surrounding areas of the project, in its phases of construction and operation.

VI.3.3. Parameters to be monitored

A) <u>Construction Phase</u>

During the construction phase, monitoring will consist of the *in situ* measurement, along the sensitive receptors, the values of the equivalent sound level (L_{Aeq}) in the evening period (20h00 - 23h00) and evening (23:00 - 7:00 a.m.) for activities deemed noisier .
It is not considered meaningful the development of measurements if the activities take place only during daytime.

B) <u>Exploration Phase</u>

The monitoring campaigns to be performed in the exploration phase, will consist of the *in situ* measurement of environmental values of the equivalent sound level (L_{Aeq}) (with the activities taking place), in the three reference periods (daytime (7:00 a.m. - 19:00), evening (19h00 - 23h00) and evening (23:00 - 7:00 a.m.)), with subsequent calculation of benchmark L_{den}.

VI.3.4. Sampling Frequency and Locations

Sampling locations

The locations where the monitoring should be carried out, correspond to the receptor sites considered for the acoustic modelling performed in the present study.

The measurement points are marked in Figure 150.

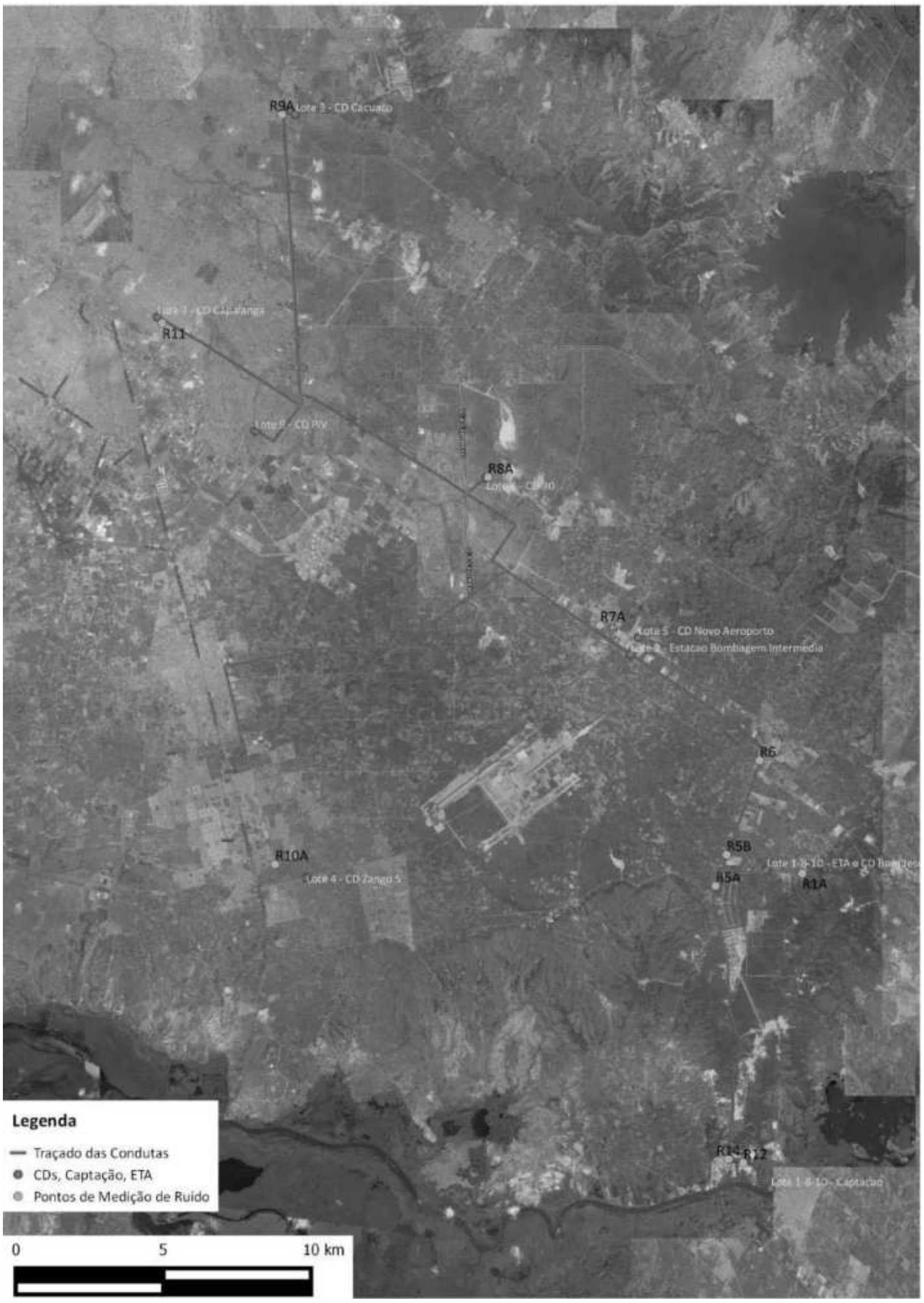


Figure 150 - Noise Measurement Points to consider

In the case of verifying the existence of additional receptors with sensitive uses near the project areas, on the day of monitoring campaigns, or in the event of complaints surrounding, these will also be covered, the respective measurements of noise being made.

Sampling frequency

A) Construction Phase

Checking the sound levels emitted during the construction phase should be performed during the noisiest activities considered, namely, land ing, stripping, excavating and earthmoving.
We propose a semiannual periodicity for this assessment.

B) B) Exploration Phase

After implantation and early operation of the project, it is sufficient to carry out environmental noise measurement campaigns each five years, beginning in the 1st year of operation. This frequency should be reduced if significant changes in the factors that determine the emission of noise, such as the implementation of measures to minimize or change in activities with noise, determinants, at least increases of 2 dB (A) at the receiver. The occurrence of complaints from nearby populations to activities relating to audible impact thereof should also induce the completion of a measurement campaign at these locations.
In case of any prior complaint, testing should occur in operating conditions that the claimant identifies as being the source of discomfort.

VI.3.5. Technical, Analysis Methods and Equipment Needed

The monitoring will be carried through *in situ* measurements, which correspond to a direct monitoring by sampling in space and discrete in time.
The team responsible for monitoring should be made by properly trained and experienced technicians.

Monitoring the soundstage will be performed following the method described in international standards considered most appropriate:

- ISO 1996-1: 2003 - Acoustics - Description, measurement and assessment of environmental noise - Part 1: Basic quantities and assessment procedures
- ISO 1996-2: 2007: - Acoustics — Description, measurement and assessment of environmental noise — Part 2: Determination of environmental noise levels

The time intervals of sampling should ensure stationary signal and statistical representation of the records relating to the entire duration of the reference range.

During the measurements traffic counts (number of light and heavy vehicles) will be made as well as the lifting of other noise sources likely to exist on site at the time of the measurements.

Equipment (SLM - Sound Level Meters) should be used in monitoring and they must be Integrator type Class 2.

The data should be done with the utmost accuracy and expeditiously, based on the applicable standards, to provide reliable, credible and results correlated with the features that are to be observed.

The data should also provide results that enable sustained draw conclusions and, if necessary, define corrective and/or complementary measures.

Data analysis and preparation of specific reports should be prepared by skilled technicians.

According to the phase in question, the assessment consists of the following:

A) Construction Phase

The periods of the acoustic assessment will be the evening (19h00 - 23h00) and night (23:00 - 7:00 a.m.).

In the construction phase the values of the indicator L are determined $_{Aeq}$ (equivalent sound level) from exterior ambient noise.

For the assessment of results, and in the absence of applicable national legislation, it is considered, for the purposes of assessment of disturbance, the use of Portuguese legislative referential, including those set out in the General Regulation on Noise, notably those defined in section 5 of Article 15, i.e., the limits of 60 dB(A) during the evening and 55 dB(A) at night time.

For purposes of checking the limit values, the L_{Aeq} indicator refers to one day for the period in question.

B) Exploration Phase

In the exploration phase, the periods of the acoustic assessment will be the evening (19h00 - 23h00) and night (23:00 - 7:00 a.m.).

From the *in situ* measurement of residual values and environmental equivalent sound level (L_{Aeq}), in the three reference periods shall be determined the following parameters:

- Indicator of daytime, evening and night-time noise (Lden): Noise indicator, expressed in dB(A), associated with global disturbance, given by the expression:

$$L_{den} = 10 \times \log \frac{1}{24}\left[12 \times 10^{\frac{Ld}{10}} + 4 \times 10^{\frac{le+5}{10}} + 8 \times 10^{\frac{Ln+10}{10}}\right]$$

- Day-noise indicator (L_d) or (L_{day}): average sound level of long duration, determined during a series of representative day periods of a year.
  - Evening-noise indicator (L_d) or (L_{day}): average sound level of long duration, determined during a series of representative day periods of a year.
  - Night-noise indicator (L_d) or (L_{day}): average sound level of long duration, determined during a series of representative day periods of a year.

Indicators for day-evening-night noise (L_{den}) and night-time noise (Ln) are calibrated against the IFC references defined in "Environmental, Health, and Safety (EHS) Guidelines - Noise Management" from IFC-World Bank, as shown in the following table.

Table 61 - Limit values of table 1.7.1 of IFC EHS Guidelines

Receptor Type		**Values of LAeq**	
		Daytime (Considered to evaluate Lden)	Night (Considered to evaluate Lnight)
Sensitive (S)	Residential, institutional, educational	55	45
Not sensitive (NS)	Industrial, commercial	70	70

Also, during measurements, the compliance of the reference directions with respect to the increase introduced when compared with the existing reference values should be measured, in particular a limit of 3 dB(A) increase.

VI.3.6. Type of Environmental Management Measures to be Adopted Following the Results of Monitoring Programs

If it is found that the results obtained from monitoring are not in accordance with the considered limits, complementary minimization measures, as well as the review of the monitoring program, should be addressed.

VI.3.7. Frequency of Monitoring Reports and Criteria for Decision on the Review of the Monitoring Programme

After each monitoring campaign (up to 30 days), a Monitoring Report (MR) will be produced.

For the aforementioned report, the following structure is proposed:

I - Introduction:

a) Identification and monitoring objectives, subject of RM;

b) Scope of RM;

c) Framework;

d) Presentation of the report structure;

e) Technical authoring the report.

II - Background:

a) Reference to the environmental impact Assessment Process;

b) Reference to the adoption of measures to prevent or reduce the monitored impacts;

c) Reference to any complaints about the sound environment.

III - Description of monitoring programs:

a) Parameters to be measured or registered. Sampling locations, measurement or recording;

b) Collection and data processing equipment and methods;

c) Criteria for evaluating data.

IV - Results of monitoring programs:

a) Obtained results;

b) Discussion, interpretation and evaluation of results achieved against the criteria;

c) Evaluation of the effectiveness of mitigation measures adopted;

V - Conclusions:

a) Summary of the impact assessment monitored and the effectiveness of measures taken to prevent or reduce the monitored impacts;

b) Proposed new mitigation measures and or alteration or deactivation of measures already taken;

c) Proposal for revision of the monitoring and reporting of the frequency of future monitoring programs.

The Monitoring Plan may be revised, to a greater or lesser extent, depending on the results obtained in measurement campaigns and described in the Monitoring Reports.

VI.4. WASTE

It is proposed a monthly monitoring of the Waste Management Plan, so as to verify compliance and the need for adjustments/improvements, depending on the progress of the project, which should include the monthly quantify residues produced in industrial. This control should be conducted to provide the implementation of mitigation measures and selection of alternative treatments to deposition, namely the internal reuse.

VII. Environmental and Social Managment Plan (ESMP)

VII.1. PREAMBLE

The role of the Environmental and Social Management Plan (ESMP) process is to identify the impacts which may be caused by the project and to develop a series of attenuating or mitigating measures which will be technically appropriate, financially acceptable and easily applicable in the context of the project. These measures are identified at the stage of the environmental impact assessment. The role of the ESMP is to complement this analysis by defining the operational context in which these measures will be implemented.

The present chapter sets out the principles, the approach, the procedures and methods which will be applied to monitor and reduce the environmental and social impacts resulting from the construction works and subsequent operation of the Project.

To this effect, the ESMP includes two Phases:

- The Construction Phase
- The Operational Phase

VII.2. SUMMARY OF POTENTIAL IMPACTS AND MITIGATION MEASURES AND ENVIRONMENTAL MONITORING

The potential impacts and corresponding mitigation measures which are included in the Environmental and Social Management Plan are summarised below.

VII.3. ENVIRONMENTAL MONITORING

Environmental monitoring is set out in the Monitoring Plan in the ESIS document.

Table 62 -63 Summary of Environmental and Social Management Plan

Activity		Issues/Potential Impacts	Summary of assessments of these issues/impacts	Mitigation Measures	Responsibility
Construction phase					
Air quality	• Construction works, earthmoving, traffic	• Air emission from vegetation removal • Earthmovings and circulation of heavy vehicles	• Changes in the quality of the air due to atmospheric emissions (particles) • Decrease uptake ability of atmospheric CO_2.	Cover truck loads of particulate material, such as soil, to avoid dispersion of particles during transportation.	Contractor
				Moisten, during dry weather, any piles of particulate matter, in order to prevent the re-suspension of dust.	
				Implement a maintenance and periodic review of fixed and mobile equipment, in order to maintain normal operating conditions and minimize the emissions air pollutants.	Contractor
				Whenever the crossing of inhabited areas is unavoidable, the circulation of trucks must be done at moderate speed (30 km/h), so as to minimize the emission of dust and gases.	Contractor
				Promote the optimization of the routes of machines circulation, to prevent excessive emissions of pollutants.	Contractor
Landscape	• Construction activities in general	• Construction site footprint (construction of building in height) • Physical presence of construction vehicles and manpower • Earthmovings	• Decrease visual quality due to stripping and leveling of the land, with the consequent removal of vegetation. • Increased fragility of the landscape resulting from excavations and the installation of construction site areas. • Changing the natural contours of the landscape through excavations and earthworks.	Develop a Landscape Plan Integration (LIP) in the dockyard areas and subject to earthworks, comprising unpacking, aeration and soil renaturalisation completing the planting of native plant species.	Client
				Landscaping recovery of all areas of the dockyard and accesses created during the construction phase, by replacement of the initial land use.	Supervised by Client
				All waste to be packaged in appropriate containers, and later sent to authorized undertakings in order to reduce their visual impact (see also waste	Contractor

Activity		Issues/Potential Impacts	Summary of assessments of these issues/impacts	Mitigation Measures	Responsibility
				management).	
				Prior to the work of land clearing and stripping, the delimitation of the area of intervention should be making, in order not to make unnecessary interventions in other areas.	Contractor
				Conducting periodic watering in the main routes of trucks movement in order to reduce dust and minimize the effects on the landscape.	Contractor
				Ensure that all temporary landscape impacts are made good before the Operational Phase, including removal of all construction equipment, waste, stockpiles material and obstructions (see also Waste Management Plan).	Supervised by Client
				For the Water Abstraction and Treatment Plants produce a Landscape Management Plan, which will minimize landscape impacts and to retain as much of the original landscape character as possible, including retention of mature baobab trees. Additionally, new landscaping will reflect native species and be harmonious with the surrounding natural landscape. The Plan should contain measures for maintaining and developing the living landscape and to monitor its implementation through regular review.	Supervised by Client
				Produce a Waste Management Plan to delineate any dump site areas during construction	Client
				Set vehicular access to minimize impacts.	Contractor
Quality of soil	• Construction activities in general	• Soil contamination and topsoil removal • Excavations of foundations	• Production of packaging waste and maintenance of equipment and USW (Urban Solid Waste) • Decrease on the most fertile portion of the soil • Land use with agricultural suitability	Develop and implement a Waste Management Plan to include soil usage	Client

Activity		Issues/Potential Impacts	Summary of assessments of these issues/impacts	Mitigation Measures	Responsibility
				Temporarily package the residues in the construction yard in a sealed, waterproof area, with easy access.	Contractor
				Proceed to stripping topsoil and its storage in ''pargas'' for future use in landscaping, prior to the execution of the works of earthmoving.	Contractor
				Whenever there is a need for backfill, utilize the materials from excavations, hereby minimizing the quantities of surplus land (to transport outside the areas being intervened)	Contractor
				If it is necessary to import soil, assure that it contains no exotic/weed species	Contractor
				Accidental spills of hydrocarbons, oils and/or other lubricants should be minimized by both the proper and safe storing of these substances, and by handling them with qualified personnel, aware of environmental matters.	Contractor
Quality of water	• Discharge of wastewater	• Contamination of water resources • Extraction of water from the Kwanza River • Changes on the depth of the water table (with induced lowering of the water table)	• Production of non-hazardous waste • Production of hazardous waste	A temporary drainage system should be built, next to the construction yards and the area surrounding the area to intervene for the construction of the intake plant and WTP. This system, if appropriate, should include settling basins.	Contractor
				Proper operation of the wastewater treatment systems should be guaranteed, with maintenance and periodic monitoring.	Contractor
				Ensure regular monitoring in the extensive supply network, for the rapid identification and correction of any significant loss of water.	Operator

Activity		Issues/Potential Impacts	Summary of assessments of these issues/impacts	Mitigation Measures	Responsibility
Fauna & Flora	• Vehicle traffic • Noise • Artificial lighting	• Deforestation and clearing of vegetation. • Direct destruction of vegetation: habitat loss. • Exclusion effect on fauna may result from land clearing and stripping. • Increase of the sound levels incident on the surrounding sensitive receivers: exclusion effect on the fauna. • Implementation of permanent structures and occupation of property (construction yards).	• Direct destruction of flora species due to the removing groundcover, deforestation and stripping • Indirect impacts due to the deposition of dust. • Loss of habitat and fragmentation effect due to the construction of buildings, along with the creation of impermeable areas. The impact will be permanent and irreversible, of immediate occurrence and on a local scale.	Perform actions to raise awareness among drivers of vehicles in the Project, especially heavy vehicles, to reduce the speed of traffic on the public roads leading to the project, in order to reduce the impacts in these pathways and the sound emission of these vehicles.	Contractor
				Reduce artificial lighting of the intake facilities to lights of discrete presence and placed in strategic locations from a standpoint of rational management of energy, and able to minimize light pollution over the surrounding areas.	Client
				Establishment of a specific Landscape Integration Plan (LIP) for associated buildings, through the planting of native plant species.	Client
				Promote environmental training/awareness during construction works, focused on good environmental practices and the application of minimization measures.	Supervised by Client
				Store and use construction materials to protect the local ecosystem.	Contractor
				Limit the actions of clearing, deforestation and blasting areas strictly necessary for the performance of the contract, which must be properly marked.	Contractor
				Retain especially mature baobab trees (Adansonia digitata) and other large trees and ensure protection during construction.	Supervised by Client
				Plant species selected for landscaping should be selected to mitigate for loss of native vegetation during construction, and should be species native to Angola and be of local provenance to the Luanda Region.	Supervised by Client

Activity		Issues/Potential Impacts	Summary of assessments of these issues/impacts	Mitigation Measures	Responsibility
				Implementation of a Construction Environmental Management Plan, which should contain measures to minimize impact on the aquatic and riparian ecosystem.	Supervised by Client
				As part of a Construction Environmental Management Plan (CEMP), include the provision for protection of the terrestrial natural environment.	Supervised by Client
				Do not use or damage ecologically sensitive areas during Construction	Supervised by Client
				Plant native vegetation to compensate for any losses.	Supervised by Client
				Protect vegetation, especially in dry weather periods and strong winds, to prevent the deposition on the vegetation by dust, using irrigation.	Contractor
				Plan pipeline routes to minimize impacts on flora and fauna.	Supervised by Client
				Consider the timing of activities generating clearing and disturbance to minimize impacts on the faunal breeding season (especially the months of November to March).	Supervised by Client
				Set a limit of 30 km/h in the worksite in order to reduce the incidence of wildlife roadkill and dust disturbance.	Contractor

Activity		Issues/Potential Impacts	Summary of assessments of these issues/impacts	Mitigation Measures	Responsibility
Socioeconomic	• Construction activities in general – Positive impacts	• Training and professional qualification • High value of the investment • Job creation	• Increase in labor supply to meet the increasing demand. • Increased rate of employed population, reduced unemployment, improved social and economic conditions of the population that is employed and their dependents.	Utilize the preliminary and final results of the Angola Census 2014, as soon as they are released, to update, complement and modify the analysis done in this ESIS. This will allow for better characterizing the baseline assessment of affected communities, along with allowing to better target any communities that haven't been interviewed/consulted	Supervised by Client
				Hire by preference local labour, subject to experience and qualification	Supervised by Client
	• Construction activities in general – Negative impacts	• Potential impact on agricultural crops. • Implantation of permanent structures and occupation of property (construction yards). • Disruption of living conditions in populated areas, next to the work fronts.	• Possible reduction on the access to local environmental resources (for instances, Cassava plantations on the terrains of the project) – possible conflict or resentment with the community.		
				Find construction yards and parks of materials near the intervention areas and in easily accessible locations, properly sealed and with safety signs properly placed.	Contractor

Activity		Issues/Potential Impacts	Summary of assessments of these issues/impacts	Mitigation Measures	Responsibility
		• Resettlements.	• Possible impact on the underground Archaeological Heritage. • Poor housing in a terrain of the project.	Promote actions of environmental training/awareness for the different intervening parties in the execution of construction works, focused on good environmental practices and on the application of the defined mitigation measures.	Supervised by Client
				In order to minimize potential impacts, the interventions should be phased, heading up progressively to the conclusion of the works. This is particularly important along the roads where the pipelines will be installed so that the populations can resume their normal daily life, because the progressively covering of the ditches of the pipelines as soon as they are installed spatially limits the mobility and that also temporally limits interventions.	Supervised by Client
				Any temporary interruption of roads, paths and tracks should be limited to the minimum period possible, and priority should be given to the reestablishment of passages and securing provisional connections, thus limiting the inconveniences caused to the local population.	Supervised by Client
				The works should be limited, if possible, to the daytime, in order to avoid disturbing the rest period of the inhabitants of the buildings in the vicinity of the works, particularly along the routes utilized for the installation of pipelines.	Supervised by Client
				The possible use of explosives in the pipelines open ditches and foundations at the intake site and WTP should be done using microretarders to reduce the magnitude of the impact on the population, and prior warning signs should be used.	Supervised by Client

Activity		Issues/Potential Impacts	Summary of assessments of these issues/impacts	Mitigation Measures	Responsibility
				Aiming at minimizing the disturbances that have been identified in the chapter of evaluation of environmental impacts, the works should be properly identified, signposting the presence of heavy vehicles from the construction works in the roads being used, through appropriate signage indicating, whenever possible, the period during which the works will take place.	Contractor
				Indications should be given to the staff assigned to the works to fully comply with traffic rules and limit the beeps in locations and/or neighborhoods being crossed. The movement of vehicles assigned to the works with the average headlights on is also recommended during the day. This will reduce the possibility of accidents occurring in the localities traversed, and in the traffic roads used, while limiting the disruption of the daily life of the inhabitants of these localities and places.	Contractor
				Following the Stakeholder and Public consultations, update accordingly the Environmental and Social Management Plan (ESMP).	Supervised by Client
				In the accesses and proximity of some Distribution Centers there are schools, namely in the Capalanga DC, New Airport DC and the DC of Km30, so the security measures in traffic, in the opening of ditches and other works that may threaten the safety of children in particular and the population in general, should be safeguarded.	Contractor
				In order to prevent accidents due to persons falling to the ditches, especially children or animals, the continuity of the fences along the service paths should be ensured, as well as in the passages of road restoration.	Contractor

Activity		Issues/Potential Impacts	Summary of assessments of these issues/impacts	Mitigation Measures	Responsibility
				The promotion of some public outreach sessions of the Project in the Municipalities would be beneficial because they would keep the population informed about the interventions, constituting an important step for the population to better assimilate and accept the Project.	Supervised by Client
				The project should promote the supply of drinking water to the population who is not covered by any Distribution Centre in the area surrounding the intake and the WTP.	Supervised by Client
				In light of the foreseen excavation and earthmoving works, the implementation of archaeological monitoring is recommended, this being applicable exclusively to the works of ditch opening and earthworks required for the implementation of linear and nonlinear structures of the Project. The end-result of the archaeological monitoring works will have to be presented in the final report to be delivered to the Client. The archaeologist must have proven experience of no less than five years in the coordination of public works.	Supervised by Client
				Definition of a monitoring plan/archaeological follow-up for the earthmoving phase, in areas not intervened by the Project.	Supervised by Client
				A feedback mechanism should be created, so that any issues raised from PAP of vulnerable groups are properly identified and addressed. Special attention should be given to vulnerable persons and gender issues.	Supervised by Client

Activity		Issues/Potential Impacts	Summary of assessments of these issues/impacts	Mitigation Measures	Responsibility
				A feedback procedure should be drafted and made available at local community centers and service points.	Supervised by Client
				A grievance mechanism should be drafted and implemented, in order to efficiently deal with potential community complaints that could be generated by the project.	Supervised by Client
				Even though there are no foreseen evictions, if any do take place, they should be done in a civil manner, providing proper compensation to the PAP and resettling them, where and when appropriate.	Supervised by Client
				Any works or intervention in areas that haven't been previously demined should be preceded of a demining campaign and a sensitizing and outreach campaign should be done in the areas of intervention of the Project.	Supervised by Client
				The results of this ESIS and a Non-Technical Summary of it should be widely made available to the general public and all the stakeholders identified in the Project.	Supervised by Client
				There is a baobab tree in the Bairro Augusto neighborhood next to which women wait for their husbands when they go fishing (interview with Bom Jesus's Assistant Communal Administrator). It is strongly advised that this tree is mapped and preserved.	Supervised by Client
				Chance Find Procedure, whereby if an object or artifact is discovered during excavations, excavations will cease and a nominated and qualified person will be contacted and their counsel sought.	Supervised by Client

Activity		Issues/Potential Impacts	Summary of assessments of these issues/impacts	Mitigation Measures	Responsibility
Operational phase					
Air quality	• Emission of particles and GHG emissions to the atmosphere	• Changes in the air quality	• Atmospheric emissions of greenhouse gases and particles: o Significant consumer of mains electricity currently estimated in terms of GHG emission of 62,266 tonnes CO_2e per year for the operation at 6 m3/s, rising to 92,975 tonnes CO_2e for the operation at 9 m^3/s. o The project is likely to exceed the EP threshold of 25,000 tonnes CO2e, for which companies are encouraged to report annually on emissions, and for which the International Finance Corporation (IFC) standards require reporting.	Monitor actual electricity consumption and other energy uses and report on an annual basis for energy consumption and CO2e per year.	Supervised by Client
				Monitor energy uses as accurately as possible in order to determine use inefficiencies and to reduce consumption linked to water production metrics.	Supervised by Client
				Opt for energy-efficient equipment, i.e., with low fuel consumption and emission rates.	Supervised by Client
Landscape	• Physical presence of the water treatment plant	• Decrease quality of the landscape due to the presence of elements foreign to the natural environment. • Artificial lighting	• New built environment infrastructure on previously natural landscape. • The seven Distribution Centers (DC) are likely to provide most landscape impact due to the height of the towers.	Establish an Environmental Management System for built facilities and pipeline route, which should include the protection of the aquatic and terrestrial environment by preventing and minimizing polluting or damaging activities, whilst also providing ecological enhancements through landscaping and wider community initiatives.	Supervised by Client
				The landscape design for the intervention areas, in particular of the intake, WTP, using the planting of native species to restore the natural quality of the landscape and create a zone of visual "cushioning".	Supervised by Client
				Paint the water towers of all Distribution Centers with colors/shades that predominate in the landscape, in order to reduce the visual impact of a structure of high dimension.	Supervised by Client

Activity		Issues/Potential Impacts	Summary of assessments of these issues/impacts	Mitigation Measures	Responsibility
				For the Water Abstraction and Treatment Plants produce a Landscape Management Plan, which will minimize landscape impacts and to retain as much of the original landscape character as possible, including retention of mature baobab trees. Additionally, new landscaping will reflect native species and be harmonious with the surrounding natural landscape. The Plan should contain measures for maintaining and developing the living landscape and to monitor its implementation through regular review.	Supervised by Client
				Ensure that lighting at the Water Abstraction and Treatment Plants is minimized and is designed to reduce light pollution at night.	Supervised by Client
				Support protection of the lagoon/marshland area at east of Bom Jesus.	Supervised by Client
Quality of soil	• Physical presence of the water treatment plant	• Contamination of soil	• Production of non-hazardous waste. • Production of hazardous waste. • Dumping of sludge issuing from the waste water treatment at the WTP.	Ensure the existence of a waste management system that guarantees the correct routing of residues to places that are duly licensed and/or authorized to receive the types of waste generated by the normal operation of the drinking water supply system.	Contractor
				Prepare the Residue Management Plan (Plano Gestão de Resíduo – PGR), in compliance with the legislation in force.	Supervised by Client
				Sent waste to authorized destinations and Recovery operations instead of elimination operations.	Contractor

Activity		Issues/Potential Impacts	Summary of assessments of these issues/impacts	Mitigation Measures	Responsibility
				Implement practices to reduce the production of residues and internally reuse them for, as an example, composting or maintenance of garden areas.	Supervised by Client
Fauna & Flora	• Increased vehicular traffic • Artificial lighting • Noise	• Increase of the sound levels incident on the surrounding sensitive receivers: exclusion effect on the fauna. • Implementation of permanent structures and occupation of property	• Impact on fauna and flora resulting from change in habitat.	Although the extensive primary and secondary pipeline infrastructure required for the project is intended to be buried, there may be arise visual and landscape impacts, especially if security fences are erected to protect the pipeline route. At the stage of detailed project planning of the exact pipeline route, landscape and visual impact should be taken into account, and mitigations employed as necessary to minimize impact. All pipe burial should be made good after the pipeline is laid, and the former landscape value restored as fully as possible.	Supervised by Client
				Manage artificial lighting to minimize the light pollution of the surrounding areas.	Supervised by Client
				Promote ecological awareness among employees.	Contractor
				Influence ecological awareness in local communities around Bom Jesus, by supporting campaigns such as the protection of the African Manatee from motor boats and other disturbing activities on the Kwanza River.	Supervised by Client
Socioeconomic	• Physical presence of the water treatment plant	• Strengthening the supply of drinking water for human consumption to the Eastern region of Luanda • Creation of companies in the area of marketing products	• Improved quality of life and greater provision of individual and collective needs of drinking water to the population.		

Activity		Issues/Potential Impacts	Summary of assessments of these issues/impacts	Mitigation Measures	Responsibility
		for water treatment and maintenance services • Marketing and sales of products and services for water treatment • Training and professional qualification • High value of the investment • Job creation	• Possibility of boosting economic activities and investment in sectors with specific water needs. • Improvement of sectors of business activity related to the sale and delivery of services for water treatment. • Increase in labor supply to meet the increasing demand. • Economy in general is benefitted with impact on local, regional, national and international spheres. • Increased rate of employed population, reduced unemployment, improved social and economic conditions of the population that is employed and their dependents.	Utilize the preliminary and final results of the Angola Census 2014, as soon as they are released, to complement and modify the analysis done in this ESIS. This will allow filling most of the gaps in them and changing any forecasts or analysis. It may be of particular influence in identifying target future employees and recruitment campaigns.	Supervised by Client
				Assess the impacts and results of mitigation and enhancement measures during the construction phase and verify is there is the need to change or implement any measure.	Supervised by Client
				A separate water supply distribution line as well as fountains should be supplied to the local neighborhoods directly impacted by the project.	Supervised by Client
				Disruption to fishing activities should be minimized from May to July near the intake area during yearly maintenance activities, for the peak of the fishing season.	Supervised by Client
				A grievance mechanism should be drafted in order to efficiently deal with potential community complaints that could potentially be generated by the project.	Supervised by Client

Activity		Issues/Potential Impacts	Summary of assessments of these issues/impacts	Mitigation Measures	Responsibility
				Assess the impacts and results of mitigation and enhancement measures during the construction phase and verify is there is the need to change or implement any measures.	Supervised by Client
				Impact mitigation and enhancement measures that are undertaken by the Client on the operational phase should also be communicated to all the stakeholders in the Project.	Supervised by Client
			• Ensuring water usage efficiency	Evaluate potential adverse effects of surface water withdrawal on the downstream withdrawal on the downstream ecosystems and use appropriate environmental flow assessment to determine acceptable withdrawal rates	Operator
			• Ensuring water usage efficiency	Design structures related to surface water withdrawal, including dams and water intake structures, to minimize impacts on aquatic life	Operator
			• Ensuring water usage efficiency	• Ensure construction meets applicable standards and industry practices; • Conduct regular inspection and maintenance; • Implement a leak detection and repair program (including records of past leaks and unaccounted-for water to identify potential problem areas); • Consider replacing mains with a history of leaks of with a greater potential for leaks because of their location, pressure stresses, and other risk factors.	Operator

Activity		Issues/Potential Impacts	Summary of assessments of these issues/impacts	Mitigation Measures	Responsibility
			• Solid Waste	Sludge treatment plant constructed according to Best Industry Practice and disposal according to Best Available Technology required for Angola	Operator
			• Community Health	Implement recommended measures to prevent or minimize potential community health risks associated with the water distribution system : Construct, operate, and manage the water distribution system in accordance with applicable national requirements and internationally accepted standards; Construct and maintain the distribution system so that it prevents external contamination from entering the water system by, for example: Inspecting storage facilities regularly, and rehabilitate or replace storage facilities when needed. This may include draining and removing sediments, applying rust proofing, and repairing structures: Ensuring that all installation, repair, replacement, and rehabilitation work conforms to requirements for sanitary protection and materials quality: Testing material, soil, and water quality and implementing best practices to prevent corrosion, such as cathodic protection.	Operator

Activity		Issues/Potential Impacts	Summary of assessments of these issues/impacts	Mitigation Measures	Responsibility
			• Community Health	Preventing cross-connections with sewerage systems: Separating water lines and sewer pressure mains): Maintain adequate water pressure and flow throughout the system, for example by: Implementing a leak detection and repair program: Reducing residence time in pipes Maintaining positive residual pressure of at least 20 pounds per square inch Monitoring hydraulic parameters, such as inflows, outflows, and water levels in all storage tanks, discharge flows and pressures, etc Prevent introduction of contamination from the distribution system. Minimizing microbial growth and biofilm development (e.g. by ensuring adequate residual disinfection levels). Collect samples from several locations throughout the distribution system, including the farthest point, and test for both free and combined chlorine residual to ensure that adequate chlorine residual is maintained. Choosing residual disinfectant (e.g. chlorine or chloramines) to balance control of pathogens and formation of potentially hazardous disinfection byproducts. Using construction materials hat do not contribute to release undesirable metals and other substance or interact with residual disinfectants.	Operator

Activity		Issues/Potential Impacts	Summary of assessments of these issues/impacts	Mitigation Measures	Responsibility
			• Cumulative Impact	The ESMP for this Project recommends that a Cumulative Assessment of total water abstraction requirements and provisions, together with impact on water quality from effluents and other sources is conducted during the first five years of Quilonga/Bita operation.	Operator

VIII. Environmental and social Assessment and Management System (ESMS)

Environmental and social management systems (ESMS) refer to the management of an organization's environmental and social programs in a comprehensive, systematic, planned and documented manner. It includes the organizational structure, planning and resources for developing, implementing and maintaining policy for environmental and social protection and enhancement.

More formally, EMS is "a system and database which integrates procedures and processes for training of personnel, monitoring, summarizing, and reporting of specialized environmental performance information to internal and external stakeholders of a firm."

EMS is typically reported using International Organization for Standardization (ISO) ISO 14001, and if compliant, an organisational EMS can be accredited under that standard.

VIII.1. BENEFITS OF AN ESMS

An ESMS can assist a company in the following ways:

- Serves as a tool, or process, to improve environmental performance and information mainly "design, pollution control and waste minimization, training, reporting to top management, and the setting of goals"
- Provides a systematic way of managing an organization’s environmental affairs
- Is the aspect of the organization’s overall management structure that addresses immediate and long-term impacts of its products, services and processes on the environment. The EMS assists with planning, controlling and monitoring policies in an organization.
- Gives order and consistency for organizations to address environmental concerns through the allocation of resources, assignment of responsibility and ongoing evaluation of practices, procedures and processes
- Creates environmental buy-in from management and employees and assigns accountability and responsibility.

- Sets framework for training to achieve objectives and desired performance
- Helps understand legislative requirements to better determine a product or service's impact, significance, priorities and objectives.
- Focuses on continual improvement of the system and a way to implement policies and objectives to meet a desired result. This also helps with reviewing and auditing the EMS to find future opportunities.
- Encourages contractors and suppliers to establish their own EMS

An ESMS can be a powerful tool for organizations to both improve their environmental performance, and enhance their business efficiency. An ESMS is not prescriptive; rather, it requires organizations to take an active role in examining their practices, and then determining how their impacts should best be managed. This approach encourages creative and relevant solutions from the organization itself.

Although the implementation of an ESMS is essentially a voluntary initiative, it can also become an effective tool for governments to protect the environment as it can assist regulation. For example, regulatory systems can encourage organizations to use ESMS to meet standards, by providing incentives for strong environmental performance.

Likewise, organizations can use ESMS to ensure that their performance is within regulatory requirements, and to keep ahead of more stringent regulations which might be introduced in the future.

VIII.2. MAIN STEPS TO DEVELOP AN ESMS

There are a number of steps that any organization may consider when investigating options and commencing the development of an EMS:

- Commence with a review of existing EMS ‘type’ structures and commitments within the organization (such as any existing Environmental policy commitment for the organization, documented procedures and responsibilities etc.).
- Investigate potential trends that effect the organization (or support the case for an EMS).
- Consider the main interests and stakeholders in the process (e.g. shareholders, customers, clients, regulators, and the public).
- Review the main options available for EMS certification and consider their suitability for your organization.

- Secure appropriate commitment at senior management level for EMS development (often this is an element within Phase 1 of the EMS but in practice there is usually an earlier commitment / agreement in principle made).

VIII.3. FRAMEWORK ENVIRONMENTAL AND SOCIAL MANAGEMENT SYSTEM OF QUILONGA GRANDE PROJECT

Policy	The Organization sets out at its highest level its commitment to Environmental and Social Management for its activities, and enshrines the main components of the ESMS in a short policy document which is available to all employees.
Identification of risks and impacts	The ESIS sets out the predicted risks and impacts prior to Construction; using these documents and an operational review, a list of significant impacts is set out and a hierarchy of importance for addressing them.
Management programs	For each issue, set out objectives and targets and assign responsibility. For Quilonga Grande, this should include as priority issues: • Energy and GHG • Water use efficiency • Pollution prevention to water, air and land • Ecology and Landscape • Community and other Stakeholders
Organizational capacity and competency	Sets out the way the organization functions with respect to Environmental and Social Aspects
Emergency preparedness and response	A written procedure is required and communicated to all employees, with adequate training and testing for those most responsible for dealing with emergencies, spillages and accidents.
Stakeholder engagement	A written programme of engagement with auditable results and review.
Monitoring and review	A defined audit and monitoring programme with assigned responsibilities. Review to take place with the involvement of the highest level of management, to assess progress and to strive for continual improvement by setting new priorities, objectives and targets.

IX. Information Gaps

In general terms, the main difficulties that the team faced in preparing the Environmental Impact Study is due to the fact that this study happens in the Ante-phase project, so there may be significant changes to the assumptions on which this study was based. We also mention the lack of bibliographic elements and specific descriptors for some environmental regulations.

Given the specificities of each descriptor, we show the gaps identified in each of them.

In the course of preparing the descriptor Ecological Factors, the following techniques and knowledge that not conditioned on environmental assessment of the implementation of this project were identified, if considered worthy of reference and which we list below.

The lack of basic data on population trends of various species of flora and fauna and therefore the absence of *Red Data Books* or specific legislation that assigns specific statutes of conservation to Angola, limits the comparison with statutes of global conservation (IUCN), which can be very fallible. Take for example a species that on continental level shows a status of *Least Concern,* may be in sharp decline in Angola.

Simultaneously, the lack of basic data conditions the identification of some plant and animal groups. There are no updated surveys to date of the different vegetation types in the country, an update of phytogeography maps and lists of species of potential occurrence in different plant communities, as well as all the associated taxonomy and nomenclature is required.

In terms of fauna, is also a need the basic characterization of population trends, but also the lifting of the constituent species of different groups. It should be noted that there are virtually no national data about species of reptiles, amphibians, bats and non-flying small mammals.

Finally it is also important to highlight the need for a national study to assess population trends and priority areas for the conservation of African Manatee.

The descriptor of Air Quality, the lack of monitoring data of air quality in the region under study, was a constraint, with respect to air emissions, allowing to quantify and qualify these emissions pollutants, present in the current situation.

The main information gaps in the descriptor Water Resources relate to the lack of hydrometric elements (flow) of the Kwanza River in the Bom Jesus area, as well as the lack of a comprehensive inventory of current and water intakes of Kwanza.

In descriptor Heritage informational gaps arise from constraints of prospecting field, associated with soil status, visibility and that are inherent in the very nature of the archaeological heritage, whose presence and importance is not always perceptible traces from the surface to the soil level. Therefore, it is noted that, in general visibility of the soils in the mapped area is reduced, with particular focus on the areas with vegetation. In this perspective, the measures to minimize here advocated would pass, as is usual in these situations, by the realization of new prospections during and after the work of land clearing, in order to bridge the existing gaps. This assertion is also valid for most areas expected to provide support to the work.

In preparing the descriptor Sound Environment, techniques and knowledge gaps were due to the lack of basic data relating to the equipment to be installed, the installation site and conditions thereof, as well as traffic associated with the installation, estimates were assumed for the same which may differ from the final solution adopted, although it is noteworthy that it was considered a conservative approach in modeling performed.

The lack of knowledge of the evolution, the acoustic level of the surrounding, led to assume, for the purposes of impact assessment, the maintainance of the values of situation existing reference. This is a conservative approach, since perspective is an increase in the values of residual noise due to the creation of new industries and the international airport, and so, a greater masking effect of the noise associated with the installation, nullifying their impact.

The lack of comprehensive topography of the region has also led to a further simplification of the terrain model adopted, although it considers that this does not affect the modeling performed.

In the course of preparing the descriptor Socio-economics, we have identified the following information gaps, each of which is to list.

The lack of data on demographic and social current and back to the four levels of base analysis considered: National, Province, District and Commune, conditions characterizing the current situation and trends of evolution of different indicators commonly used in this context.

The local, district and commune level, where it was felt the greatest difficulties to the characterization of population dynamics. Still, using interviews to local authorities we have managed to bridge some of these gaps, especially in the municipality of Bom Jesus.

The Gates of Provincial Governments still have little background information about the province and their communes.

Finally, it is also important to highlight the need to establish and make available as soon as possible data from Census of Population of the Republic of Angola, which is ongoing, as it is a precondition for closer characterization of demographic, social and economic reality of the element Angolan population.

X. Conclusions

This chapter sets out a summary of the most relevant findings throughout this report.

The main objectives of the Environmental Impact Study focused on identifying, predicting, evaluating, and especially preventing major environmental and socio-economic impacts induced by the implementation of the Project.

In this context, it is intended that the obtained results contribute to the definition preventing and minimizing necessary measures to avoid, minimize and/or compensate the resulting adverse effects. Similarly, the necessary actions in order to enhance the positive effects resulting from the implementation of the project were considered.

Thus, the ESIS looked beyond the description of the project essentially based on Preliminary project itself, the characterization of the reference situation and the identification and evaluation for the various descriptors considered, the main impacts arising from the construction and operation phases. Through the main actions of the project and the impacts that are inherent been defined and mitigating (in the case of negative impacts) and maximizing (for those identified positive impacts)measures been recommended, as well as proposed a Monitoring Plan for the environmental variables with higher incidence impacts.

Based on the studies and the results obtained it can be concluded that we are before a project that will result in positive and negative impacts. Specifing the analysis it appears that in the construction phase the negative impacts of high magnitude will occur, particularly in descriptors Heritage and Socio economy, attaching to the earthworks and foundations works. In the remaining descriptors, negative impacts are reduced to moderate magnitude and temporary in nature.

The negative socio-economic impacts level of greater magnitude are associated with the occupation of the property and alteration or inhibition of uses and the reduction or restriction of mobility of the population resulting from trenching and placement of security protection fences. These impacts are predict in the construction phase and will be mostly temporary.

In the exploration phase, the negative impacts occur in the descriptors Water Resources, Sound Environment, Landscape and Waste but have a reduced magnitude.

To emphasize, however, that currently there are already negative impacts in the project area, as this is an area with strong intervention for industrial purposes or housing.

It is noted that for the majority of considered identified negative impacts, effective and appropriate measures with a view to preventing and minimizing have been defined, highlighting that some of them were incorporated into the Ante-project (Draft).

Recommended measures highlight the Monitoring Plans of various environmental variables (Water Resources (water quality), Sound Environment, Waste and Ecological Factors) that will assess over time the meaning of environmental effects and, if necessary, allow strengthening and/or adoption of further concrete measures.

Through the analysis it is considered that the majority of impacts resulting from the project are amenable to prevention, control and mitigation.

In the case of the positive impacts that will occur mainly in the exploration phase, these are mainly associated with socio-economic aspects, with emphasis on improving the quality of life and greater satisfaction of individual and collective needs of drinking water to the people, and for boosting the economy in general.

During the construction phase of the project will be an increase in the construction sector with positive repercussions on employment at local and regional level.

Of note, the project Water Supply to Luanda - System 5 Quilonga Grande involves high investment of the Angolan State, which implies first and foremost benefits to the economy and will that the targets set are achieved through Governmental Programs and Strategies.

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XII. Attachments

ANEX 1

1. INTRODUÇÃO

O conjunto dos equipamentos presentes nas filas de água e ar está indicado neste documento. Diz respeito ao lote 1 de QUILONGA e inclui:

- A tomada de água
- A estação de bombagem de água bruta
- A rejeição de água bruta
- A estação de tratamento de água com um reservatório elevado de água
- O posto de bombagem de água tratada
- Os edifícios e as instalações auxiliares necessárias

As principais características técnicas destes equipamentos (especificações, materiais, ...) estão também descritas.

2. EQUIPAMENTOS

2.1. PRÉ-TRATAMENTO

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Válvulas para isolamento dos canais de gradagem	Válvula mural	1000 x 1400 mm Accionador manual Materiais : Quadro: Inox 304L Tampa: Inox 304L Parafusos: Inox 304L	P	12

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Grades grossas	Automático	Caudal unitário admissível: 3750 m^3/h Espaçamento : 30 mm Largura do canal : 1300 mm Motor : Potência instalada unitária: 1,5 kW Materiais : Chassis : Inox 304L Grade, peça em movimento, cobertura : Inox 304L Protecção catódica Acessórios : Chegada de água industrial e rampa de aspersão para lavagem	P	6
Grades finas	Automático	Caudal unitário admissível: 3750 m^3/h Espaçamento : 2 mm Largura do canal : 1300 mm Motor : Potência instalada unitária: 2,2 kW Materiais : Chassis : Inox 304L Grade, peça em movimento, cobertura integral: Inox 304L Protecção catódica Acessórios : Chegada de água industrial e rampa de aspersão para lavagem.	P	6

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Tapete de deslocação dos resíduos		Comprimento : 18 m Largura : 0,5 m <u>Motor</u> : Potência unitária instalada: 2,2 kW	P	2
Contentores de resíduos para o armazenamento da rejeição de gradagem	Ampliroll	Capacidade : 8 m^3	P	2

2.2. POSTO DE BOMAGEM DE ÁGUA BRUTA

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
BOMBAGEM DE ÁGUA BRUTA				
Bombas para rejeição das águas brutas	Bomba centrífuga de eixo vertical	Caudal unitário: 3750 m^3/h AMT : 136 m CA Potência unitária instalada: 2000 kW Materiais : Corpo : Ferro fundido Eixo : Inox Acessórios: Conjunto de torneiras de isolamento	P	6
Válvula de retenção	Válvula axial de discos concêntricos	Válvula pequena dimensão, com alta resposta dinâmica DN 800 PN 25 Materiais : Corpo : Inox Obturador: Poliuretano	P	6

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Válvulas de isolamento das bombas	Borboleta	DN 800 PN25 Accionador manual Materiais : Corpo e obturador : Ferro fundido revestido Junta : EPDM	P	6
Manutenção das bombas de água bruta	Ponte rolante dupla-viga	Capacidade : 10 T Alcance : 9 m Altura de elevação: 9 m Distância de deslocação : 40 m Carro : eléctrico Talha : eléctrica por cabo	P	1
Equipamento anti-golpe de aríete	Reservatório hidropneumático	Capacidade : 20 m^3 Pressão de serviço: 17 bars Pressão de pré-enchimento : 7 bars Material: aço pintado com certificação alimentar Acessórios : Conjunto de válvulas e de torneiras de isolamento Compressor de ar	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Sistema de ventilação do local de bombagem de água bruta	Ventilador helicoidal	Caudal unitário : 37500 m^3/h Potência unitária instalada: 7.5 kW Acessórios : Conjunto de válvulas e torneiras de isolamento	P	Conjunto
Conjunto de grelhas de ventilação		Materiais : Aço galvanizado	P	
REDES				
Equipamento anti-golpe de aríete	Reservatório hidráulico	Capacidade : 30 m^3 Pressão de serviço: 10 bars Pressão de pré-enchimento : 4 bars Material : Reservatório: aço pintado com certificação alimentar Câmara de ar :butil com certificação alimentar Acessórios : Câmara de ar substituível Válvulas e torneiras de isolamento	P	4
Ligação ao equipamento anti-golpe de Aríete	Tê	Dimensões: 1 entrada DN 1200 1 saída DN 600 1 Saída DN 1200 Material: Ferro fundido dúctil	P	4

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Ligação ao equipamento anti-golpe de aríete	Curva	Dimensões: Curvas de 90° DN600 Material: Ferro fundido dúctil	P	6
Válvulas de isolamento das linhas	Válvula borboleta	DN 1200 PN 16 Accionador manual Materiais : Corpo e obturador : Ferro fundido revestido Junta : EPDM Acessórios : Válvula de escorvagem DN200 Conjunto de válvulas e torneiras de isolamento	P	2
Válvulas de descarga de fundo da rede	Válvula borboleta	DN 200 PN 10 Accionador manual Materiais : Corpo e obturador : Ferro fundido revestido	P	2

2.3. CONDUTAS E CAIXAS DE VISITA

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Condutas de alimentação da estação de água potável de QUILONGA	Condutas de embocamento	DN 1200 aço	P	6500 m (2 x 3250m)
Peças especiais – Condutas de alimentação da estação de produção de água potável de QUILONGA	Conjunto de curvas	DN 1200 Curva 45° Junta: tubos soldados	P	Conjunto
Caixa para conduta DN1200 com 1 ventosa	Caixa subterrada	Peças especiais das condutas: DN 1200 Tê flangeado em aço Acessórios: Ventosa tripla função DN200 para água potável. Corpo em ferro fundido	P	2
Picagem para conduta DN 1200 com 1 descarga	Caixa subterrada	Peças especiais de condutas: DN 1200 Tê flangeado em aço Acessórios: Válvula subterrada DN 200 em ferro fundido Coluna de manobra para válvula	P	2

2.4. ENTRADA DE ESTAÇÃO

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Válvulas de isolamento da medição de débito	Válvula borboleta	DN 1200 PN 16 Accionador manual Materiais: Corpo e obturador em ferro fundido revestido	P	4
Válvulas de regulação de entrada de estação	Válvula de regulação	DN 1200 PN 16 Accionador eléctrico Materiais : Corpo e obturador em ferro fundido revestido	P	2

2.5. TRATAMENTO PRIMÁRIO – DECANTADOR LAMELAR (ACTIFLO)

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Válvulas de isolamento das linhas de tratamento primário	Válvula mural	1000 x 1000 mm Accionador manual Materiais : quadro : Inox 304L Tampa : Inox 304L Parafusos : Inox 304L	P	6
Válvulas bypass duma linha do tratamento primário	Válvula mural	1600 x 1600 mm Accionador manual Materiais : Quadro : Inox 304L Tampa : Inox 304L Parafusos : Inox 304L	P	4
COAGULAÇÃO				
Agitadores dos tanques de coagulação	Agitador vertical rápido	Potência unitária instalada : 9.5 kW Variador de velocidade mecânica Materiais : Eixo e pás em Inox 304L	P	6

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
INJECÇÃO				
Agitadores dos tanques de injecção	Agitador vertical rápido	Potência unitária instalada : 9.5 kW Variador de velocidade mecânica Materiais : Eixo e pás em Inox 304L	P	6
MATURAÇÃO				
Agitadores dos tanques de maturação	Agitador vertical lento	Potência unitária instalada : 7,5 kW Variador de velocidade mecânica Materiais : Eixo e pás de Inox 304L	P	12
DÉCANTADOR				
Conjuntos lamelares para decantação dos flocos	placas	Superfie unitária: 62 m^2 Inclinação da placa : 60° Acessórios : Conjuntos de fixação Sistema de limpeza automática das lâminas	P	6 conjuntos
Conjuntos de caleiras para a recuperação de água clarificada	Caleiras em U com decarregadores dentados	Inox 304L	P	6 conjuntos

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Raspadores de fundo dos Actiflo®	Ponte raspadora circular	Diâmetro : 10 m Potência instalada: 0.55 kW Variador de velocidade mecânica Material : Inox 304L	P	6
Válvulas de esvaziamento dos Actiflo para operações de manutenção	Válvula borboleta	DN 80 Accionador manual Material: ferro fundido	P	6
Válvulas de esvaziamento das lamas do decantador	Válvula guilhotina	DN 150 Accionador manual Material : ferro fundido	P	12

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Bombas para a recuperação das lamas	Centrífuga	Caudal unitário: 90 m^3/h Potência unitária instalada : 15 kW Variador de frequência <u>Materiais</u> : Corpo e impulsor: Ferro fundido Revestimento anti-abrasivo <u>Acessórios</u> : Conjunto de válvulas e torneiras de isolamento e de descolmatagem	P	14 (das quais, 2 de socorro em caixa)
Separadores de microareia e lamas	Hidrociclone	Capacidade : 90 m^3/h Diâmetro do dispositivo: 420 mm Altura: 1900 mm <u>Materiais</u> : Corpo: Aço Revestimento interior: borracha	P	12

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
MICROAREIA				
Sistema automático de dosagem de microareia	Posto de extracção de microareia	Capacidade : 1 m^3 Posto inclui: - 1 vibrador Potência unitária instalada : 0,18 kW - 1 tremonha tampão - 1 doseador Potência unitária instalada: 0,37kW - 1 tapete Potência unitária instalada : 0.55 kW - 1 hidroejector com alimentação de água industrial	P	2
Pontes rolantes para a manutenção dos Big Bags de microareia		Capacidade : 3T Alcance : 7 m Altura de elevação: 3 m Distância de deslocação: 22.5 m Carro : eléctrico Talha : eléctrica por cabo	P	2

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
TANQUE DE BOMBAGEM				
Bombas de recuperação das águas de transbordo	Centrífuga em poço seco	Caudal unitário: 300 m^3/h Potência unitária instalada : 15 kW Materiais : Corpo : Ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento	P	6 (das quais, 2 de socorro instaladas)

2.6. FILTRAÇÃO SOBRE AREIA

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
Válvulas de alimentação dos filtros em água decantada	Válvula mural	700 x 700 mm Accionador pneumático Materiais : Quadro : Inox 304L Tampa : Inox 304L Parafusos : Inox 304L Acessórios : Macaco + extensão	P	16
Válvulas de saída das águas sujas de lavagem	Válvula mural	800 x 700 mm Accionador pneumático Materiais : Quadro : Inox 304L Tampa : Inox 304L Parafusos : Inox 304L Acessórios : Macaco + extensão	P	16
Alçapão de acesso para visita dos filtros		DN 800	P	16

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
Meio filtrante	Filtro bicamada : Camada superior : brita Camada Inferior : areia	Brita : espessura : 0,10 m Areia : espessura : 1,6 m	P	16
Conjuntos de lajes	Solo filtrante em betão	Dimensões : 994 x 3600 mm Espessura : 120 mm	P	
Conjunto de crepinas de filtração		Comprimento unitário : 350 mm Diâmetro do bocal : 55 mm Material: Polipropileno	P	
Válvulas de lavagem	Válvula de regulação de tipo borboleta	DN 900 Accionador pneumático Material : Ferro fundido revestido	P	16

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
Válvulas de entrada de água de lavagem	Válvula borboleta	DN 900 Accionador pneumático Material : Ferro fundido revestido	P	16
Válvulas de entrada de ar de lavagem	Válvula borboleta	DN 350 Accionador pneumático de tipo TOR Material : Ferro fundido revestido	P	16
Válvulas de purga de ar	Válvula borboleta	DN 100 Accionador manual Material: Ferro fundido revestido	P	16
Válvulas de esvaziamento de filtro e tanque	Válvula borboleta	DN 100 Accionador manual Material: Ferro fundido revestido	P	32

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
Monocarril de manutenção dos filtros		Capacidade : 1T Altura de elevação : 4 m Distância de deslocação : 41 m Carro : manual Talha : manual por cabo	P	4
Grupos de produção de ar comprimido	Compressor de pistão	Potência unitária instalada: 11 kW Pressão de serviço: 10 bars Caudal : 60 Nm^3/h Tinta anticorrosiva Acessórios : 1 secador 1 balão 500 l Regulador de pressão Filtro desengordurador com purga automática Manómetro Válvulas de isolamento	P	4 (dos quais, 2 de socorro instalados)

2.7. LAVAGEM DOS FILTROS

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P)/ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
LAVAGEM DE AR				
Sopradores de ar para lavagem dos filtros	Soprador de pistões rotativos	Caudal unitário nominal : 5750 Nm^3/h Potência unitária instalada installée: 250 kW Acessórios: cobertura de insonorização em aço galvanizado Filtro na aspiração Silenciador na rejeição Válvula de segurança Válvula de retenção Manómetro de pressão da rejeição Detector de descolmatagem do filtro	P	4 (dos quais, 2 de secorro instalados)
Válvulas de isolamento dos sopradores	Válvula borboleta	DN 400 Accionador manual Material: Ferro fundido revestido	P	4

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P)/ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
Monocarril de manutenção dos sopradores		Capacidade: 5T Altura de elevação: 4,4m Distância de deslocação: 8 m Carro: manual Talha: Manual por cabo	P	4
Sistema de ventilação do local dos sopradores	Ventilador helicoidal	Potência unitária instalada: 0.75 kW <u>Acessórios</u> : Conjunto de registros de isolamento	P	Conjunto
Conjunto de grelhas de ventilação		<u>Material</u> : Aço galvanizado	P	4
LAVAGEM COM ÁGUA				
Bombas de lavagem dos filtros de caudal alto	Centrífuga de poço seco	Caudal unitário: 2615 m^3/h Potência unitária instalada : 110 kW AMT : 10 m <u>Materiais</u> : Corpo : Ferro fundido <u>Acessórios</u> : Conjunto de válvulas e torneiras de isolamento	P	6 (das quais, 2 de socorro instaladas)

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P)/ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
Bombas de lavagem dos filtros de caudal baixo	Centífuga de poço seco	Caudal unitário : 1050 m^3/h Potência unitária instalada : 45 kW AMT : 9 m Materiais : Corpo : Ferro fundido Acessórios : Variador de frequência Conjunto de válvulas e torneiras de isolamento	P	2
Válvulas de isolamento das bombas de lavagem	Válvula borboleta	DN 900 Accionador manual pneumático de tipo TOR Material : Ferro fundido revestido	P	2
Válvulas de isolamento do colector de águas de lavagem	Válvula borboleta	DN 900 Accionador manual Material: Ferro fundido revestido	P	2
Manutenção das bombas de lavagem	Ponte rolante	Capacidade : 3T Alcance : 8 m Altura de elevação : 7.5 m Distância de deslocação : 24 m Carro : eléctrico Talha : eléctrica por cabo	P	2

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P)/ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
RECICLAGEM DAS PRIMEIRAS ÁGUAS FILTRADAS				
Válvulas de isolamento do tanque das primeiras águas filtradas	Válvula borboleta	DN 600 Accionador pneumático de tipo TOR Material : Ferro fundido revestido	P	2
Bombas de recirculação das primeiras águas filtradas	Horizontal de poço seco	Caudal unitário nominal : 1485 m^3/h Potência unitária instalada : 35 kW Materiais: Corpo : ferro fundido Acessórios : Conjunto de álvulas e torneiras de isolamento DN 500	P	4 (das quais, 2de socorro instaladas)
Válvulas de isolamento dos caudalímetros	Válvula borboleta	DN 400 Accionador manual Material : Ferro fundido revestido	P	4

2.8. POSTO DE BOMBAGEM DAS ÁGUAS TRATADAS

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
BOMBAGEM DO RESERVATÓRIO ELEVADO DE ÁGUA				
Bombas de alimentação do reservatório elevado de água da estação	Centrífuga em poço seco	Caudal nominal unitário: 300 m^3/h Potência unitária instalada : 90 kW Materiais : Corpo : ferro fundido Acessórios : Conjunto de válvulas torneiras de isolamento DN 300	P	3 (das quais, 1 de socorro instalada)
Válvulas de isolamento dos caudalímetros	Válvula borboleta	DN 400 Accionador manual Material : Ferro fundido revestido	P	2
Válvulas de isolamento do reservatório elevado de água	Válvula borboleta	DN 400 Accionador manual Material : Ferro fundido revestido	P	4

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
BOMBAGEM DE REDE				
Bombas de rejeição da água tratada para a estação de bombagem intermediária	Centrífuga horizontal de câmara bipartida	Caudal nominal unitário: 3420 m^3/h AMT: 140 m Potência unitária instalada : 1750 kW Materiais: Corpo : ferro fundido Acessórios : Variador de frequência Conjunto de válvulas e torneiras de isolamento	P	6
Equipamento anti-golpe de aríete da bombagem	Balão de câmara de ar	Capacidade : 3 m^3 Pressão de serviço: 10 bars Pressão de pré-enchimento : 5 bars Materiais: Reservatório: Aço pintado com certificação alimentar Câmara de ar: butil com certificação alimentar Acessórios: Conjunto de válvulas e torneiras de isolamento Compressor de ar	P	2

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Motor de socorro em caixa		Potência unitária: 1350 kW	P	1
Válvulas de isolamento da rede que alimenta a estação de bombagem intermediária	Válvula borboleta	DN 1200 PN 16 Acionador manual Material: Ferro fundido revestido	P	4
BOMBAGEM ÁGUA MOTRIZ E CONTRA INCÊNDIOS				
Grupo de água motriz	Bomba centrífuga	6 Bombas (das quais, 1 de socorro instalada) Caudal unitário: 30 m^3/h Potência unitária do grupo: 66 kW Materiais: Corpo : ferro fundido Acessórios : Conjunto de válvulas e torneiras d'isolement Balão de expansão	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Grupo de água de incêndios	Grupo de 3 bombas	1 electrobomba jockey 1 electrobomba de serviço 1 motobomba (diesel) Caudal do grupo: 230 m^3/h Motor: Potência unitária instalada: 92 + 3 KW Corpo: Ferro fundido Impulsor: Ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento Balão de expansão	P	1
Bombas do posto todas as águas do local de bombagem das águas tratadas	Bomba centrífuga submersa	Caudal unitário: 25 m^3/h Potência unitária instalada: 5.5 kW Acessórios : Conjunto de válvulas e torneiras de isolamento	P	1
Manutenção das bombas de água tratada	Ponte rolante	Capacidade : 10T Alcance : 16 m Altura de elevação : 12 m Distância de deslocação : 49 m Carro : eléctrico Talha : eléctrica por cabo	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Sistema de ventilação do local de bombagem de água tratada	Ventilador helicoidal	Caudal unitário: 37500 m^3/h Potência unitária instalada: 7,5 kW Acessórios: Conjunto de registros de isolamento	P	Conjunto
Conjunto de grelhas ventilação		Materiais: Aço galvanizado	P	

2.9. DECANTAÇÃO DAS ÁGUAS SUJAS DOS ACTIFLO

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
COAGULAÇÃO				
Agitadores dos tanques de coagulação dos Actidyn®	Agitador pendular	Potência unitária instalada : 0,75 kW Materiais: Eixo e hélice em Inox 304L Acessórios : Variador de velocidade mecânico	P	2
FLOCULAÇÃO				
Agitatadores dos tanques de floculação dos Actidyn®	Agitador pendular	Punitária instalada: 1,1 kW Materiais: Eixo e hélice em inox 304L Acessórios : Variador de velocidade mecânico	P	2
Válvulas de esvaziamento do tanque de floculação	Válvula guilhotina	DN 80 Accionador manual Material: ferro fundido	P	2

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
DÉCANTAÇÃO				
Raspador de fundo dos Actidyn®	Ponte raspadora circular	Diâmetro: 6.80 m Potência unitária instalada: 0,55 kW Material: Inox 304L Acessórios : Variador de velocidade mecânico	P	2
Conjuntos lamelares para decantação dos flocos	Placas	Surfície : 30 m^2 Inclinação da placa : 60° Acessórios : Conjuntos de fixação	P	2 conjuntos
Conjunto de caleiras para a recuperação da água clarificada	Caleiras em U com descarregadores dentados	Material : Inox 304L	P	2 conjuntos
Válvulas de esvaziamento dos Actydyn® para operações de manutenção	Válvula guilhotina	DN 80 Accionador manual Material: ferro fundido	P	2

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
BOMBAGEM DE LAMAS				
Bombas de extracção das lamas dos Actidyn®	Bomba de parafuso excêntrico	Caudal unitário : 40 m^3/h Potência unitária instalada: 7,5 kW Materiais: Corpo: ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento, de repartição e de descolmatagem	P	4 (das quais, 2 de socorro instaladas comuns aos Actidyn das águas sujas de lavagem dos filtros)

2.10. DECANTAÇÃO DAS ÁGUAS SUJAS DE LAVAGEM DOS FILTROS

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
TANQUE DE ÁGUAS SUJAS DE LAVAGEM				
Bombas das águas sujas de lavagem	Centrífuga em poço seco	Caudal unitário: 330 m^3/h Potência unitária instalada: 18.5 kW Materiais: Corpo : ferro fundido Acessórios : Variador de frequência Conjunto de válvulas e torneiras de isolamento	P	4 (das quais, 2 de socorro instaladas)
COAGULAÇÃO				
Agitatadores dos tanques de coagulação dos Actidyn®	Agitador pendular	Potência unitária instalada: 0.75 kW Materiais: Eixo e hélice em inox 304L Acessórios : Variador de velocidade mecânico	P	2

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
FLOCULAÇÃO				
Agitadores dos tanques de floculação dos Actidyn®	Agitador pendular	Potência unitária instalada: 1.1 kW Materiais: Eixo e hélice em inox 304L Acessórios : Variador de velocidade mecânico	P	2
Válvulas de esvaziamento do tanque de floculação	Válvula guilhotina	DN 80 Accionador manual Material: ferro fundido	P	2
DÉCANTAÇÃO				
Raspadores de fundo dos Actidyn®	Ponte raspadora circular	Diâmetro : 6.80 m Potência unitária instalada: 0.55 kW Material : Inox 304L Acessórios : Variador de velocidade mecânico	P	2
Conjunto lamelar para decantação dos flocos	Placas	Superfície : 30 m^2 Inclinação da placa: 60° Acessórios : Conjuntos de fixação	P	2 Conjuntos

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Conjunto de caleiras de recuperação de água clarificada	Caleiras em U com descarregadores dentados	Material : Inox 304L	P	2 conjuntos
Válvulas de esvaziamento dos Actidyn® para operações de manutenção	Válvula guilhotina	DN 80 Accionador manual Material: ferro fundido	P	2
BOMBAGEM DAS LAMAS				
Bombas de extracção das lamas dos Actidyn®	Parafuso excêntrico	Caudal unitário : 40 m^3/h Potência unitária instalada: 7.5 kW Material: Corps : ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento, de repartição e de descolmatagem	P	2

2.12. TRATAMENTO UV DAS ÁGUAS DECANTADAS

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Tratamento UV das águas decantadas	Reactor UV	Caudal unitário : 380 m^3/h Potência unitária instalada: 8 kW Acessórios : Conjunto de válvulas e torneiras de isolamento	P	4
Válvulas de isolamento para a neutralização	Válvula borboleta	DN 350 PN10 Accionador manual Material : Ferro fundido revestido	P	2
Bombas de recuperação das águas decantadas	Centrífuga de poço seco	Caudal unitário: 360 m^3/h Potência unitária instalada: 15 kW Material: Corpo : ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento	P	6 (das quais, 2 de socorro instaladas)

2.13. PREPARAÇÃO DE LEITE E DE ÁGUA DE CAL

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
PREPARAÇÃO DE LEITE DE CAL				
Sistemas automáticos de dosagem de cal	Posto de extracção Big-bag	Capacidade : 1 m^3 Acessórios incluídos no posto: - 1 vibrador : Potência unitária instalada: 0,18 kW - 1 tremonha tampão: - 2 doseadores: Potência unitária instalada: 0,37 kW - 2 tapetes: Potência unitária instalada: 0.55 kW 1 filtro de despoeiramento	P	2
Agitadores dos tanques de preparação de leite de cal	Pendular	Potência unitária instalada: 3 kW Material: Eixo e pás em Inox 304L	P	4
Segurança do pessoal	Chuveiro de segurança e lava-olhos	Com válvula manual de alimentação	P	1
Bombas de leite de cal. Injecção para o Actiflo®	Bomba de rotor excêntrico	Caudal unitário : 1335 L/h Potência unitária instalada: 1,1 kW Acessórios : Variadores de frequência Válvulas de repartição	P	9 (das quais, 1 de secorro em caixa)

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
PREPARAÇÃO DE ÁGUA DE CAL				
Bombas de leite de cal. Injecção para os saturadores	Parafuso excêntrico	Caudal unitário : 3000 L/h Potência unitária instalada: 3 kW <u>Acessórios</u> : Variador de frequência Válvulas de repartição	P	3 (das quais 1 de socorro instalada)
Agitadores dos saturadores	Pendular	Potência unitária instalada: 1.1 kW <u>Material</u> : Eixo e pás em Inox 304L <u>Acessórios</u> : Variador de velocidade mecânico	P	2
Raspadores do fundo do saturador	Ponte raspadora circular	Diâmetro : 4 m Potência unitária instalada: 0.55 kW <u>Material</u> : Inox 304L <u>Acessórios</u> : Variador de velocidade mecânico	P	2
Conjunto lamelar para decantação	Placas	Superfície : 10,9 m^2 Inclinação da placa: 60° <u>Acessórios</u> : Conjuntos de fixação	P	2 Conjuntos

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Conjunto das caleiras de recuperação de águas de cal	Caleiras em U com descarregadores dentados	Material : Inox 304L	P	2 Conjuntos
Válvulas de esvaziamento parcial para limpeza das lâminas	Válvula guilhotina	DN 80 Accionador manual Material: ferro fundido	P	2
Bombas de extracção dos grumos de cal	Bomba de rotor excêntrico	Caudal unitário: 5 m^3/h Potência unitária instalada: 3 kW Materiais : Corpo : Ferro fundido Revestimento antiabrasivo Eixo : inox Acessórios : Conjunto de válvulas e torneiras de isolamento e de descolmatagem	P	3 (das quais, 1 de socorro instalada)
Bombas de água de cal. Injecção	Bomba de rotor excêntrico	Caudal unitário: 82 800 L/h Potência unitária instalada: 11 kW Acessórios : Variador de frequência Conjunto de válvulas e torneiras de isolamento	P	3 (das quais, 1 de socorro instalada)

2.14. CLORAÇÃO INTERMEDIÁRIA E FINAL

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P)/ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
ARMAZENAMENTO DE CLORO E EXTRACÇÃO DE CLORO				
Armazenamento de cloro	Cilindro de cloro gasoso	Capacidade : 1 tonelada	P	36 (dos quais, 30 em espera)
Inversor que permite a passagem de uma linha de cilindros à outra	Inversor automático	Acessórios : Reservatório de expansão Conjunto de válvulas e torneiras de isolamento	P	1
Evaporador		<u>Potência instalada</u>: 9 kW <u>Acessórios</u> : Conjunto de válvulas e torneiras de isolamento	P	4 (2 dos quais de socorro instalados)
Regulador de vácuo	Pré-reguladores	<u>Acessórios</u> : Conjunto de válvulas e torneiras de isolamento Filtro de carbono activado	P	4 (dos quais, 2 de socorro instalados)
Separador de cloro líquido		<u>Acessórios</u> : Conjunto de válvulas e torneiras associado	P	4 (dos quais, 2 de socorro instalados)
Segurança do pessoal	Chuveiro de segurança e lava-olhos	Com válvula manual de alimentação	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P)/ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
Manutenção dos cilindros de cloro	Ponte rolante	Capacidade : 1.5T Alcance: 8 m Altura de elevação: 4 m Distância de deslocação: 36 m Carro: eléctrico Talha: eléctrica por cabo	P	1
Sistema de ventilação do local de cloração	Ventilador helicoidal	Potência unitária instalada: 0,55 kW Acessórios: Conjunto de registros de isolamento	P	Conjunto
Conjunto de grelhas de ventilação		Materiais: Aço galvanizado	P	
LOCAL CLORÓMETRO				
Clorómetros	Dosagem automática através de um servomotor	Capacidade : 0 à 20 Kg/h Acessórios : Conjunto de válvulas e torneiras de isolamento e de repartição	P	6 (dos quais, 2 de socorro)
Injectores de cloro	Hidroinjector	Acessórios : Reductor de pressão Conjunto de válvulas e torneiras de isolamento	P	4
Segurança do pessoal	Chuveiro de segurança e lava-olhos	Com válvula manual de alimentação	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P)/ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
NEUTRALIZAÇÃO DAS FUGAS				
Extractores das fugas de cloro	Ventilador centrífuga	Potência unitária instalada: 5,5 kW Acessórios: Válvulas de retenção Registros manuais de isolamento	P	4 (das quais, 2 de segurança)
Coluna de lavagem	Coluna com enchimento	A coluna de lavagem inclui: 1 Eliminador de névoa e a sua estrutura, 1 Rampa de pulverização de soda, Anéis de enchimento	P	1
Bombas de recirculação da solução neutralizante	Centrífuga	Caudal unitário: 25 m^3/h Potência uitária instalada: 4 kW Material: Material plástico Acessórios : Conjunto de válvulas e torneiras de isolamento Válvula de retenção	P	2 (das quais, 1 de socorro instalada)
Agitador	Pendular	Potência unitária instalada : 0,75 KW Material : Eixo e hélice em Inox 304L	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P)/ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
Permutador térmico para a solução neutralizante	Permutador por placa	Acessórios: Conjunto de válvulas e torneiras de isolamento Termómetros	P	1
Segurança do pessoal	Chuveiro de segurança e lava-olhos	Com válvula manual de alimentação	P	1

2.15. PREPARAÇÃO DE SULFATO DE ALUMÍNIO

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
PREPARAÇÃO				
Sistemas automáticos de descarga dos sacos de sulfato de alumínio	Posto de extracção Big-bag	Capacidade : 1 m^3 Acessórios do posto: - 1 vibrador : Potência unitária instalada: 0,18 kW - 1 tremonha tampão: - 2 doseadores: Potência unitária instalada: 0,37kW - 2 tapetes: Potência unitária instalada: 0.55 kW	P	2
Agitadores para a mistura do coagulante nos tanques de preparação	Agitador pendular	Potência unitária instalada: 3 kW Matéria: Eixo e pás em Inox 304L	P	4
COAGULAÇÃO ACTIFLO				
Bombas para injecção de coagulante	Doseadora de parafuso excêntrico	Caudal unitário: 950 L/h Potência unitária instalada: 0,75 kW Acessórios : Válvulas de repartição e armários Variadores de frequência	P	12 (das quais, 4 de socorro instalada)

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
COAGULAÇÃO ACTIDYN				
Bombas para injecção de coagulante	Doseadora de parafuso excêntrico	Caudal unitário nominal : 35 L/h Potência unitária instalada: 0,75 kW Acessórios : Conjunto de válvulas e torneiras de isolamento e armário Variadores de frequência	P	4
Segurança do pessoal	Chuveiro de segurança e lava-olhos	Com válvula manual de alimentação	P	1
Ventilação do local de preparação de sulfato de alumínio	Ventilador helicoidal	Potência unitária instalada: 0,37 kW Acessórios: Conjunto de registros de isolamento	P	Conjunt
Conjunto de grelhas de ventilação		Material: Aço galvanizado	P	

2.16. PREPARAÇÃO DE POLIELECTRÓLITO

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
POLÍMERO DOS ACTIDYN DAS ÁGUAS DE LAVAGEM DOS FILTROS				
Preparação automática de polielectólito para os Actidyn das águas sujas de lavagem	Central de polímero	Potência instalada: 1 kW A instalação inclui: - 1 linha de chegada de água que inclui: 1 válvula de paragem e de regulação 1 Regulador de pressão 1 Electroválvula 1 Contador - 1 doseador de pó - 1 tanque de três compartimentos (molhagem, maturação, extracção) equipado com: 1 agitador no tanque de molhagem 1 agitador no tanque de maturação Acessórios: Indicação de nível no tanque de extracção Armário de gestão automática Materiais : Tremonha de alimentação : PEHD Tanques : poliéster Agitatador : inox 304L	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Bombas de polímero	Doseadora de parafuso excêntrico	Caudal unitário: 20 l/h Potência unitária instalada: 0.37 kW Material : Corpo : Ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento e de repartição Variador de frequência	P	2

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
POLÍMERO DOS SATURADORES				
Preparação automática de polielectrólito para os saturadores de cal	Central de polímero	Potência instalada: 1 kW A instalação inclui: - 1 linha de chegada de água que inclui: 1 válvula de paragem e de regulação 1 Regulador de pressão 1 Electroválvula 1 Contador - 1 doseador de pó - 1 tanque de três compartimentos (molhagem, maturação, extracção) equipado com: 1 agitador no tanque de molhagem 1 agitador no tanque de maturação Acessórios: Indicação de nível no tanque de extracção Armário de gestão automática Materiais : Tremonha de alimentação : PEHD Tanques : poliéster Agitatador : inox 304L	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Bombas de polímero	Doseadora de parafuso excêntrico	Caudal unitário: 14 l/h Potência unitária instalada: 0.37 kW Material : Corpo : Ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento e de repartição Variador de frequência	P	2
Segurança do pessoal	Chuveiro de segurança e lava-olhos	Com válvula manual de alimentação	P	1
Bombas do posto todas as águas do local dos reagentes	Bomba centrífuga submersa	Caudal unitário: 25 m^3/h Potência unitária instalada: 5.5 kW Acessórios : Conjunto de válvulas e torneiras de isolamento	P	2 (das quais, 1 de socorro em caixa)

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
POLÍMERO DOS ACTIFLO				
Preparação automática de polielectólito para a floculação Actiflo	Central de polímero	Potência unitária instalada: 2.2 kW A instalação inclui: - 1 linha de chegada de água que inclui: 1 válvula de paragem e de regulação 1 Regulador de pressão 1 Electroválvula 1 Contador - 1 doseador de pó - 1 tanque de três compartimentos (molhagem, maturação, extracção) equipado com: 1 agitador no tanque de molhagem 1 agitador no tanque de maturação Acessórios: Indicação de nível no tanque de extracção Armário de gestão automática Materiais : Tremonha de alimentação : PEHD Tanques : poliéster Agitatador : inox 304L	P	3 (das quais, 1 de socorro instalado)

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Bombas de polímero	Doseadora de parafuso excêntrico	Caudal unitário: 500 l/h Potência unitária instalada: 0.37 kW Material : Corpo: Ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento e de repartição Variador de frequência	P	12 (das quais 4 de socorro instaladas)

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
POLÍMERO DOS ACTIDYN DAS ÁGUAS SUJAS DOS ACTIFLO				
Preparação automática de polielectrólito para os Actidyn das águas sujas dos Actiflo	Central de polímero	Potência instalada: 1.5 kW A instalação inclui: - 1 linha de chegada de água que inclui: 1 válvula de paragem e de regulação 1 Regulador de pressão 1 Electroválvula 1 Contador - 1 doseador de pó - 1 tanque de três compartimentos (molhagem, maturação, extracção) equipado com: 1 agitador no tanque de molhagem 1 agitador no tanque de maturação Acessórios: Indicação de nível no tanque de extracção Armário de gestão automática Materiais : Tremonha de alimentação : PEHD Tanques : poliéster Agitatador : inox 304L	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Bombas de polímero	Doseadoras de parafuso excêntrico	Caudal unitário : 600 l/h Potência unitária instalada: 0.37 kW Material : Corpo: Ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento e de repartição Variador de frequência	P	3 (das quai 1 de socorro em caixa)
Segurança do pessoal	Chuveiro de segurança e lava-olhos	Com válvula manual de alimentação	P	1

2.17. UNIDADE DE TRATAMENTO DAS ÁGUAS USADAS DA ESTAÇÃO

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
TRATAMENTO DAS UAS USADAS DA ESTAÇÃO DE BOMBAGEM				
Grade	Grade manual	Inox 304L	P	1
Válvula de isolamento da fossa séptica	Válvula mural	Accionador manual Materiais : Quadro : Inox 304L Tampa: Inox 304L Parafusos: Inox 304L	P	1
TRATAMENTO DAS ÁGUAS USADAS DA ESTAÇÃO DE PRODUÇÃO DE ÁGUA POTÁVEL				
Grade	Grade manual	Inox 304L	P	1
Válvula de seccionamento de caudal	Modular por máscaras	Inox 304L	P	1
Válvulas de isolamento dos leitos de macrófitos	Válvulas murais	Accionador manual Materiais: Quadro: Inox 304L Tampa: Inox 304L Parafusos: Inox 304L	P	1
Condutas de alimentação dos leitos de macrófitos		DN 100 Inox 304L	P	Conjunto

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Suporte dos macrófitos	Brita		P	Conjunto
Drenos de infiltração		DN 160 PVC	P	Conjunto
Chaminés de arejamento		DN 160	P	Conjunto
Membrana de impermeabilidade	Geomembran a	Membrana EPDM	P	1

3. INSTRUMENTAÇÃO

3.1 ELEVAÇÃO DE ÁGUA BRUTA

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
CANAL DE ÁGUA BRUTA				
Medição de nível do canal	Piezométrica		P	1
Detector de nível	Bóia de nível	Nível muito alto	P	1
TANQUE DE ÁGUA BRUTA				
Analisador de hidrocarboneto da água bruta	Laser		P	1

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Medição de nível do tanque	Piezométrica		P	1
Detectores de nível	Bóia de nível	Nível muito baixo Nível muito alto	P	2
ESTAÇÃO DE BOMBAGEM				
Medições de pressão da bombagem	de membrana		P	6
Analisador de turvação da água bruta	Óptico		P	1
Medição da temperatura da água bruta	Por resistências		P	1
Analisador de pH da água bruta	Eléctrodo		P	1
Analisador de rH da água bruta	Eléctrodo		P	1

3.2 ALIMENTAÇÃO DA ESTAÇÃO DE TRATAMENTO

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
ALIMENTAÇÃO DA ESTAÇÃO DE TRATAMENTO				
Medições de caudal de água bruta	Electromagné tico	Caudal unitário : 11 237 m^3/h DN 1200, PN 6 Revestimento interior em poliuretano Qualidade da água potável Acessórios: Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2

3.3 DECANTAÇÃO LAMELAR ACTIFLO

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
INSTALAÇÃO DE REPARTIÇÃO				
Analisadores da turvação da água bruta	Óptica		P	2
FLOCULAÇÃO				
Analisadores do pH de floculação	Eléctrodo		P	6
MATURAÇÃO				
Analisadores do pH de maturação	Eléctrodo		P	6
DECANTAÇÃO				
Medições de nível da parede das lamas	Óptica		P	6
RECIRCULAÇÃO DA MICROAREIA				
Medição de pressão na entrada de cada hidrociclone	de membrana		P	12
RECUPERAÇÃO DAS ÁGUAS SUJAS DO ACTIFLO				
Medições de nível dos tanques	Piezométrica		P	2

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Detectores de nível	Bóia de nível	Nível muito baixo Nível baixo Nível muito alto	P	6
Medições de caudal de águas sujas	Electromagnético	Caudal unitário: 576 m^3/h DN 250, PN 10 Revestimento interior em poliuretano Qualidade da água potável Acessórios: Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2
INJECÇÃO DE MICROAREIA				
Detectores de nível nas tremonhas de cargamento	Lâmina vibrante	Nível muito baixo	P	2

3.4 FILTRAÇÃO DE AREIA

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
FILTRO DE AREIA				
Analisadores de turvação de água decantada	Óptico		P	2
Medições de nível nos filtros	US		P	16
Medições de pressão em saída de filtração	de membrana		P	16
Medições de nível de água filtrada nos tanques	Piezométrica		P	16
LOCAL SOPRADOR				
Medições de pressão de ar	de membrana		P	2
Medições de temperatura nos locais	Por resistências		P	2

3.5 RESERVA DE LAVAGEM DOS FILTROS

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
RESERVA DE LAVAGEM DOS FILTROS				
Analisadores de turvação da água filtrada	Óptico		P	2
Medições de nível nos tanques	Piezométrica		P	2
Detectores de nível	Bóia de nível	De nível baixo De nível muito baixo De nível muito alto	P	6
Medições de caudal de água de lavagem	Electromagné tico	Caudal unitário : 5 225 m^3/h DN 800, PN 10 Revestimento interior em poliuretano Qualidade da água potável Acessórios : Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2

3.6 RECIRCULAÇÃO DAS PRIMEIRAS ÁGUAS FILTRADAS

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
RECIRCULAÇÃO DAS PRIMEIRAS AGUAS FILTRADAS				
Medições de nível dos tanques	Piezométrica		P	2
Detectores de nível	Bóia de nível	De nível baixo De nível muito baixo De nível muito alto	P	6
Medições de caudal de água de lavagem	Electromagnético	Caudal unitário : 1 485 m^3/h DN 400, PN 10 Revestimento interior em poliuretano Qualidade da água potável Acessórios: Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2
Analisador de turvação da água tratada	Óptico		P	2
Analisador de cloro da água tratada	Eléctrodo		P	2

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Analisador de pH da água bruta	Eléctrodo		P	2

3.7 BOMBAGEM DE ÁGUA TRATADA

NOME DO EQUIPAMENTO	TIPO	CARACTERISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
BOMBAGEM PARA O RESERVATÓRIO ELEVADO DE ÁGUA DE QUILONGA				
Medição de caudal	Electromagnética	Caudal unitário : 600 m^3/h DN 400 Revestimento interior em poliuretano Qualidade da água potável Acessórios : Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTERISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
BOMBAGEM ESTAÇÃO DE BOMBAGEM INTERMEDIÁRIA				
Medições de caudal	Electromagnética	Caudal unitário: 10800 m^3/h DN 1 200 Revestimento interior em poliuretano Qualidade de água potável <u>Acessórios :</u> Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2
BOMBAGEM DA ÁGUA MOTRIZ DA CLORAÇÃO				
Medição de caudal	Electromagnético	Caudal unitário: 150 m^3/h DN 100 Revestimento interior em poliuretano Qualidade da água potável <u>Acessórios :</u> Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	1
RESERVATÓRIO ELEVADO DE ÁGUA DE QUILONGA				
Detectores de nível	Bóia de nível	Nível muito alto Nível muito baixo	P	2
Medições de nível do reservatório elevado	Piezométrica		P	1

3.8 DECANTAÇÃO ACTIDYN

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
TANQUES DE ÁGUA SUJAS				
Medições de nível dos tanques	Piezométrica		P	2
Detectores de nível	Bóia de nível	De nível baixo De nível muito baixo De nível muito alto	P	6
Medições de caudal de águas sujas	Electromagnético	Caudal unitário : 330 m^3/h DN 250 Revestimento interior em poliuretano Qualidade da água potável Acessórios: Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2
DECANTAÇÃO				
Medições de nível da parede de lamas	Óptico		P	4
BOMBAGEM DE LAMAS				
Dispositivo contra funcionamento a seco das bombas	Sensor de temperatura		P	6

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Medições de caudal de lamas	Electromagné tico	Caudal unitário : 80 m^3/h DN 150 Revestimento interior em poliuretano Qualidade de água potável Acessórios: Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2
TANQUE DE BOMBAGEM DOS SOBRENADANTES				
Medições de nível dos tanques	Piezométrica		P	2
Detectores de nível	Bóia de nível	De nível baixo De nível muito baixo De nível muito alto	P	6
Medições de caudal de sobrenadantes	Electromagné tico	Caudal unitário: 720 m^3/h DN 350 Revestimento interior em poliuretano Qualidade da água potável Acessórios : Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2

3.9 PREPARAÇÃO DE CAL

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
PREPARAÇÃO DE LEITE DE CAL				
Detectores de nível das tremonhas de descarga	Lâmina vibrante	Nível muito baixo	P	2
Detectores de nível dos tanques de preparação	Bóia de nível	Nível muito baixo Nível baixo Nível alto	P	12
Dispositivo contra o funcionamento a seco das bombas	Sensor de temperatura		P	8
Medições de caudal de leite de cal bombeado para os Actiflo®	Electromagné tico	Caudal unitário : 1,3 m^3/h DN 25 Acessórios: Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	8
PREPARAÇÃO DE ÁGUA DE CAL				
Dispositivo contra o funcionamento a seco das bombas de leite de cal	Sensor de temperatura		P	3

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Medições de caudal de leite de cal	Electromagné tico	Caudal unitário: 3 m^3/h DN 40 Acessórios : Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2
Medição de nível do tanque de água de cal	Piezométrica		P	1
Detectores de nível do tanque e água de cal	Bóia de nível	Nível muito baixo Nível baixo Nível alto	P	3
Dispositivo contra o funcionamento a seco das bombas	Sensor de temperatura		P	3
Medições de caudal de água de cal bombeada	Electromagné tico	Caudal unitário : 83 m^3/h DN 125 Acessórios: Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2
BOMBAGEM DOS GRUMOS				
Dispositivo contra o funcionamento a seco das bombas	Sensor de temperatura		P	3

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Medição de caudal bombeado	Electromagné tico	Caudal unitáro : 10 m^3/h DN 80 <u>Acessórios :</u> Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	1

3.10 CLORAÇÃO INTERMEDIÁRIA E FINAL

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
CLORAÇÃO				
Acompanhamento do peso dos cilindros interligados	balanças		P	6
Detector de gás	Detecção de cloro		P	3
Alarme sonoro	Buzina		P	2
Sinais luminosos intermitentes	Farol rotativo		P	3
Analisador de cloro da solução neutralizante	Detecção de cloro		P	1
Detecções de nível do reservatório de solução neutralizante	Bóia de nível	Nível muito alto, Nível alto, Nível muito baixo	P	3

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Medições de caudal bombeado	Electromagné tico	Caudal unitário : 0,6 m^3/h DN 20 Acessórios: Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2

3.13 POSTOS TODAS AS ÁGUAS

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
POSTO TODAS AS ÁGUAS N°1				
Medição de nível no tanque	Piezométrico		P	1
Detectores de nível	Bóia de nível	De nível baixo De nível muito baixo De nível muito alto	P	3
Medição de caudal bombeado	Electromagné tico	Caudal unitário: 25 m^3/h DN 80 Revestimento em poliuretano Qualidade da água potável Acessórios: Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	1
POSTO TODAS AS ÁGUAS N°2				
Medição de nível no tanque	Piezométrico		P	1

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Detectores de nível	Bóia de nível	De nível baixo De nível muito baixo De nível muito alto	P	3
Medição de caudal bombeado	Electromagné tico	Caudal unitário: 20 m^3/h DN 80 Revestimento interior em poliuretano Qualidade da água potável <u>Acessórios:</u> Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	1

2. EQUIPAMENTOS

2.1. PRÉ-TRATAMENTO

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Válvulas para isolamento dos canais de gradagem	Válvula mural	1000 x 1400 mm Accionador manual <u>Materiais</u> : Quadro: Inox 304L Tampa: Inox 304L Parafusos: Inox 304L	P	12

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Grades grossas	Automático	Caudal unitário admissível: 3750 m^3/h Espaçamento : 30 mm Largura do canal : 1300 mm Motor : Potência instalada unitária: 1,5 kW Materiais : Chassis : Inox 304L Grade, peça em movimento, cobertura : Inox 304L Protecção catódica Acessórios : Chegada de água industrial e rampa de aspersão para lavagem	P	6
Grades finas	Automático	Caudal unitário admissível: 3750 m^3/h Espaçamento : 2 mm Largura do canal : 1300 mm Motor : Potência instalada unitária: 2,2 kW Materiais : Chassis : Inox 304L Grade, peça em movimento, cobertura integral: Inox 304L Protecção catódica Acessórios : Chegada de água industrial e rampa de aspersão para lavagem.	P	6

SISTEMA V - QUILONGA GRANDE LOTE I

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Tapete de deslocação dos resíduos		Comprimento : 18 m Largura : 0 5 m Motor : Potência unitária instalada: 2,2 kW	P	2
Contentores de resíduos para o armazenamento da rejeição de gradagem	Ampliroll	Capacidade : 8 m^3	P	2

2.2. POSTO DE BOMAGEM DE ÁGUA BRUTA

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
BOMBAGEM DE ÁGUA BRUTA				
Bombas para rejeição das águas brutas	Bomba centrífuga de eixo vertical	Caudal unitário: 3750 m^3/h AMT : 136 m CA Potência unitária instalada: 2000 kW Materiais : Corpo : Ferro fundido Eixo : Inox Acessórios: Conjunto de torneiras de isolamento	P	6
Válvula de retenção	Válvula axial de discos concêntricos	Válvula pequena dimensão, com alta resposta dinâmica DN 800 PN 25 Materiais : Corpo : Inox Obturador: Poliuretano	P	6

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Válvulas de isolamento das bombas	Borboleta	DN 800 PN25 Accionador manual <u>Materiais</u> : Corpo e obturador : Ferro fundido revestido Junta : EPDM	P	6
Manutenção das bombas de água bruta	Ponte rolante dupla viga	Capacidade : 10 T Alcance : 9 m Altura de elevação: 9 m Distância de deslocação : 40 m Carro : eléctrico Talha : eléctrica por cabo	P	1
Equipamento anti-golpe de aríete	Reservatório hidropneumático	Capacidade : 20 m^3 Pressão de serviço: 1[illegible] bars Pressão de pré-enchimento : 7 bars <u>Material:</u> aço pintado com certificação alimentar <u>Acessórios</u> : Conjunto de válvulas e de torneiras de isolamento Compressor de ar	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Sistema de ventilação do local de bombagem de água bruta	Ventilador helicoidal	Caudal unitário : 37500 m^3/h Potência unitária instalada: 7.5 kW Acessórios : Conjunto de válvulas e torneiras de isolamento	P	Conjunto
Conjunto de grelhas de ventilação		Materiais : Aço galvanizado	P	
REDES				
Equipamento anti-golpe de aríete	Reservatório hidráulico	Capacidade : 30 m^3 Pressão de serviço: 10 bars Pressão de pré-enchimento : 4 bars Material : Reservatório: aço pintado com certificação alimentar Câmara de ar :butil com certificação alimentar Acessórios : Câmara de ar substituível Válvulas e torneiras de isolamento	P	4
Ligação ao equipamento anti-golpe de Aríete	Tê	Dimensões: 1 entrada DN 1200 1 saída DN 600 1 Saída DN 1200 Material: Ferro fundido dúctil	P	4

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Ligação ao equipamento anti-golpe de aríete	Curva	<u>Dimensões:</u> Curvas de 90° DN600 <u>Material:</u> Ferro fundido dúctil	P	6
Válvulas de isolamento das linhas	Válvula borboleta	DN 1200 PN 16 Accionador manual <u>Materiais</u> : Corpo e obturador : Ferro fundido revestido Junta : EPDM <u>Acessórios</u> : Válvula de escorvagem DN200 Conjunto de válvulas e torneiras de isolamento	P	2
Válvulas de descarga de fundo da rede	Válvula borboleta	DN 200 PN 10 Accionador manual <u>Materiais</u> : Corpo e obturador : Ferro fundido revestido	P	2

2.3. CONDUTAS E CAIXAS DE VISITA

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Condutas de alimentação da estação de água potável de QUILONGA	Condutas de embocamento	DN 1200 aço	P	6500 m (2 x 3250m)
Peças especiais – Condutas de alimentação da estação de produção de água potável de QUILONGA	Conjunto de curvas	DN 1200 Curva 45° Junta: tubos soldados	P	Conjunto
Caixa para conduta DN1200 com 1 ventosa	Caixa subterrada	<u>Peças especiais das condutas:</u> DN 1200 Tê flangeado em aço <u>Acessórios:</u> Ventosa tripla função DN200 para água potável. Corpo em ferro fundido	P	2
Picagem para conduta DN 1200 com 1 descarga	Caixa subterrada	<u>Peças especiais de condutas:</u> DN 1200 Tê flangeado em aço <u>Acessórios:</u> Válvula subterrada DN 200 em ferro fundido Coluna de manobra para válvula	P	2

2.4. ENTRADA DE ESTAÇÃO

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Válvulas de isolamento da medição de débito	Válvula borboleta	DN 1200 PN 16 Accionador manual Materiais: Corpo e obturador em ferro fundido revestido	P	4
Válvulas de regulação de entrada de estação	Válvula de regulação	DN 1200 PN 16 Accionador eléctrico Materiais : Corpo e obturador em ferro fundido revestido	P	2

2.5. TRATAMENTO PRIMÁRIO – DECANTADOR LAMELAR (ACTIFLO)

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Válvulas de isolamento das linhas de tratamento primário	Válvula mural	1000 x 1000 mm Accionador manual Materiais : quadro : Inox 304L Tampa : Inox 304L Parafusos : Inox 304L	P	6
Válvulas bypass duma linha do tratamento primário	Válvula mural	1600 x 1600 mm Accionador manual Materiais : Quadro : Inox 304L Tampa : Inox 304L Parafusos : Inox 304L	P	4
COAGULAÇÃO				
Agitadores dos tanques de coagulação	Agitador vertical rápido	Potência unitária instalada : 9.5 kW Variador de velocidade mecânica Materiais : Eixo e pás em Inox 304L	P	6

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
INJECÇÃO				
Agitadores dos tanques de injecção	Agitador vertical rápido	Potência unitária instalada : 9.5 kW Variador de velocidade mecânica Materiais : Eixo e pás em Inox 304L	P	6
MATURAÇÃO				
Agitadores dos tanques de maturação	Agitador vertical lento	Potência unitária instalada : 7,5 kW Variador de velocidade mecânica Materiais : Eixo e pás de Inox 304L	P	12
DECANTADOR				
Conjuntos lamelares para decantação dos flocos	placas	Superfie unitária: 62 m^2 Inclinação da placa : 60° Acessórios : Conjuntos de fixação Sistema de limpeza automática das lâminas	P	6 conjuntos
Conjuntos de caleiras para a recuperação de água clarificada	Caleiras em U com decarregadores dentados	Inox 304L	P	6 conjuntos

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Raspadores de fundo dos Actiflo®	Ponte raspadora circular	Diâmetro : 10 m Potência instalada: 0.55 kW Variador de velocidade mecânica Material : Inox 304L	P	6
Válvulas de esvaziamento dos Actiflo para operações de manutenção	Válvula borboleta	DN 80 Accionador manual Material: ferro fundido	P	6
Válvulas de esvaziamento das lamas do decantador	Válvula guilhotina	DN 150 Accionador manual Material : ferro fundido	P	12

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Bombas para a recuperação das lamas	Centrifuga	Caudal unitário: 90 m^3/h Potência unitária instalada : 15 kW Variador de frequência Materiais : Corpo e impulsor: Ferro fundido Revestimento anti-abrasivo Acessórios : Conjunto de válvulas e torneiras de isolamento e de descolmatagem	P	14 (das quais, 2 de socorro em caixa)
Separadores de microareia e lamas	Hidrociclone	Capacidade : 90 m^3/h Diâmetro do dispositivo: 420 mm Altura: 1900 mm Materiais : Corpo: Aço Revestimento interior borracha	P	12

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
MICROAREIA				
Sistema automático de dosagem de microareia	Posto de extracção de microareia	Capacidade : 1 m^3 Posto inclui: - 1 vibrador Potência unitária instalada : 0,18 kW - 1 tremonha tampão - 1 doseador Potência unitária instalada: 0,37kW - 1 tapete Potência unitária instalada : 0.55 kW - 1 hidroejector com alimentação de água industrial	P	2
Pontes rolantes para a manutenção dos Big Bags de microareia		Capacidade : 3T Alcance : 7 m Altura de elevação: 3 m Distância de deslocação: 22.5 m Carro : eléctrico Talha : eléctrica por cabo	P	2

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
TANQUE DE BOMBAGEM				
Bombas de recuperação das águas de transbordo	Centrífuga em poço seco	Caudal unitário: 300 m^3/h Potência unitária instalada : 15 kW Materiais : Corpo : Ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento	P	6 (das quais, 2 de socorro instaladas)

2.6. FILTRAÇÃO SOBRE AREIA

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
Válvulas de alimentação dos filtros em água decantada	Válvula mural	700 x 700 mm Accionador pneumático Materiais : Quadro : Inox 304L Tampa : Inox 304L Parafusos : Inox 304L Acessórios : Macaco + extensão	P	16
Válvulas de saída das águas sujas de lavagem	Válvula mural	800 x 700 mm Accionador pneumático Materiais : Quadro : Inox 304L Tampa : Inox 304L Parafusos : Inox 304L Acessórios : Macaco + extensão	P	16
Alçapão de acesso para visita dos filtros		DN 800	P	16

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
Meio filtrante	Filtro bicamada : Camada superior : brita Camada Inferior : areia	Brita : espessura : 0,10 m Areia : espessura : 1,5 m	P	16
Conjuntos de lajes	Solo filtrante em betão	Dimensões : 994 x 3600 mm Espessura : 120 mm	P	
Conjunto de crepinas de filtração		<u>Comprimento unitário :</u> 350 mm <u>Diâmetro do bocal :</u> 55 mm <u>Material</u>: Polipropileno	P	
Válvulas de lavagem	Válvula de regulação de tipo borboleta	DN 900 Accionador pneumático <u>Material</u> : Ferro fundido revestido	P	16

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
Válvulas de entrada de água de lavagem	Válvula borboleta	DN 900 Accionador pneumático Material : Ferro fundido revestido	P	16
Válvulas de entrada de ar de lavagem	Válvula borboleta	DN 350 Accionador pneumático de tipo TOR Material : Ferro fundido revestido	P	16
Válvulas de purga de ar	Válvula borboleta	DN 100 Accionador manual Material: Ferro fundido revestido	P	16
Válvulas de esvaziamento de filtro e tanque	Válvula borboleta	DN 100 Accionador manual Material: Ferro fundido revestido	P	32

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
Monocarril de manutenção dos filtros		Capacidade : 1T Altura de elevação : 4 m Distância de deslocação : 41 m Carro : manual Talha : manual por cabo	P	4
Grupos de produção de ar comprimido	Compressor de pistão	Potência unitária instalada: 11 kW Pressão de serviço: 10 bars Caudal : 60 Nm^3/h Tinta anticorrosiva <u>Acessórios</u> : 1 secador 1 balão 500 l Regulador de pressão Filtro desengordurador com purga automática Manómetro Válvulas de isolamento	P	4 (dos quais, 2 de socorro instalados)

2.7. LAVAGEM DOS FILTROS

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P)/ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
LAVAGEM DE AR				
Sopradores de ar para lavagem dos filtros	Soprador de pistões rotativos	Caudal unitário nominal : 5750 Nm^3/h Potência unitária instalada installée: 250 kW <u>Acessórios</u>: cobertura de insonorização em aço galvanizado Filtro na aspiração Silenciador na rejeição Válvula de segurança Válvula de retenção Manómetro de pressão da rejeição Detector de descolmatagem do filtro	P	4 (dos quais, 2 de secorro instalados)
Válvulas de isolamento dos sopradores	Válvula borboleta	DN 400 Accionador manual <u>Material</u>: Ferro fundido revestido	P	4

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P)/ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
Monocarril de manutenção dos sopradores		Capacidade: 5T Altura de elevação: 4,4m Distância de deslocação: 8 m Carro: manual Talha: Manual por cabo	P	4
Sistema de ventilação do local dos sopradores	Ventilador helicoidal	Potência unitária instalada: 0.75 kW Acessórios : Conjunto de registros de isolamento	P	Conjunto
Conjunto de grelhas de ventilação		Material : Aço galvanizado	P	4
LAVAGEM COM ÁGUA				
Bombas de lavagem dos filtros de caudal alto	Centrífuga de poço seco	Caudal unitário: 2615 m^3/h Potência unitária instalada : 110 kW AMT : 10 m Materiais : Corpo : Ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento	P	6 (das quais, 2 de socorro instaladas)

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P)/ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
Bombas de lavagem dos filtros de caudal baixo	Centrífuga de poço seco	Caudal unitário : 1050 m^3/h Potência unitária instalada : 45 kW AMT : 9 m Materiais : Corpo : Ferro fundido Acessórios : Variador de frequência Conjunto de válvulas e torneiras de isolamento	P	2
Válvulas de isolamento das bombas de lavagem	Válvula borboleta	DN 900 Accionador manual pneumático de tipo TOR Material : Ferro fundido revestido	P	2
Válvulas de isolamento do colector de águas de lavagem	Válvula borboleta	DN 900 Accionador manual Material: Ferro fundido revestido	P	2
Manutenção das bombas de lavagem	Ponte rolante	Capacidade : 3T Alcance : 8 m Altura de elevação : 7.5 m Distância de deslocação : 24 m Carro : eléctrico Talha : eléctrica por cabo	P	2

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P)/ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
RECICLAGEM DAS PRIMEIRAS ÁGUAS FILTRADAS				
Válvulas de isolamento do tanque das primeiras águas filtradas	Válvula borboleta	DN 600 Accionador pneumático de tipo TOR Material : Ferro fundido revestido	P	2
Bombas de recirculação das primeiras águas filtradas	Horizontal de poço seco	Caudal unitário nominal : 1485 m^3/h Potência unitária instalada : 35 kW Materiais: Corpo : ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento DN 500	P	4 (das quais, 2 de socorro instaladas)
Válvulas de isolamento dos caudalímetros	Válvula borboleta	DN 400 Accionador manual Material : Ferro fundido revestido	P	4

2.8. POSTO DE BOMBAGEM DAS ÁGUAS TRATADAS

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
BOMBAGEM DO RESERVATÓRIO ELEVADO DE ÁGUA				
Bombas de alimentação do reservatório elevado de água da estação	Centrífuga em poço seco	Caudal nominal unitário: 300 m^3/h Potência unitária instalada : 90 kW Materiais : Corpo : ferro fundido Acessórios : Conjunto de válvulas torneiras de isolamento DN 300	P	3 (das quais, 1 de socorro instalada)
Válvulas de isolamento dos caudalímetros	Válvula borboleta	DN 400 Accionador manual Material : Ferro fundido revestido	P	2
Válvulas de isolamento do reservatório elevado de água	Válvula borboleta	DN 400 Accionador manual Material : Ferro fundido revestido	P	4

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
BOMBAGEM DE REDE				
Bombas de rejeição da água tratada para a estação de bombagem intermediária	Centrífuga horizontal de câmara bipartida	Caudal nominal unitário: 3420 m^3/h AMT: 140 m Potência unitária instalada : 1750 kW Materiais: Corpo : ferro fundido Acessórios : Variador de frequência Conjunto de válvulas e torneiras de isolamento	P	6
Equipamento anti-golpe de ariete da bombagem	Balão de câmara de ar	Capacidade : 3 m^3 Pressão de serviço: 10 bars Pressão de pré-enchimento : 5 bars Materiais: Reservatório: Aço pintado com certificação alimentar Câmara de ar: butil com certificação alimentar Acessórios: Conjunto de válvulas e torneiras de isolamento Compressor de ar	P	2

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Motor de socorro em caixa		Potência unitária: 1350 kW	P	1
Válvulas de isolamento da rede que alimenta a estação de bombagem intermediária	Válvula borboleta	DN 1200 PN 16 Acionador manual Material: Ferro fundido revestido	P	4
BOMBAGEM ÁGUA MOTRIZ E CONTRA INCÊNDIOS				
Grupo de água motriz	Bomba centrífuga	6 Bombas (das quais, 1 de socorro instalada) Caudal unitário: 30 m^3/h Potência unitária do grupo: 66 kW Materiais: Corpo : ferro fundido Acessórios : Conjunto de válvulas e torneiras d'isolement Balão de expansão	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Grupo de água de incêndios	Grupo de 3 bombas	1 electrobomba jockey 1 electrobomba de serviço 1 motobomba (diesel) Caudal do grupo: 230 m^3/h Motor: Potência unitária instalada: 92 + 3 KW Corpo: Ferro fundido Impulsor: Ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento Balão de expansão	P	1
Bombas do posto todas as águas do local de bombagem das águas tratadas	Bomba centrífuga submersa	Caudal unitário: 25 m^3/h Potência unitária instalada: 5.5 kW Acessórios : Conjunto de válvulas e torneiras de isolamento	P	1
Manutenção das bombas de água tratada	Ponte rolante	Capacidade : 10T Alcance : 16 m Altura de elevação : 12 m Distância de deslocação : 49 m Carro : eléctrico Talha : eléctrica por cabo	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Sistema de ventilação do local de bombagem de água tratada	Ventilador helicoidal	Caudal unitário: 37500 m^3/h Potência unitária instalada: 7,5 kW Acessórios: Conjunto de registros de isolamento	P	Conjunto
Conjunto de grelhas ventilação		Materiais: Aço galvanizado	P	

2.9. DECANTAÇÃO DAS ÁGUAS SUJAS DOS ACTIFLO

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
COAGULAÇÃO				
Agitadores dos tanques de coagulação dos Actidyn®	Agitador pendular	Potência unitária instalada : 0,75 kW Materiais: Eixo e hélice em Inox 304L Acessórios : Variador de velocidade mecânico	P	2
FLOCULAÇÃO				
Agitatadores dos tanques de floculação dos Actidyn®	Agitador pendular	Punitária instalada: 1,1 kW Materiais: Eixo e hélice em inox 304L Acessórios : Variador de velocidade mecânico	P	2
Válvulas de esvaziamento do tanque de floculação	Válvula guilhotina	DN 80 Accionador manual Material: ferro fundido	P	2

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
DÉCANTAÇÃO				
Raspador de fundo dos Actidyn®	Ponte raspadora circular	Diâmetro: 6.80 m Potência unitária instalada: 0,55 kW Material: Inox 304L Acessórios : Variador de velocidade mecânico	P	2
Conjuntos lamelares para decantação dos flocos	Placas	Surfície : 30 m^2 Inclinação da placa : 60° Acessórios : Conjuntos de fixação	P	2 conjuntos
Conjunto de caleiras para a recuperação da água clarificada	Caleiras em U com descarregadores dentados	Material : Inox 304L	P	2 conjuntos
Válvulas de esvaziamento dos Actydyn® para operações de manutenção	Válvula guilhotina	DN 80 Accionador manual Material: ferro fundido	P	2

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
BOMBAGEM DE LAMAS				
Bombas de extracção das lamas dos Actidyn®	Bomba de parafuso excêntrico	Caudal unitário : 40 m^3/h Potência unitária instalada: 7,5 kW Materiais: Corpo: ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento, de repartição e de descolmatagem	P	4 (das quais, 2 de socorro instaladas comuns aos Actidyn das águas sujas de lavagem dos filtros)

2.10 DECANTAÇÃO DAS ÁGUAS SUJAS DE LAVAGEM DOS FILTROS

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
TANQUE DE ÁGUAS SUJAS DE LAVAGEM				
Bombas das águas sujas de lavagem	Centrífuga em poço seco	Caudal unitário: 330 m^3/h Potência unitária instalada: 18.5 kW Materiais: Corpo : ferro fundido Acessórios : Variador de frequência Conjunto de válvulas e torneiras de isolamento	P	4 (das quais, 2 de socorro instaladas)
COAGULAÇÃO				
Agitatadores dos tanques de coagulação dos Actidyn®	Agitador pendular	Potência unitária instalada: 0.75 kW Materiais: Eixo e hélice em inox 304L Acessórios : Variador de velocidade mecânico	P	2

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
FLOCULAÇÃO				
Agitadores dos tanques de floculação dos Actidyn®	Agitador pendular	Potência unitária instalada: 1.1 kW Materiais: Eixo e hélice em inox 304L Acessórios : Variador de velocidade mecânico	P	2
Válvulas de esvaziamento do tanque de floculação	Válvula guilhotina	DN 80 Accionador manual Material: ferro fundido	P	2
DÉCANTAÇÃO				
Raspadores de fundo dos Actidyn®	Ponte raspadora circular	Diâmetro : 6.80 m Potência unitária instalada: 0.55 kW Material : Inox 304L Acessórios : Variador de velocidade mecânico	P	2
Conjunto lamelar para decantação dos flocos	Placas	Superfície : [illegible]0 m^2 Inclinação da placa: 60° Acessórios : Conjuntos de fixação	P	2 Conjuntos

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Conjunto de caleiras de recuperação de água clarificada	Caleiras em U com descarregadores dentados	Material : Inox 304L	P	2 conjuntos
Válvulas de esvaziamento dos Actidyn® para operações de manutenção	Válvula guilhotina	DN 80 Accionador manual Material: ferro fundido	P	2
BOMBAGEM DAS LAMAS				
Bombas de extracção das lamas dos Actidyn®	Parafuso excêntrico	Caudal unitário : 40 m^3/h Potência unitária instalada: 7.5 kW Material: Corps : ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento, de repartição e de descolmatagem	P	2

2.12. TRATAMENTO UV DAS ÁGUAS DECANTADAS

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Tratamento UV das águas decantadas	Reactor UV	Caudal unitário : 380 m^3/h Potência unitária instalada: 8 kW Acessórios : Conjunto de válvulas e torneiras de isolamento	P	4
Válvulas de isolamento para a neutralização	Válvula borboleta	DN 350 PN10 Accionador manual Material : Ferro fundido revestido	P	2
Bombas de recuperação das águas decantadas	Centrífuga de poço seco	Caudal unitário: 360 m^3/h Potência unitária instalada: 15 kW Material: Corpo : ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento	P	6 (das quais, 2 de socorro instaladas)

2.13. PREPARAÇÃO DE LEITE E DE ÁGUA DE CAL

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
PREPARAÇÃO DE LEITE DE CAL				
Sistemas automáticos de dosagem de cal	Posto de extracção Big-bag	Capacidade : 1 m^3 Acessórios incluídos no posto: - 1 vibrador : Potência unitária instalada: 0,18 kW - 1 tremonha tampão: - 2 doseadores: Potência unitária instalada: 0,37 kW - 2 tapetes: Potência unitária instalada: 0.55 kW 1 filtro de despoeiramento	P	2
Agitadores dos tanques de preparação de leite de cal	Pendular	Potência unitária instalada: 3 kW Material: Eixo e pás em Inox 304L	P	4
Segurança do pessoal	Chuveiro de segurança e lava-olhos	Com válvula manual de alimentação	P	1
Bombas de leite de cal. Injecção para o Actiflo®	Bomba de rotor excêntrico	Caudal unitário : 1335 l/h Potência unitária instalada: 1,1 kW Acessórios : Variadores de frequência Válvulas de repartição	P	9 (das quais, 1 de secorro em caixa)

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
PREPARAÇÃO DE ÁGUA DE CAL				
Bombas de leite de cal. Injecção para os saturadores	Parafuso excêntrico	Caudal unitário : 3000 L/h Potência unitária instalada: 3 kW Acessórios : Variador de frequência Válvulas de repartição	P	3 (das quais 1 de socorro instalada)
Agitadores dos saturadores	Pendular	Potência unitária instalada: 1.1 kW Material : Eixo e pás em Inox 304L Acessórios : Variador de velocidade mecânico	P	2
Raspadores do fundo do saturador	Ponte raspadora circular	Diâmetro : 4 m Potência unitária instalada: 0.55 kW Material : Inox 304L Acessórios : Variador de velocidade mecânico	P	2
Conjunto lamelar para decantação	Placas	Superfície : 10,9 m^2 Inclinação da placa: 60° Acessórios : Conjuntos de fixação	P	2 Conjuntos

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Conjunto das caleiras de recuperação de águas de cal	Caleiras em U com descarregadores dentados	<u>Material</u> : Inox 304L	P	2 Conjuntos
Válvulas de esvaziamento parcial para limpeza das lâminas	Válvula guilhotina	DN 80 Accionador manual <u>Material</u>: ferro fundido	P	2
Bombas de extracção dos grumos de cal	Bomba de rotor excêntrico	Caudal unitário: 5 m^3/h Potência unitária instalada: 3 kW <u>Materiais</u> : Corpo : Ferro fundido Revestimento antiabrasivo Eixo : inox <u>Acessórios</u> : Conjunto de válvulas e torneiras de isolamento e de descolmatagem	P	3 (das quais, 1 de socorro instalada)
Bombas de água de cal. Injecção	Bomba de rotor excêntrico	Caudal unitário: 82 800 L/h Potência unitária instalada: 11 kW <u>Acessórios</u> : Variador de frequência Conjunto de válvulas e torneiras de isolamento	P	3 (das quais, 1 de socorro instalada)

2.14. CLORAÇÃO INTERMEDIÁRIA E FINAL

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P)/ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
ARMAZENAMENTO DE CLORO E EXTRACÇÃO DE CLORO				
Armazenamento de cloro	Cilindro de cloro gasoso	Capacidade : 1 tonelada	P	36 (dos quais, 30 em espera)
Inversor que permite a passagem de uma linha de cilindros à outra	Inversor automático	Acessórios : Reservatório de expansão Conjunto de válvulas e torneiras de isolamento	P	1
Evaporador		<u>Potência instalada</u>: 9 kW <u>Acessórios</u> : Conjunto de válvulas e torneiras de isolamento	P	4 (2 dos quais de socorro instalados)
Regulador de vácuo	Pré-reguladores	<u>Acessórios</u> : Conjunto de válvulas e torneiras de isolamento Filtro de carbono activado	P	4 (dos quais, 2 de socorro instalados)
Separador de cloro líquido		<u>Acessórios</u> : Conjunto de válvulas e torneiras associado	P	4 (dos quais, 2 de socorro instalados)
Segurança do pessoal	Chuveiro de segurança e lava-olhos	Com válvula manual de alimentação	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P)/ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
Manutenção dos cilindros de cloro	Ponte rolante	Capacidade : 1.5T Alcance: 8 m Altura de elevação: 4 m Distância de deslocação: 36 m Carro: eléctrico Talha: eléctrica por cabo	P	1
Sistema de ventilação do local de cloração	Ventilador helicoidal	Potência unitária instalada: 0,55 kW Acessórios: Conjunto de registros de isolamento	P	Conjunto
Conjunto de grelhas de ventilação		Materiais: Aço galvanizado	P	
LOCAL CLORÓMETRO				
Clorómetros	Dosagem automática através de um servomotor	Capacidade : 0 à 20 Kg/h Acessórios : Conjunto de válvulas e torneiras de isolamento e de repartição	P	6 (dos quais, 2 de socorro)
Injectores de cloro	Hidroinjector	Acessórios : Reductor de pressão Conjunto de válvulas e torneiras de isolamento	P	4
Segurança do pessoal	Chuveiro de segurança e lava-olhos	Com válvula manual de alimentação	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P)/ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
NEUTRALIZAÇÃO DAS FUGAS				
Extractores das fugas de cloro	Ventilador centrífuga	Potência unitária instalada: 5,5 kW Acessórios: Válvulas de retenção Registros manuais de isolamento	P	4 (das quais, 2 de segurança)
Coluna de lavagem	Coluna com enchimento	A coluna de lavagem inclui: 1 Eliminador de névoa e a sua estrutura, 1 Rampa de pulverização de soda, Anéis de enchimento	P	1
Bombas de recirculação da solução neutralizante	Centrífuga	Caudal unitário: 25 m^3/h Potência unitária instalada: 4 kW Material: Material plástico Acessórios : Conjunto de válvulas e torneiras de isolamento Válvula de retenção	P	2 (das quais, 1 de socorro instalada)
Agitador	Pendular	Potência unitária instalada : 0,75 KW Material : Eixo e hélice em Inox 304L	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P)/ALUGADO (A)	NO.MÍNIMO NECESSÁRIO
Permutador térmico para a solução neutralizante	Permutador por placa	Acessórios: Conjunto de válvulas e torneiras de isolamento Termómetros	P	1
Segurança do pessoal	Chuveiro de segurança e lava-olhos	Com válvula manual de alimentação	P	1

2.15. PREPARAÇÃO DE SULFATO DE ALUMÍNIO

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
PREPARAÇÃO				
Sistemas automáticos de descarga dos sacos de sulfato de alumínio	Posto de extracção Big-bag	Capacidade : 1 m^3 Acessórios do posto: - 1 vibrador : Potência unitária instalada: 0,18 kW - 1 tremonha tampão: - 2 doseadores: Potência unitária instalada: 0,37kW - 2 tapetes: Potência unitária instalada: 0.55 kW	P	2
Agitadores para a mistura do coagulante nos tanques de preparação	Agitador pendular	Potência unitária instalada: 3 kW Matéria: Eixo e pás em Inox 304L	P	4
COAGULAÇÃO ACTIFLO				
Bombas para injecção de coagulante	Doseadora de parafuso excêntrico	Caudal unitário: 950 L/h Potência unitária instalada: 0,75 kW Acessórios : Válvulas de repartição e armários Variadores de frequência	P	12 (das quais, 4 de socorro instalada)

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
COAGULAÇÃO ACTIDYN				
Bombas para injecção de coagulante	Doseadora de parafuso excêntrico	Caudal unitário nominal : 35 L/h Potência unitária instalada: 0,75 kW Acessórios : Conjunto de válvulas e torneiras de isolamento e armário Variadores de frequência	P	4
Segurança do pessoal	Chuveiro de segurança e lava-olhos	Com válvula manual de alimentação	P	1
Ventilação do local de preparação de sulfato de alumínio	Ventilador heliccidal	Potência unitária instalada: 0,37 kW Acessórios: Conjunto de registros de isolamento	P	Conjunt
Conjunto de grelhas de ventilação		Material: Aço galvanizado	P	

2.16. PREPARAÇÃO DE POLIELECTRÓLITO

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
POLÍMERO DOS ACTIDYN DAS ÁGUAS DE LAVAGEM DOS FILTROS				
Preparação automática de polielectólito para os Actidyn das águas sujas de lavagem	Central de polímero	Potência instalada: 1 kW A instalação inclui: - 1 linha de chegada de água que inclui: 1 válvula de paragem e de regulação 1 Regulador de pressão 1 Electroválvula 1 Contador - 1 doseador de pó - 1 tanque de três compartimentos (molhagem, maturação, extracção) equipado com: 1 agitador no tanque de molhagem 1 agitador no tanque de maturação Acessórios: Indicação de nível no tanque de extracção Armário de gestão automática Materiais : Tremonha de alimentação : PEHD Tanques : poliéster Agitatador : inox 304L	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Bombas de polímero	Doseadora de parafuso excêntrico	Caudal unitário: 20 l/h Potência unitária instalada: 0.37 kW Material : Corpo : Ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento e de repartição Variador de frequência	P	2

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
POLÍMERO DOS SATURADORES				
Preparação automática de polielectrolito para os saturadores de cal	Central de polímero	Potência instalada: 1 kW A instalação inclui: - 1 linha de chegada de água que inclui: 1 válvula de paragem e de regulação 1 Regulador de pressão 1 Electroválvula 1 Contador - 1 doseador de pó - 1 tanque de três compartimentos (molhagem, maturação, extracção) equipado com: 1 agitador no tanque de molhagem 1 agitador no tanque de maturação Acessórios: Indicação de nível no tanque de extracção Armário de gestão automática Materiais : Tremonha de alimentação : PEHD Tanques : poliéster Agitatador : inox 304L	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Bombas de polímero	Doseadora de parafuso excêntrico	Caudal unitário: 14 l/h Potência unitária instalada: 0.37 kW Material : Corpo : Ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento e de repartição Variador de frequência	P	2
Segurança do pessoal	Chuveiro de segurança e lava-olhos	Com válvula manual de alimentação	P	1
Bombas do posto todas as águas do local dos reagentes	Bomba centrífuga submersa	Caudal unitário: 25 m^3/h Potência unitária instalada: 5.5 kW Acessórios : Conjunto de válvulas e torneiras de isolamento	P	2 (das quais, 1 de socorro em caixa)

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
POLÍMERO DOS ACTIFLO				
Preparação automática de polielectólito para a floculação Actiflo	Central de polímero	Potência unitária instalada: 2.2 kW A instalação inclui: - 1 linha de chegada de água que inclui: 1 válvula de paragem e de regulação 1 Regulador de pressão 1 Electroválvula 1 Contador - 1 doseador de pó - 1 tanque de três compartimentos (molhagem, maturação extracção) equipado com: 1 agitador no tanque de molhagem 1 agitador no tanque de maturação Acessórios: Indicação de nível no tanque de extracção Armário de gestão automática Materiais : Tremonha de alimentação : PEHD Tanques : poliéster Agitatador : inox 304L	P	3 (das quais, 1 de socorro instalado)

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Bombas de polímero	Doseadora de parafuso excêntrico	Caudal unitário: 500 l/h Potência unitária instalada: 0.37 kW Material : Corpo: Ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento e de repartição Variador de frequência	P	12 (das quais 4 de socorro instaladas)

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
POLÍMERO DOS ACTIDYN DAS ÁGUAS SUJAS DOS ACTIFLO				
Preparação automática de polielectrólito para os Actidyn das águas sujas dos Actiflo	Centra de polímero	Potência instalada: 1.5 kW A instalação inclui: - 1 linha de chegada de água que inclui: 1 válvula de paragem e de regulação 1 Regulador de pressão 1 Electroválvula 1 Contador - 1 doseador de pó - 1 tanque de três compartimentos (molhagem, maturação, extracção) equipado com: 1 agitador no tanque de molhagem 1 agitador no tanque de maturação <u>Acessórios:</u> Indicação de nível no tanque de extracção Armário de gestão automática <u>Materiais</u> : Tremonha de alimentação : PEHD Tanques : poliéster Agitatador : inox 304L	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Bombas de polímero	Doseadoras de parafuso excêntrico	Caudal unitário : 600 l/h Potência unitária instalada: 0.37 kW Material : Corpo: Ferro fundido Acessórios : Conjunto de válvulas e torneiras de isolamento e de repartição Variador de frequência	P	3 (das quai 1 de socorro em caixa)
Segurança do pessoal	Chuveiro de segurança e lava-olhos	Com válvula manual de alimentação	P	1

2.17. UNIDADE DE TRATAMENTO DAS ÁGUAS USADAS DA ESTAÇÃO

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
TRATAMENTO DAS ÁGUAS USADAS DA ESTAÇÃO DE BOMBAGEM				
Grade	Grade manual	Inox 304L	P	1
Válvula de isolamento da fossa séptica	Válvula mural	Accionador manual Materiais : Quadro : Inox 304L Tampa: Inox 304L Parafusos: Inox 304L	P	1
TRATAMENTO DAS ÁGUAS USADAS DA ESTAÇÃO DE PRODUÇÃO DE ÁGUA POTÁVEL				
Grade	Grade manual	Inox 304L	P	1
Válvula de seccionamento de caudal	Modular por máscaras	Inox 304L	P	1
Válvulas de isolamento dos leitos de macrófitos	Válvulas murais	Accionador manual Materiais: Quadro: Inox 304L Tampa: Inox 304L Parafusos: Inox 304L	P	1
Condutas de alimentação dos leitos de macrófitos		DN 100 Inox 304L	P	Conjunto

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Suporte dos macrófitos	Brita		P	Conjunto
Drenos de infiltração		DN 160 PVC	P	Conjunto
Chaminés de arejamento		DN 160	P	Conjunto
Membrana de impermeabilidade	Geomembrana	Membrana EPDM	P	1

3. INSTRUMENTAÇÃO

3.1 ELEVAÇÃO DE ÁGUA BRUTA

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
CANAL DE ÁGUA BRUTA				
Medição de nível do canal	Piezométrica		P	1
Detector de nível	Bóia de nível	Nível muito alto	P	1
TANQUE DE ÁGUA BRUTA				
Analisador de hidrocarboneto da água bruta	Laser		P	1

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Medição de nível do tanque	Piezométrica		P	1
Detectores de nível	Bóia de nível	Nível muito baixo Nível muito alto	P	2
ESTAÇÃO DE BOMBAGEM				
Medições de pressão da bombagem	de membrana		P	6
Analisador de turvação da água bruta	Óptico		P	1
Medição da temperatura da água bruta	Por resistências		P	1
Analisador de pH da água bruta	Eléctrodo		P	1
Analisador de rH da água bruta	Eléctrodo		P	1

3.2 ALIMENTAÇÃO DA ESTAÇÃO DE TRATAMENTO

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
ALIMENTAÇÃO DA ESTAÇÃO DE TRATAMENTO				
Medições de caudal de água bruta	Electromagnético	Caudal unitário : 11 237 m^3/h DN 1200, PN 6 Revestimento interior em poliuretano Qualidade da água potável Acessórios: Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2

3.3 DECANTAÇÃO LAMELAR ACTIFLO

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
INSTALAÇÃO DE REPARTIÇÃO				
Analisadores da turvação da água bruta	Óptica		P	2
FLOCULAÇÃO				
Analisadores do pH de floculação	Eléctrodo		P	6
MATURAÇÃO				
Analisadores do pH de maturação	Eléctrodo		P	6
DECANTAÇÃO				
Medições de nível da parede das lamas	Óptica		P	6
RECIRCULAÇÃO DA MICROAREIA				
Medição de pressão na entrada de cada hidrociclone	de membrana		P	12
RECUPERAÇÃO DAS ÁGUAS SUJAS DO ACTIFLO				
Medições de nível dos tanques	Piezometrica		P	2

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Detectores de nível	Bóia de nível	Nível muito baixo Nível baixo Nível muito alto	P	6
Medições de caudal de águas sujas	Electromagnético	Caudal unitário: 576 m^3/h DN 250, PN 10 Revestimento interior em poliuretano Qualidade da água potável <u>Acessórios:</u> Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2
INJECÇÃO DE MICROAREIA				
Detectores de nível nas tremonhas de cargamento	Lâmina vibrante	Nível muito baixo	P	2

3.4 FILTRAÇÃO DE AREIA

NOME DO EQUIPAMENTO	TIPO	CARACTÉRÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
FILTRO DE AREIA				
Analisadores de turvação de água decantada	Óptico		P	2
Medições de nível nos filtros	US		P	16
Medições de pressão em saída de filtração	de membrana		P	16
Medições de nível de água filtrada nos tanques	Piezométrica		P	16
LOCAL SOPRADOR				
Medições de pressão de ar	de membrana		P	2
Medições de temperatura nos locais	Por resistências		P	2

3.5 RESERVA DE LAVAGEM DOS FILTROS

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
RESERVA DE LAVAGEM DOS FILTROS				
Analisadores de turvação da água filtrada	Óptico		P	2
Medições de nível nos tanques	Piezométrica		P	2
Detectores de nível	Bóia de nível	De nível baixo De nível muito baixo De nível muito alto	P	6
Medições de caudal de água de lavagem	Electromagnético	Caudal unitário : 5 225 m^3/h DN 800, PN 10 Revestimento interior em poliuretano Qualidade da água potável <u>Acessórios :</u> Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2

3.6 RECIRCULAÇÃO DAS PRIMEIRAS ÁGUAS FILTRADAS

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
RECIRCULAÇÃO DAS PRIMEIRAS AGUAS FILTRADAS				
Medições de nível dos tanques	Piezométrica		P	2
Detectores de nível	Bóia de nível	De nível baixo De nível muito baixo De nível muito alto	P	6
Medições de caudal de água de lavagem	Electromagnético	Caudal unitário : 1 485 m^3/h DN 400, PN 10 Revestimento interior em poliuretano Qualidade da água potável Acessórios: Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2
Analisador de turvação da água tratada	Óptico		P	2
Analisador de cloro da água tratada	Eléctrico		P	2

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Analisador de pH da água bruta	Eléctrodo		P	2

3.7 BOMBAGEM DE ÁGUA TRATADA

NOME DO EQUIPAMENTO	TIPO	CARACTERISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
BOMBAGEM PARA O RESERVATÓRIO ELEVADO DE ÁGUA DE QUILONGA				
Medição de caudal	Electromagnética	Caudal unitário : 600 m^3/h DN 400 Revestimento interior em poliuretano Qualidade da água potável Acessórios : Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	1

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
BOMBAGEM ESTAÇÃO DE BOMBAGEM INTERMEDIÁRIA				
Medições de caudal	Electromagnética	Caudal unitário: 10800 m^3/h DN 1 200 Revestimento interior em poliuretano Qualidade de água potável <u>Acessórios :</u> Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2
BOMBAGEM DA ÁGUA MOTRIZ DA CLORAÇÃO				
Medição de caudal	Electromagnético	Caudal unitário: 150 m^3/h DN 100 Revestimento interior em poliuretano Qualidade da água potável <u>Acessórios :</u> Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	1
RESERVATÓRIO ELEVADO DE ÁGUA DE QUILONGA				
Detectores de nível	Bóia de nível	Nível muito alto Nível muito baixo	P	2
Medições de nível do reservatório elevado	Piezométrica		P	1

3.8 DECANTAÇÃO ACTIDYN

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
TANQUES DE ÁGUA SUJAS				
Medições de nível dos tanques	Piezométrica		P	2
Detectores de nível	Bóia de nível	De nível baixo De nível muito baixo De nível muito alto	P	6
Medições de caudal de águas sujas	Electromagnético	Caudal unitário : 330 m^3/h DN 250 Revestimento interior em poliuretano Qualidade da água potável Acessórios: Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2
DECANTAÇÃO				
Medições de nível da parede de lamas	Óptico		P	4
BOMBAGEM DE LAMAS				
Dispositivo contra funcionamento a seco das bombas	Sensor de temperatura		P	6

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Medições de caudal de lamas	Electromagnético	Caudal unitário : 80 m^3/h DN 150 Revestimento interior em poliuretano Qualidade de água potável <u>Acessórios:</u> Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2
TANQUE DE BOMBAGEM DOS SOBRENADANTES				
Medições de nível dos tanques	Piezométrica		P	2
Detectores de nível	Bóia de nível	De nível baixo De nível muito baixo De nível muito alto	P	6
Medições de caudal de sobrenadantes	Electromagnético	Caudal unitário: 720 m^3/h DN 350 Revestimento interior em poliuretano Qualidade da água potável <u>Acessórios :</u> Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2

3.9 PREPARAÇÃO DE CAL

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
PREPARAÇÃO DE LEITE DE CAL				
Detectores de nível das tremonhas de descarga	Lâmina vibrante	Nível muito baixo	P	2
Detectores de nível dos tanques de preparação	Bóia de nível	Nível muito baixo Nível baixo Nível alto	P	12
Dispositivo contra o funcionamento a seco das bombas	Sensor de temperatura		P	8
Medições de caudal de leite de cal bombeado para os Actiflo®	Electromagnético	Caudal unitário : 1,3 m^3/h DN 25 <u>Acessórios:</u> Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	8
PREPARAÇÃO DE ÁGUA DE CAL				
Dispositivo contra o funcionamento a seco das bombas de leite de cal	Sensor de temperatura		P	3

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Medições de caudal de leite de cal	Electromagnético	Caudal unitário: 3 m^3/h DN 40 Acessórios : Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2
Medição de nível do tanque de água de cal	Piezométrica		P	1
Detectores de nível do tanque e água de cal	Bóia de nível	Nível muito baixo Nível baixo Nível alto	P	3
Dispositivo contra o funcionamento a seco das bombas	Sensor de temperatura		P	3
Medições de caudal de água de cal bombeada	Electromagnético	Caudal unitário : 83 m^3/h DN 125 Acessórios: Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2
BOMBAGEM DOS GRUMOS				
Dispositivo contra o funcionamento a seco das bombas	Sensor de temperatura		P	3

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Medição de caudal bombeado	Electromagnético	Caudal unitáro : 10 m^3/h DN 80 <u>Acessórios :</u> Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	1

3.10 CLORAÇÃO INTERMEDIÁRIA E FINAL

NOME DO EQUIPAMENTO	TIPO	CARACTÉRISTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
CLORAÇÃO				
Acompanhamento do peso dos cilindros interligados	balanças		P	6
Detector de gás	Detecção de cloro		P	3
Alarme sonoro	Buzina		P	2
Sinais luminosos intermitentes	Farol rotativo		P	3
Analisador de cloro da solução neutralizante	Detecção de cloro		P	1
Detecções de nível do reservatório de solução neutralizante	Bóia de nível	Nível muito alto, Nível alto, Nível muito baixo	P	3

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Medições de caudal bombeado	Electromagnético	Caudal unitário : 0,6 m^3/h DN 20 Acessórios: Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	2

3.13 POSTOS TODAS AS ÁGUAS

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
POSTO TODAS AS ÁGUAS N°1				
Medição de nível no tanque	Piezométrico		P	1
Detectores de nível	Bóia de nível	De nível baixo De nível muito baixo De nível muito alto	P	3
Medição de caudal bombeado	Electromagnético	Caudal unitário: 25 m^3/h DN 80 Revestimento em poliuretano Qualidade da água potável Acessórios: Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	1
POSTO TODAS AS ÁGUAS N°2				
Medição de nível no tanque	Piezométrico		P	1

NOME DO EQUIPAMENTO	TIPO	CARACTERÍSTICAS	PRÓPRIO (P) /ALUGADO (A)	No.Mínimo necessário
Detectores de nível	Bóia de nível	De nível baixo De nível muito baixo De nível muito alto	P	3
Medição de caudal bombeado	Electromagnético	Caudal unitário: 20 m^3/h DN 80 Revestimento interior em poliuretano Qualidade da água potável Acessórios: Caixa e cabo associados Conjunto de válvulas e torneiras de isolamento	P	1

C2 – OBRAS HIDRO-MECÂNICAS E ELÉCTRICAS

ÍNDICE

1. INTRODUÇÃO

O conjunto dos equipamentos eléctricos que constituem o lote 1 de QUILONGA está indicado neste documento. Inclui:

- A estação de bombagem de água bruta
- A estação de tratamento de água com um reservatório elevado de água
- As construções e as instalações auxiliares necessárias

2. EQUIPAMENTOS ALTAS TENSÕES 60KV

Nome do Equipamento	Tipo	Características	Próprio (P)/ Alugado (A)	Nº. Mínimo necessário para o Lote/Contrato
Seccionador 60KV		Número de pólos: 3 Tensão nominal de isolamento: 72.5 kV Corrente permanente atribuída: 1250 A Corrente de curto-circuito admissível: 31,5 kA, Comando tripolar Eléctrico, Dispositivo de bloqueio por fechadura sobre comando de linha e de terra, Sinalizações das posições,	P	2
Disjuntor 60KV		Número de pólos: 3 Tensão nominal de isolamento: 72.5 kV Corrente permanente atribuída: 2500 A Corrente curto-circuito admissível: 31,5 kA, Dieléctrico: Hexafluoreto SF6, Comando tripolar Eléctrico, Tipo de Comando: Carregamento da mola, Sinalizações das posições.	P	1
Transformador de medição de tensão	Condensador	Dieléctrico: Óleo Tensão nominal de isolamento: 72.5 kV Tensão admissível durante 1 min com chuva/a seco: 140 KV Potência 200 VAI Classe 0,5.	P	3

Nome do Equipamento	Tipo	Características	Próprio (P)/ Alugado (A)	Nº. Mínimo necessário para o Lote/Contrato
Transformador de medição de corrente	Tipo tanque (Forquilha)	Tensão nominal de isolamento: 72.5 kV Dieléctrico óleo - papel - quartzo Enrolamentos secundários 2	P	3
Pára-raios		Tensão nominal de isolamento: 72.5 kV Corrente de descarga nominal: 10 KA Comportamento às correntes de descarga - Corrente forte 4/10µs: 100KA - Corrente fraca 2000µs: 900KA Capacidade de curto-circuito: 50 kA	P	3
Poste eléctrico 60KV		Família: H2 - Aço galvanizado Altura: 21m Isolador: 60KV	P	56

2.1 ALIMENTAÇÕES DOS AUXILIARES DE ALTA TENSÃO

Nome do Equipamento	Tipo	Características	Próprio (P)/ Alugado (A)	Nº. Mínimo necessário para o Lote/Contrato
Rectificador 127Vdc		Alimentação 230/400 Vac Corrente contínua nominal: 40A (125V) Índice de protecção: IP20 Tipo de Bateria: Chumbo Capacidade: 330Ah Duração de descarga: 8 horas	P	2
Rectificador 48Vdc		Alimentação 230/400 Vac Corrente contínua nominal: 40A Índice de protecção: IP20 Tipo de Bateria: Chumbo Capacidade: 330Ah Duração de descarga: 8 horas	P	2

3. TRANSFORMADORES ALTAS TENSÕES

Nome do Equipamento	Tipo	Características	Próprio (P)/ Alugado (A)	Nº. Mínimo necessário para o Lote/Contrato
Transformador 60KV/11KV	Transformador de enrolamentos separados	Potência nominal: 25/30 MVA Tensão nominal de enrolamento primário: 60 kV Tensão nominal de enrolamento secundário: 11 kV Frequência: 50 Hz Transformador: Imerso em óleo mineral Tipo externo: Instalação externa Modo de arrefecimento: ONAN/ONAF Conversor de tomada: Sim Isolamento enrolamento 60 kV: 72,5 kV Isolamento enrolamento 11 kV: 17,5 kV Tensão de curto-circuito: 11% Neutro de enrolamento secundário: Ligado à terra através de uma resistência Tensão dos auxiliares (Ventilação, etc.): 220/380Vca Tensão dos auxiliares (Comando de conversor de tomada, alarmes, etc.): 127 Vcc	P	1
Resistência de ligação à terra do neutro		Tensão nominal 17,5/ √3 Intensidade nominal: 300A, Duração: 5s	P	1

Nome do Equipamento	Tipo	Características	Próprio (P)/ Alugado (A)	Nº. Mínimo necessário para o Lote/Contrato
Transformador 11KV/400V		Tipo: Transformador de enrolamentos separados Tensão nominal de enrolamento primário: 11 kV Tensão nominal de enrolamento secundário: 400V Frequência: 50 Hz Transformador: Imerso em óleo mineral Isolamento enrolamento 11 kV: 17,5 kV Acoplamento: Dyn11 Tensão de curto-circuito: 6% Regime de neutro: IT	P	5

4. QUADROS/CÉLULAS ALTAS TENSÕES

4.1 QUADRO PRINCIPAL 11 KV - ESTAÇÃO DE TRATAMENTO DE ÁGUA

Nome do Equipamento	Tipo	Características	Próprio (P)/ Alugado (A)	Nº. Mínimo necessário para o Lote/Contrato
Disjuntor 11KV		Tensão atribuída: 12 kV Tensão de isolamento: 28 kV Frequência: 50 Hz Comportamento à corrente de curto-circuito Icw: 25 KA Corrente nominal: 630A/1250A/2500 A	P	9

4.2 QUADRO SECUNDÁRIO 11 KV - SUBESTAÇÕES ELÉCTRICAS

Nome do Equipamento	Tipo	Características	Próprio (P)/ Alugado (A)	Nº. Mínimo necessário para o Lote/Contrato
Interruptor 11KV		Tensão atribuída: 12 kV Frequência: 50 Hz Comportamento à corrente de curto-circuito Icw: 25 KA Corrente nominal: 630 A	P	10
Disjuntor 11KV		Tensão atribuída: 12 kV Frequência: 50 Hz Comportamento à corrente de curto-circuito Icw: 25 KA Corrente nominal: 400/630/1250 A	P	4
Arranque motor Disjuntor 11KV		Tensão atribuída: 12 kV Frequência: 50 Hz Comportamento à corrente de curto-circuito Icw: 25 KA Corrente nominal: 400/630/1250 A	P	6

4.2.1 Central grupos electrogéneos 11 KV - Subestações eléctricas

Nome do Equipamento	Tipo	Características	Próprio (P)/ Alugado (A)	Nº. Mínimo necessário para o Lote/Contrato
Disjuntor 11KV		Tensão atribuída: 12 kV Tensão de isolamento: 28 kV Frequência: 50 Hz Comportamento à corrente de curto-circuito Icw: 25 KA Corrente nominal: 630A/1250A/2500 A	P	7

4.2.2 Quadro principal 11 KV - Posto de bombagem águas brutas

Nome do Equipamento	Tipo	Características	Próprio (P)/ Alugado (A)	Nº. Mínimo necessário para o Lote/Contrato
Disjuntor 11KV		Tensão atribuída: 12 kV-50Hz Tensão de isolamento: 28 kV Comportamento à corrente curto-circuito Icw: 25 KA Corrente nominal: 630A/1250A/2500 A	P	9

4.2.3 Arranque motor 11 KV - Posto de bombagem águas brutas

Nome do Equipamento	Tipo	Características	Próprio (P)/ Alugado (A)	Nº. Mínimo necessário para o Lote/Contrato
Arranque motor por auto-transformador 11KV		Tensão atribuída: 12 kV Frequência: 50 Hz Comportamento à corrente de curto-circuito Icw: 4 KA Corrente nominal: 152 A Bateria de condensador: integrada	P	6

4.2.4 Central grupos electrogéneos 11 KV - Posto de bombagem águas brutas

Nome do Equipamento	Tipo	Características	Próprio (P)/ Alugado (A)	Nº. Mínimo necessário para o Lote/Contrato
Disjuntor 11KV		Tensão atribuída: 12 kV Tensão de isolamento: 28 kV Frequência: 50 Hz Comportamento à corrente de curto-circuito Icw: 25 KA Corrente nominal: 630A/1250A/2500 A	P	7

5. VARIADORES DE VELOCIDADE ALTAS TENSÕES

Nome do Equipamento	Tipo	Características	Próprio (P)/ Alugado (A)	Nº. Mínimo necessário para o Lote/Contrato
Variador de velocidade 11KV		Conversor Multi-níveis IGBT Reacção na rede distribuição Díodos de impulso 36 impulsos Tensão nominal de entrada 11 kV Tipo de entrada 3 fases Frequência de entrada 50/60 Hz + 3% Variador MV IGBT Controlo conversor PWM digital Tensão de saída 11000 Vrms Tipo saída 3 fases Faixa frequência saída 5..70 Hz Saída frequência nominal 50/60 Hz Rendimento na P. nominal ~97% Factor de potência ≥ 0,96 Controlo motor U/f ou controlo vectorial Quadrantes 2 Modo de travagem de tipo não (THDI saída < 2%)	P	6
Transformador de entrada variador de velocidade 11KV	seco	Tensão de entrada kV 11 Tensão de saída: 30 x 640 V Índice de protecção: 31 Arrefecimento: Ar Potência: 2754 Kva	P	6
Armário variador de velocidade 11KV		Índice de protecção 31 Nível sonoro < 80 dB (A) @ 1m Arrefecimento Ar	P	6

6. EQUIPAMENTOS BAIXAS TENSÕES 400V

Nome do Equipamento	Tipo	Características	Próprio (P)/ Alugado (A)	Nº. Mínimo necessário para o Lote/Contrato
Quadro Geral Baixa Tensão		Forma: 2b, Intensidade admissível: 2500A, Corrente de curto-circuito admissível: 50KA, Índice de protecção: IP 31, Regime de neutro: IT Equipamentos auxiliares: - Central de medição, - Controlador permanente de isolamento, - Busca de defeito,	P	5
Disjuntor chegada transformador		Tipo de protecção chegada: - Desconectável sobre chassis	P	5
Ondulador	Online (Dupla conversão)	Autonomia: 10min Regime de neutro: TNS	P	10
Transformador de isolamento		Tensão primária: 400V 3P Tensão secundária: 400V 3P+Neutro Regime de neutro: TNS	P	10
Variador de velocidade 400V		Tensão de alimentação: 400 V Alimentação frequência: 50/60 Hz ± 5% Frequência de saída: 0,1... 599 Hz Potência: 0,37 à 15 KW Tensão de alimentação: 400 V Alimentação frequência:	P	46

Nome do Equipamento	Tipo	Características	Próprio (P)/ Alugado (A)	Nº. Mínimo necessário para o Lote/Contrato
		50/60 Hz ± 5% Frequência de saída: 0,1... 500 Hz Potência: 0,37 à 630 KW		
Motor de arranque 400V		Tensão de alimentação: 400 V Alimentação frequência: 50/60 Hz ± 5% Potência: 4 à 630 KW	P	15
Revestimento Armários		Protecção: IP23	P	100

7. CENTRAL GRUPOS ELECTROGÉNEOS

Nome do Equipamento	Tipo	Características	Próprio (P)/ Alugado (A)	Nº. Mínimo necessário para o Lote/Contrato
Grupo Electrogéneo		Grupo Electrogéneo tipo coberto (Não insonorizado) para instalação externa, Potência nominal a 40°C: 2500 KVA Frequência nominal: 50 Hz Tensão de saída: 11000 V Factor de potência: 0,8 Velocidade motor: 1500 rpm Equipamentos auxiliares: - Sistema de controlo/Comando, - Módulo de sincronização automática, - Motor de arranque eléctrico, - Bomba de alimentação combustível, - Bomba de lubrificação, com óleo, - Sistema de arrefecimento do motor com água, - Radiador de arrefecimento: Tipo dianteiro, Rendimento a 75% de carga: 95,7% Rendimento a 100% de carga: 95,8% Classe de isolamento: F Grau de protecção: 23	P	10

Nome do Equipamento	Tipo	Características	Próprio (P)/ Alugado (A)	N°. Mínimo necessário para o Lote/Contrato
Gerador homopolar		Dieléctrico: Óleo Tensão Primária: 11 KV Tensão Secundária: 400 V Nível de isolamento 38 KV Acoplamento primário: Estrela Acoplamento secundário: Triângulo Aberto Corrente permanente: 5 A Corrente de defeito limitado: 20 A durante 5 s	P	2

8. AUTOMATISMO E SUPERVISÃO

8.1 AUTOMATOS

Nome do Equipamento	Tipo	Características	Próprio (P)/ Alugado (A)	Nº. Mínimo necessário para o Lote/Contrato
Autómato		Unidade Central: TSXH5744M ou equivalente Memória: SRAM 1,7MO ou equivalente	P	8
Entradas Saídas remotas		Módulo de comunicação: Ethernet Módulo Entradas TOR: 16 vias 24vCC Módulo Saídas TOR: 16 vias 0,5A Módulo Entradas ANA: 8 vias 0-20mA Módulo Saídas ANA: 2 vias 4-20mA	P	20

8.1.1 Teletransmissor

Nome do Equipamento	Tipo	Características	Próprio (P)/ Alugado (A)	Nº. Mínimo necessário para o Lote/Contrato
Teletransmissor			P	1
Modem Rádio			P	1

8.1.2 Supervisão

Nome do Equipamento	Tipo	Características	Próprio (P)/ Alugado (A)	Nº. Mínimo necessário para o Lote/Contrato
PC de supervisão		Processador: 3.30 GHz Memória: 4 Go RAM Discos Duros: 500 Go Ecrã: Prato 24"	P	3
Servidor de supervisão		Processador: 2.13 GHz Memória: 4 Go RAM Discos Duros: 500 Go	P	2
Painel PC de Supervisão		Processador: 1.6 GHz Memória: 2 Go RAM Disco duro: 160 Go RAM Ecrã: Plano 21,5"	P	1
Switch		Alimentação: 24vcc	P	1

CONSTRUTORA: CENTRO CERRO ANGOLA
DONO DE OBRA: EPAL
EMPREITADA: Lote Q2 - conduta adutora - Quilonga
PRAZO: 20 meses (608 Dias de calendário)

CENTROCERRO

PLANO DE EQUIPAMENTOS

	MESES																			
DESCRIÇÃO DOS EQUIPAMENTOS:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
APOIO DE ESTALEIRO / SEGURANÇA																				
EQUIPAMENTO SEGURANÇA E AVISO (VG)	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB
VEDAÇÕES AMOVÍVEIS PARA ESTALEIRO - V.G.	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB
ARMAZÉM P/ MATERIAIS	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
MÓDULOS DE 6,21X2,44	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
MÓDULO PORTARIA	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
WC INDIVIDUAL QUÍMICO	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
GRUA TORRE																				
PLATAFORMA ELEVATÓRIA																				
GERADOR TRIFASICO	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
EQUIPAMENTO TOPOGRAFIA (VG)	1	1				1	1					1	1							
BOMBAS DE DRENAGEM	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
VEÍCULOS																				
CAMIÃO GRUA	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
VIATURAS TRANSP. PESSOAL E MERCAD.	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
VIATURAS LIGEIRAS PASSAGEIROS	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ESTRUTURA, FUNDAÇÕES, TUBAGEM E ACESSÓRIOS																				
ESCAVAÇÕES / MOVIMENTOS DE TERRAS																				
GIRATÓRIA CATERPILLAR 312 B	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
RECTROESCAVADORA 438 D	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
MULTICARREGADORA	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
MINI PÁ CARREGADORA																				
CAMIÃO BASCULANTE 4 EIXOS	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
DIVERSAS FERRAMENTAS DE INDIVIDUAIS (VG)	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB
PLACA VIBRADORA / CILINDRO PÉS DE CARNEIRO / CILINDRO ROLO	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
BETÃO ARMADO																				
MÁQUINA DE CORTE E DOBRAGEM DE FERRO	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
MÁQUINA DE CORTE DE MADEIRA	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
DIVERSAS FERRAMENTAS MANUAIS DE CARPINTEIRO	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB
DIVERSAS FERRAMENTAS MANUAIS DE SERVENTE	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB
DIVERSAS FERRAMENTAS MANUAIS DE PEDREIRO	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB
NIVEL "LASER"	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
CHAVES DIVERSAS DE APERTO E RESTANTES FERRAMENTAS "HIDRÁULICA"	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB
DIVERSOS																				
RESTANTES FERRAMENTAS / EQUIPAMENTOS, DESIGNADAMENTE ENTIVAÇÃO	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB	QB
Legenda:																				

"QB" - em quantidade e qualidade suficientes para as actividades em curso no momento;

Acronyms and abbreviations

Acronymes/ abbreviations	Description
CH_4	Methane
CO_2	Carbon dioxide
ASS	Environmental, Health and Safety
PE	Equator Principles
IFPE	Equator Principles Financial Institution
GEE	Greenhouse gas
PAG	Global warming potential
HFCs	Hydrofluorocarbons
CFI	International Finance Corporation
PIMC	Intergovernmental Panel on Climate Change
N_2O	Nitrous oxide
PFCs	Perfluorocarbons
SF_6	Sulfur hexafluoride

Units

Units	Description
CO_2e	Carbon dioxide equivalents
$kgCO_2$	Kilograms of carbon dioxide
km	Kilometres
m	Metres
MWh	Megawatt hours
t	Tonnes

EXECUTIVE SUMMARY

This technical report estimates the quantity of greenhouse gas (GHG) that will be emitted during the operational phase of the proposed Quilonga water treatment plant. The proposed project is the construction of a new water abstraction plant from the River Kuanza, water treatment plant and water distribution into Luanda, the capital of Angola. The perimeter of this analysis is limited to Lots 1 and 10, namely the systems of water intake, of treatment of raw water and of final sludge treatment but not the distribution system.

The report has been prepared to meet the requirements of Performance Standard 3 of the Equator Principles (EP), defining the physical project boundary, and limit of direct and indirect GHG emissions for the operational phase of the project.

Estimated carbon dioxide equivalent (CO2e) emissions for the consumption of electricity were calculated using emission factors data of the IFC Carbon Emissions Estimation Tool 2014 for electricity consumption and of the GHG Protocol (Calculating CO2 Emissions – Guidance to calculation worksheets -2005) for transport emissions. On the assumption of a total treated flow of 518,000 m3 per day, namely the operation of two lines of 3 m3/s, emissions were assessed to be approximately 62,266 tones CO2e per year, with more than 99% resulting from electricity consumption. This suggests the project is likely to exceed the EP threshold of 25,000 tonnes CO2e, for which companies are encouraged to report annually on emissions, and for which the International Finance Corporation (IFC) standards require reporting.

1. INTRODUCTION

1.1. PURPOSE OF THIS TECHNICAL REPORT

The purpose of this technical report is to quantify Greenhouse Gas (GHG) emissions during the operational phase of the proposed Quilonga water treatment project.

At this stage operational technology options can only be considered in a generic methodology. The estimations were calculated by considering the operation of two lines of treatment of 3m3/s, for a total treated of 6m3/s.

Subsequently, it is planned to add a new line of 3m3/s, which would increase the flow capacity of Quilonga Project to 9m3/s. We take into account this future capacity increase, as it will have a significant impact on the carbon footprint of the plant, since the electricity consumption would be higher.

The plant will be powered by an electricity transmission line. Diesel generators are foreseen as back up but they are not taken into account in this GHG assessment as their use is supposed to be infrequent.

This report has been prepared to meet the requirements of Performance Standard 3 of the Equator Principles (EP) (EP Association, 2013).

2. QUANTIFICATION OF GHG EMISSIONS

A GHG emissions estimation has been undertaken for the project in order to meet the requirements of Annex A of the EP. The estimation has been undertaken on the operational phase of the project. However, at this stage, the energy consumption estimations are based on elements of the initial consultation, but if the project is still subject to minor changes, such as changes of locations (problems of land availability for example), or technical adjustments (for the same reasons), the outlines of the project will be retained in general.

2.1. DEFINING THE PROJECT SCOPE

Once operational, power for systems of water intake, of treatment of raw water and of final sludge treatment will be supplied by the electric grid, by the power line of 60 kV from the Agostinho Neto Airport substation.

Therefore, the electricity consumption of these systems is considered as Scope 2 emissions.

The estimations were calculated by considering the operation of two lines of treatment of 3m3/s, for a total treated of 6m3/s. Subsequently, it is planned to add a new line of 3m3/s, which would increase the flow capacity of Quilonga Project to 9m3/s. We have estimated this expansion, which means higher energy consumption, in the emissions calculation.

Diesel generators are foreseen as back up but they are not taken into account in this GHG assessment as their use is supposed to be infrequent.

Direct emissions from the sludge treatment are considered negligible, as sludge from water treatment consist mainly of mineral materials and releases very few gases.

The reagents used in water treatment are not manufactured on site. In addition, the chemical process doesn't emit gas.

Consequently, the only emission sources identified as Scope 1 emissions of GHG are the combustion emissions from vehicles used by personnel on the site.

2.2. EMISSIONS CALCULATION

Emissions of GHG are calculated by multiplying a unit of activity (such as a tonne of fuel combusted) with an emissions factor (which is the average emission rate of a pollutant (greenhouse gas) per activity rate i.e. tonne carbon dioxide per tonne fuel combusted).

There are six GHGs commonly considered for GHG assessments, which are:

- carbon dioxide (CO2);
- methane (CH4);
- nitrous oxide (N2O);
- hydrofluorocarbons (HFCs);
- sulphur hexafluoride (SF6); and
- perfluorocarbons (PFCs).

In order to provide comparisons between activities, GHGs are usually expressed as carbon dioxide equivalents (CO2e). CO2e describes for a given GHG, the amount of CO2 that would have the same global warming potential (GWP) (an index of the total energy added to the climate system by the gas in question relative to that added by CO2), when measured over 100 years.

Within this assessment the emission factors taken into account are:

- CO2 emissions per kWh of Electricity for Angola, gave by the IFC Carbon Emissions Estimation Tool (2014): 390.4288 grams of CO2 per kWh (2010).
- CO2 emissions per km for average petrol cars, gave by the GHG Protocol in *Calculating CO2 Emissions – Guidance to calculation worksheets* : 0.20 kg of CO2 per km (Source: COPERT II emission factors and Transport Research Laboratory data, combined with real road testing cycle data).

The total estimated annual CO2 emissions for Scope 2 activities associated with the operation of the Project are presented in Table 1. The full calculations and assumptions used are presented in **Appendix A**.

Table 1: CO2 Emissions

Emission source		Operation of 2 lines for a total capacity of 6m3/s		Operation of 3 lines for a total capacity of 9m3/s	
		Total electricity consumption (kWh/year)	**Total CO2 (tonnes/year)**	**Total electricity consumption (kWh/year)**	**Total CO2 (tonnes/year)**
Lot 1 : water intake and treatment of raw water	Pumping station from gross water	78 978 385	30 835	118 467 578	46 253
	Water treatment process	74 748 996	29 184	112 123 495	43 776
	Reagents	2 019 585	789	3 029 378	1 183
	Other (lighting, instrumentation set…)	740 220	289	740 220	289
	Subtotal lot 1	**156 487 187**	**61 097**	**234 360 671**	**91 501**
Lot 10 : sludge treatment	Sludge process	946 158	369	1 419 236	554
	Reagents	756 673	295	1 135 009	443
	Other (lighting, instrumentation set…)	70 080	27	70 080	27
	Subtotal lot 10	**1 842 990**	**720**	**2 624 326**	**1 025**
Total lote 1 e lote 10		**Total lot 1 and lot 10**	**61 457**	**235 282 166**	**91 861**
		Estimated annual kilometers (km/year)		**Total CO2 (tonnes/year)**	
Vehicles		**800 000**		**160**	
Total lot 1, lot 10 and vehicles		**Operation of 2 lines for a total capacity of 6m3/s**		**Operation of 3 lines for a total capacity of 9m3/s**	
		Total CO2 (tonnes/year)		**Total CO2 (tonnes/year)**	
		62 266		**92 975**	

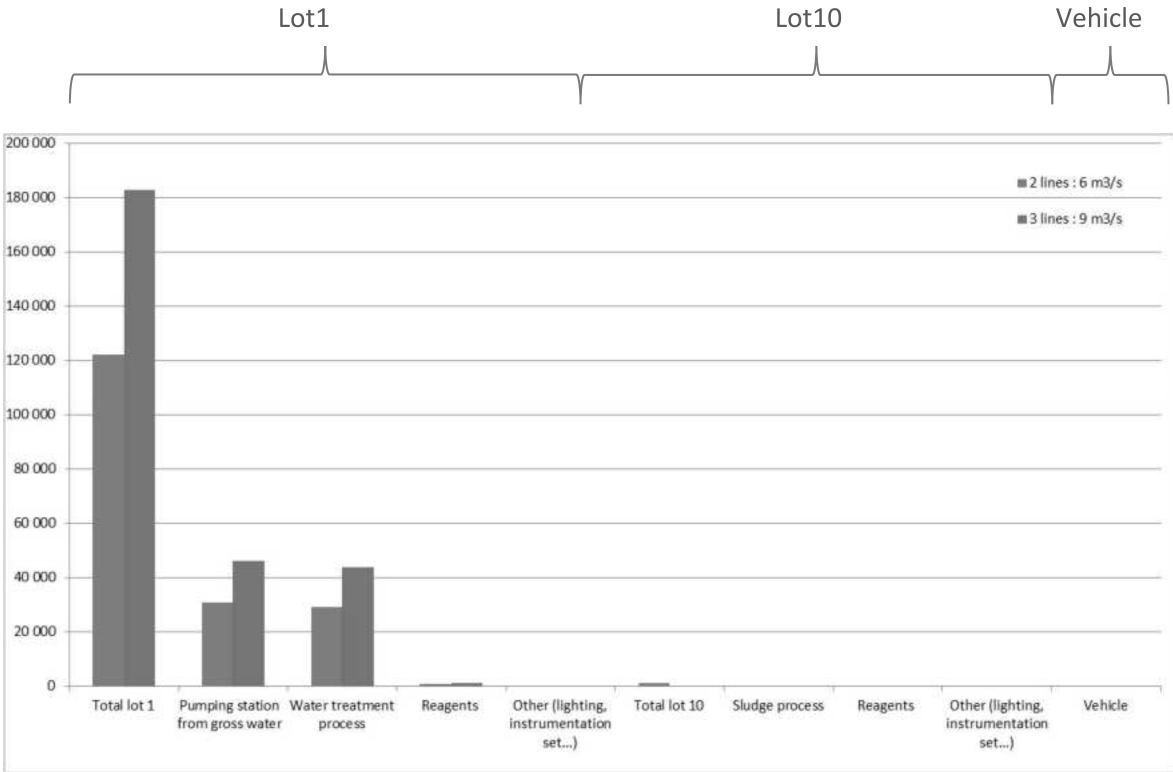

Figure 1: Comparison of the emissions of the different activities of the plant

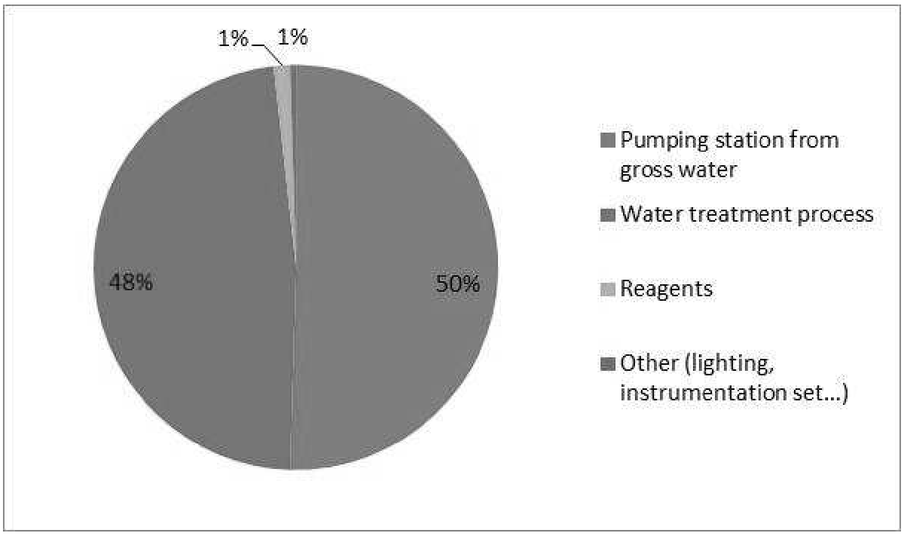

Figure 2: Repartition of emissions for Lot 1 (water intake and treatment of raw water)

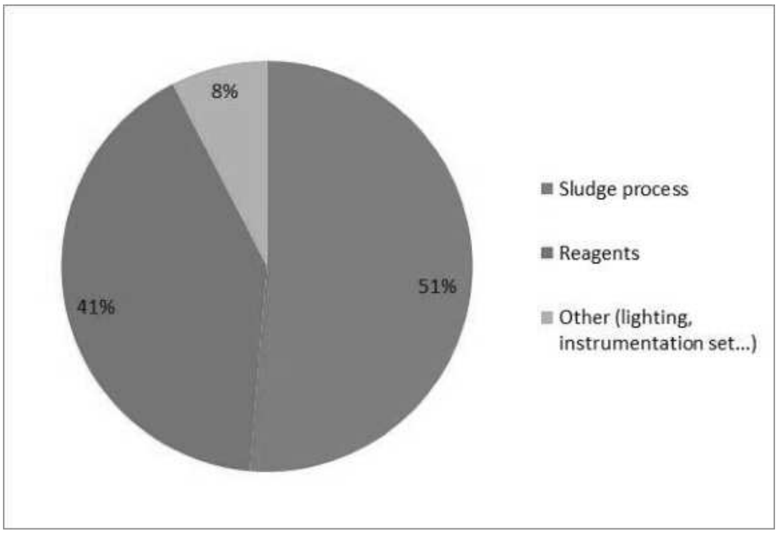

Figure 3: Repartition of emissions for Lot 10 (sludge treatment)

Zoom on the most CO2 emitting process:

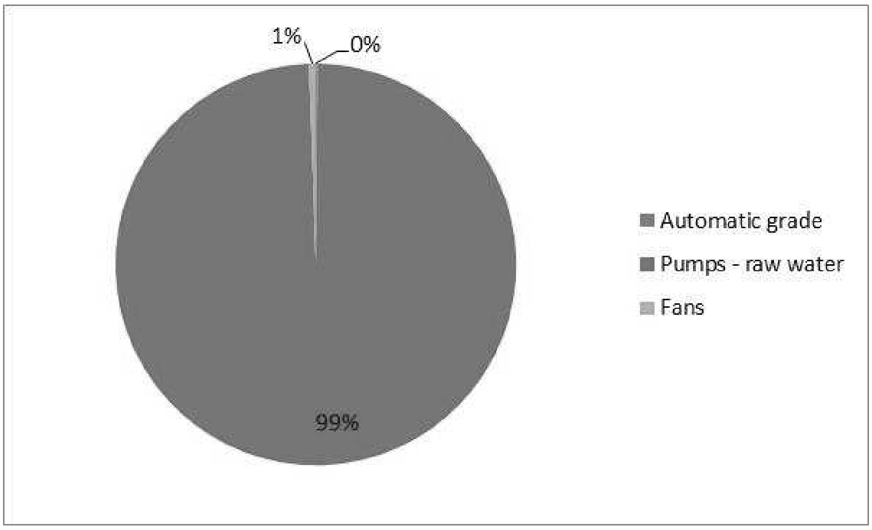

Figure 4: Repartition of emissions for the pumping station from gross water of Lot 1

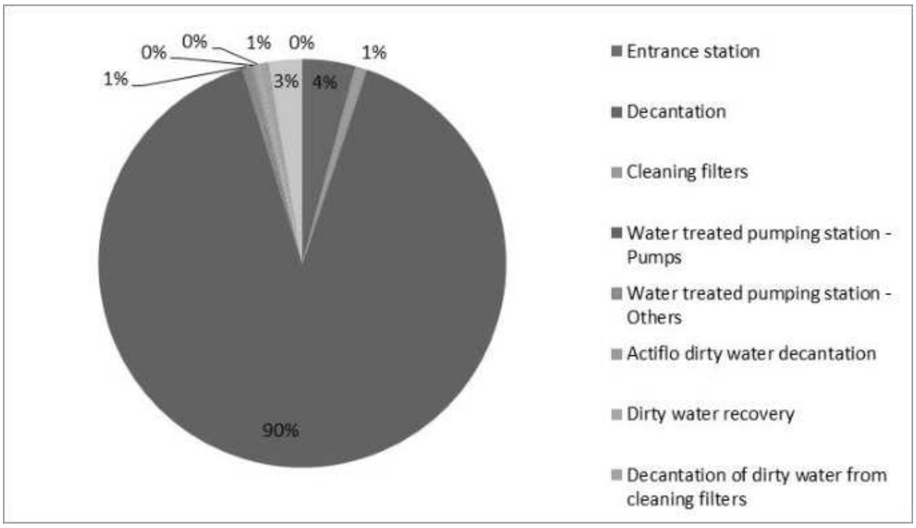

Figure 5: Segmentation of emissions for the water treatment process of Lot 1

3. EMISSIONS REDUCCTION OPTIONS

The major contributors to GHG emissions during the operational phase of the project are the pumping station from gross water and the water treatment process.

Improvements of the carbon footprint are possible on various areas of the water treatment plant operation.

Concerning emissions from electricity consumption:

- Design of the plant and technology options:
  - ✓ Architecture of the plant : optimize location of pumping stations and store water to avoid pumping at times of peak energy cost;
  - ✓ Use efficient pumping systems (energy-efficient motors, variable frequency drives, pump impeller trimming);
  - ✓ Blower technology and air distribution systems (up to 30% energy reduction with screw type blowers rather than tri-lobe blowers);
  - ✓ Mixer technology (a hyperbolic mixer may save up to 50% in mixing energy);
  - ✓ Advanced control software;
  - ✓ Improve efficiency of HVAC (heating, ventilation and air conditioning)/lighting of the building itself.
- Energy management : Establishment of a permanent diagnostic of the energy consumption of the plant, install Supervisory Control and Data Acquisition (SCADA) system;

- Vehicle fuel use:
  - ✓ Maintenance of the fleet to increase the life of vehicles;
  - ✓ Installation of electric vehicles;
  - ✓ Raising employee awareness about Eco-driving (possible gain of 10% on GHG emissions);
  - ✓ Rationalization of travel planning in the interventions of the company;
- Energy recovery / renewable energy: implement cogeneration (heat recovery), capture energy from water moving downhill and other onsite renewable power options (e.g., solar panels, wind turbines, low-head hydro…).

Concerning other emissions (not taken into account in this assessment):

- Waste: Implementation of recycling process for sand, grease, ash, and others waste of gross water.
- Purchases:
  - ✓ Reduced paper consumption with the introduction of e-billing and rational printing documents (recto / verso).
  - ✓ Use of environmentally friendly products for office supplies (recycled paper, etc).

4. CONCLUSION

During the operation of the two lines, the estimated annual emissions (based on emission factor of electricity of Angola by IFC) shows that the water treatment plant is unlikely to exceed the EP annual reporting threshold of 100,000 tonnes of CO2e. However, the assessment of approximately 62,266 tonnes CO2e, does suggest the project will exceed the EP threshold of 25,000 tonnes CO2e, for which companies are encouraged to report annually on emissions, and for which the IFC standards require reporting.

In addition, the assessment considering the future operation of three lines, of approximately 92,975 tonnes CO2e, shows the project will be very close of the EP annual reporting threshold of 100,000 tonnes CO2e.

5. REFERENCES

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APPENDIX A. GHG EMISSION QUANTIFICATION CALCULATIONS

	1 line operation for (3 m3/s treated)	2 lines operation for (6 m3/s treated)		3 lines operation for (9 m3/s treated)	
	Electricity consumption	Electricity consumption	Emissions	Electricity consumption	Electricity consumption
	kWh/year	kWh/year	tCO2/year	kWh/year	kWh/year
Total lot 1	78 613 704	312 974 374	122 194	468 721 342	183 002
Subtotal for Pumping station from gross water	39 489 193	78 978 385	30 835	118 467 578	46 253
Automatic grade	59 356	118 711	46	178 067	70
Pumps - raw water	39 207 436	78 414 871	30 615	117 622 307	45 923
Fans	222 401	444 803	174	667 204	260
Subtotal for Water treatment process	37 374 498	74 748 996	29 184	112 123 495	43 776
Control valves	696	1 391	1	2 087	1
Decantation - Mixers	742 821	1 485 642	580	2 228 462	870
Decantation - Big bags	10 342	20 683	8	31 025	12
Decantation - Scraper decanter	15 513	31 025	12	46 538	18
Decantation - Automatic cleaning of the blades	1 563	3 126	1	4 689	2
Decantation - Pumps	841 356	1 682 712	657	2 524 068	985
Decantation - Fans	4 701	9 402	4	14 102	6
Cleaning filters - Compressors	7 712	15 425	6	23 137	9
Cleaning filters - Pumps	135 308	270 616	106	405 925	158
Cleaning filters - Fans	40 899	81 798	32	122 697	48
Cleaning filters - Other	165 378	330 757	129	496 135	194
Water treated pumping station - Pumps	34 600 365	69 200 729	27 018	103 801 094	40 527
Water treated pumping station - Fans	278 002	556 004	217	834 005	326
Water treated pumping station - Other	2 433	4 866	2	7 299	3
Actiflo dirty water decantation - Mixers	15 104	30 209	12	45 313	18
Actiflo dirty water decantation - Pumps	13 900	27 800	11	41 700	16
Actiflo dirty water decantation - Fans	4 174	8 349	3	12 523	5
Actiflo dirty water decantation - UV Reactors	59 307	118 614	46	177 921	69
Actiflo dirty water decantation - Other	3 479	6 957	3	10 436	4
Dirty water recovery - Pumps	129 709	259 418	101	389 127	152
Decantation of dirty water from cleaning filters - Mixers	15 104	30 209	12	45 313	18
Decantation of dirty water from cleaning filters - UV Reactors	59 307	118 614	46	177 921	69
Decantation of dirty water from cleaning filters - Pumps	11 120	22 240	9	33 360	13
Decantation of dirty water from cleaning filters - Fans	4 174	8 349	3	12 523	5
Decantation of dirty water from cleaning filters - Other	1 692	3 385	1	5 077	2
Decanted water recovery - Pumps	210 339	420 678	164	631 017	246
Subtotal for Reagents	1 009 793	2 019 585	789	3 029 378	1 183
Lime water	234 709	469 419	183	704 128	275
Aluminium sulfate	102 143	204 286	80	306 429	120
Polyelectrolyte	79 258	158 515	62	237 773	93
Ventilation of reagents	29 220	58 440	23	87 660	34
Chlorination	116 399	232 798	91	349 198	136

	1 line operation for (3 m3/s treated)	2 lines operation for (6 m3/s treated)		3 lines operation for (9 m3/s treated)	
	Electricity consumption	Electricity consumption	Emissions	Electricity consumption	Electricity consumption
	kWh/year	kWh/year	tCO2/year	kWh/year	kWh/year
Pumps	448 063	896 127	350	1 344 190	525
Subtotal for Other (lighting, instrumentation set…)	740 220	740 220	289	740 220	289
Other	39 420	39 420	15	39 420	15
Interior lighting	157 680	157 680	62	157 680	62
Outdoor lighting	262 800	262 800	103	262 800	103
Instrumentation set	280 320	280 320	109	280 320	109

Total lot 10	921 495	3 545 821	1 384	5 248 651	2 049
Subtotal for Sludge process	473 079	946 158	369	1 419 236	554
Mixer	151 074	302 148	118	453 222	177
Dehydratation	292 613	585 225	228	877 838	343
Fan	29 392	58 784	23	88 176	34
Subtotal for Reagents	378 336	756 673	295	1 135 009	443
Polyelectrolyte	54 020	108 040	42	162 060	63
Service water	3 058	6 116	2	9 174	4
AR Pilot	3 336	6 672	3	10 008	4
Other	317 922	635 844	248	953 767	372
Subtotal for Other (lighting, instrumentation set…)	70 080	70 080	27	70 080	27
Other	2 190	2 190	1	2 190	1
Interior lighting	2 190	2 190	1	2 190	1
Outdoorlighting	13 140	13 140	5	13 140	5
Instrumentation set	52 560	52 560	21	52 560	21