Republic of Togo

Environmental and Social Impact Assessment for the project of Industrial Platform of Adetikope – Phase 2 and Industrial Corridor, Connecting Road and Transmission Line.

Environmental and Social Impact Assessment Report

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Technical data sheet

Republic of Togo
Environmental and Social Impact Assessment for the project « INDUSTRIAL PLATFORM OF ADETIKOPE » Phase 2
Environmental and Social Impact Assessment Report

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Lists of abbreviations and acronyms

ANGE	:	National Agency for Environmental Management
ANASAP	:	National Agency of Sanitation and Public Health
ATN	:	Togolese Normalization Agency
ATOMET	:	Togolese Metrology Agency
ATOPROQ	:	Togolese Agency for Quality Promotion
BLEVE	:	Boiling Liquid Expanding Vapor Explosion
BOD	:	Biological Oxygen demand
CAB	:	Cabinet
CEET	:	Electric Energy Company of Togo
CGCT	:	General Confederation of Managerial Staff of Togo
CNP-TOGO	:	National Council of Employers of Togo
CNTT	:	National Confederation of Togolese Workers
CO	:	Carbon monoxide
CO_2	:	Carbon Dioxide
COD	:	Chemical Oxygen Demand
COTAG	:	Togolese Approval Committee
COV	:	Volatile Organic Compounds (VOCs)
CPES	:	Presidential Cell for Project Execution and Monitoring
CSTT	:	Trade Union Confederation of Togolese Workers
DPAT	:	Agricultural policy document of Togo
ECC	:	Environmental Compliance certificate
ECOWAS	:	Economic Community of West African States
EHS	:	Environmental, Health and Safety
EN	:	Endangered
ESMP	:	Environmental and Social Management Plan
ESU	:	Environmental and social unit
GATU	:	Group of Autonomous Trade Unions
GMOs	:	Genetically modified organisms

GUFTU	:	General Union of Free Trade Unions (GUFTU)
HAUQE	:	High Authority of Quality and Environment
HC	:	hydrocarbon particles
HCFC	:	Hydro chlorofluorocarbons
IFC	:	International Finance Corporation
ITRA	:	Togolese Institute of Agronomic Research
IUCN	:	International Union for Conservation of Nature (IUCN)
IZ	:	Industrial Zone
m^3	:	Cubic meter
m^3/h	:	Cubic meter per hour
MERF	:	Ministry of Environment and Forest Resources
mm	:	Millimeter
MW	:	Megawatts
NA	:	Not Applicable
NO_2	:	Nitrogen Dioxide
NOx	:	Nitrogen oxide
NPD	:	National Development Plan
O_3	:	Ozone
PIA	:	Industrial Platform of Adetikope
PNPOT	:	National Programme for Territorial Planning Policy
PNRCME-SD	:	National Program for Capacity Building and State Modernization for Sustainable Development
PPE	:	Personal Protective Equipment
PR	:	President
PS	:	Perfomance Standard
RAP	:	Resettlement action plan
RE	:	Regionally Extinct
RMP	:	Risk management plan
SAZOF	:	Free Zone Administration Company
SDG	:	Sustainable Development Goals

SNB	:	New brewery company
SO_2	:	Sulfur Dioxide
TACSH	:	Technical Advisory Committee on Safety and Health at work
TOR	:	Terms of Reference
UNFCCC	:	United Nations Framework Convention on Climate Change
UNSIT	:	National Union of Independent Trade Unions of Togo
VCD	:	Village Development Committee
VU	:	Vulnerable
WHO	:	World Health Organization
WTO	:	World Trade Organization

1. Introduction

1.1. Project context

While remaining on top of national priorities, sustainable development and economic growth are now paired with tackling climate change and developing a sustainable and resilient infrastructure on the Togolese government agendas. In this framework, the Togolese government has drawn up its National Development Plan (NDP) for the period 2018-2022.

In this favorable context of constant improvement in the business climate, investment opportunities and the supply of skilled workers, the Togolese government wishes to create an integrated industrial zone in Adetikope which includes a logistics base capable of hosting many economic and industrial operators wishing to set up operations in the zone. It aims at the establishment of agro-industrial units whose nature and importance are quite diverse, ranging from commercial units to units of small and medium industries. These are mainly textile units and agro-industries. As and when they are approved, these industrial units will be built on cleared land.

The industrial platform of Adetikope (PIA) is a public-private partnership between ARISE and the Republic of Togo. ARISE designs, creates, finances, and builds interconnected infrastructure, namely integrated Industrial Zones. This zone, called the '*Plateforme Industrielle d'Adetikope*' will be developed in two main parts: PIA Phase 1 and PIA Phase 2.

PIA Phase I covers an area of 129 ha and has already been the subject of an ESIA submitted and validated by ANGE via Order N°047/MERF/CAB/ANGE/DEIE/CCE of 21 December 2020 issuing the environmental compliance certificate for the Project.

The second phase of PIA development (referred to in this document as 'PIA Phase 2') will be contructed on 716 ha land, 9.7 km east of the Phase 1 location. It will host a solar park taking up approximately 77% of the total surface area. Additionally, a 209.18 ha Industrial Corridor will be developed connecting PIA Phase 1 and PIA Phase 2. It will be occupied by small scale commercial and industrial enterprises and supporting infrastructure, including road and a power transmission line (TL) . Both of these components constitute "The Project" assessed in this ESIA.

The Adetikope IZ will have an agro-industrial and manufacturing vocation which will provide investors, national and foreign companies with serviced land, advantageous economic and financial conditions, common infrastructure and shared public services (water, electricity and wastewater treatment), Plug-and-Play facilities and privileged access to Togo's natural resources. Potential investors may be entrepreneurs in sectors such as fertilizer production, construction materials or consumer goods. The construction work on this industrial zone and its subsequent operation are likely to have both positive and negative impacts on the environment and the populations concerned. Thus, the development Project of the PIA zone must comply with the legal regulatory requirements prescribed regarding the realization of environmental and social impact studies and referred to in Article 42 of the framework law on the Environment in Togo. In addition, this Project aims to meet the IFC's requirements in terms of impact analysis, proposed measures and their implementation methods.

The environmental and social impact assessment (ESIA) is therefore a prerequisite that will allow the impacts of the Project to be assessed, and various measures (mitigation, enhancement and compensation) to be identified for the Project to be developed in responsible and sustaibale manner. In this sense, the ESIA will comply with IFC standards and national regulations.

1.2. Purpose and Project justification

The growth of the industrial sector in Togo is mainly focused on investments in exporting companies established in the Free zone. These active companies achieved in 2009 a total turnover of 171 billion CFA francs including 158 billion in exports. They employed 9087 Togolese for a payroll of 6.3 billion CFA francs. Their cumulative investments (1990 - 2009) amounted to 130 billion CFA[1].

To support the development of the manufacturing industry in Togo, the Government has agreed to create industrial parks on the national territory. Togo intends to structure its industrial sector to further accelerate its growth as indicated in the National Development Plan (NDP) adopted in August 2018 for the period 2018-2022.

Furthermore, the Government of Togo has long been committed to the extention of its Free Economic Zone. Several factors are indeed favorable to this extension, including the constant improvement of the business climate, growing investment opportunities and the supply of skilled workers. The Togolese government wishes to develop the national economy through a vast economic development plan transcribed in the National Development Plan (PND) 2018-2022 which is divided into 3 axis:

- Axis 1: The implementation of a logistics platform and a financial centre of excellence.
- Axis 2: The development of agricultural processing, manufacturing and extractive industries poles.
- Axis 3: The consolidation of social development and the strengthening of inclusion mechanisms.

The second axis of this strategy is made up of several flagship projects already identified: The Togo food processing project, the Vo-Zio agropole, the Incentive Mechanism for Agricultural Financing based on risk sharing (MIFA), the Special Economic Zone of the autonomous port of Lome, the **Adetikope industrial park (PIA)** and phosphate processing.

As part of the Phase 1 development of the Adetikope Industrial Park, a site was **identified and acquired** by the Republic of Togo on behalf of the Society for the Administration of the Free Zone (SAZOF) and whose rights (99-year concession) were transferred to PIA in 2009 and 2019: this is the site of Adetikope, located 25 km north of Lome (see Annex VI Land Title No. 19829 - 81 ha and No. 46249 - 57 ha).

Pursuant to Decrees No 2021-078/PR dated July 2021 and No. 2021-079/PR dated 24 July 2021, the Government of Togo has declared of public utility and authorized the extension works of PIA and the construction works of its associated infrastructure, thus allowing the implementation of the Adetikope Industrial Park Phase 2.

In order to guarantee its attractiveness, the Adetikope IZ falls under the free zone regime, which will allow companies wishing to set up there to see their investment, financing and operating costs significantly reduced compared to a "classic" economic environment. Incentives take the form of customs and tax benefits, for example tax exemptions.

Thanks to this economic model, the IZ will benefit investor businesses and at the same time contribute significantly to Togo's growth and socio-economic development through job creation and the opening of new outlets for national production. In addition, the development of a solar park is part of the national strategy to tackle climate change by the adoption of renewable energy.

1.3. IFC categorization of the project

[1] Comete, 2016

As part of the review of environmental and social risks and impacts of a proposed investment, the IFC uses a process of environmental and social categorization to reflect the magnitude of risks and impacts. The resulting category also specifies IFC's institutional requirements for disclosure in accordance with IFC's Access to Information Policy.

These categories are:

- **Category A**: Business activities with potential significant adverse environmental or social risks and/or impacts that are diverse, irreversible, or unprecedented.
- **Category B**: Business activities with potential limited adverse environmental or social risks and/or impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures.
- **Category C**: Business activities with minimal or no adverse environmental or social risks and/or impacts.

The creation of the industrial zone falls within the definition of category A projects. The expected environmental and social impacts are diverse, significant, some of which are irreversible.

In that sense, the project PIA Phase 2 is considered to be classified in the category A by IFC.

1.4. Project location

PIA Industrial Zone is located in the Maritime Region, 27 km from the center of Lome, along National Road 1 leading to Burkina Faso. The Phase 1 site is located east of this road, on the lands of the village of Akplome attached to the District of Adetikope, Municipality of Agoe-Nyive 6 in the Prefecture of Agoe-Nyive (formerly the Prefecture of Zio).

The PIA Phase 2 site is located 9.7km east of the Phase 1, on the lands of the Municipality of Zio 1 (Cantons of Dalavé and Kpomé). The two phases will be connected by a 260m wide Industrial Corridor with a new road and trasmission line (Figure 1).

The site is a parcel of land that is shared between the villages, farms/hamlets of Dalavé and Kpomé cantons. It is more rural than urban, although urbanisation is progressing in this area. It is either villages, farms or hamlets that are directly affected or agricultural land. This area is part of the land reserve constituted by the government, i.e. 1177 hectares in the cantons of Dalavé and Kpomé, through the declaration of public utility through decrees N°2020/065/PR of 26 August 2020 and N°2020/066/PR of 26 August 2020.

The plot is neither fenced nor secured. There are buildings, huts, agricultural activities, trees, etc. The parts not used for agricultural purposes are colonised by vegetation.

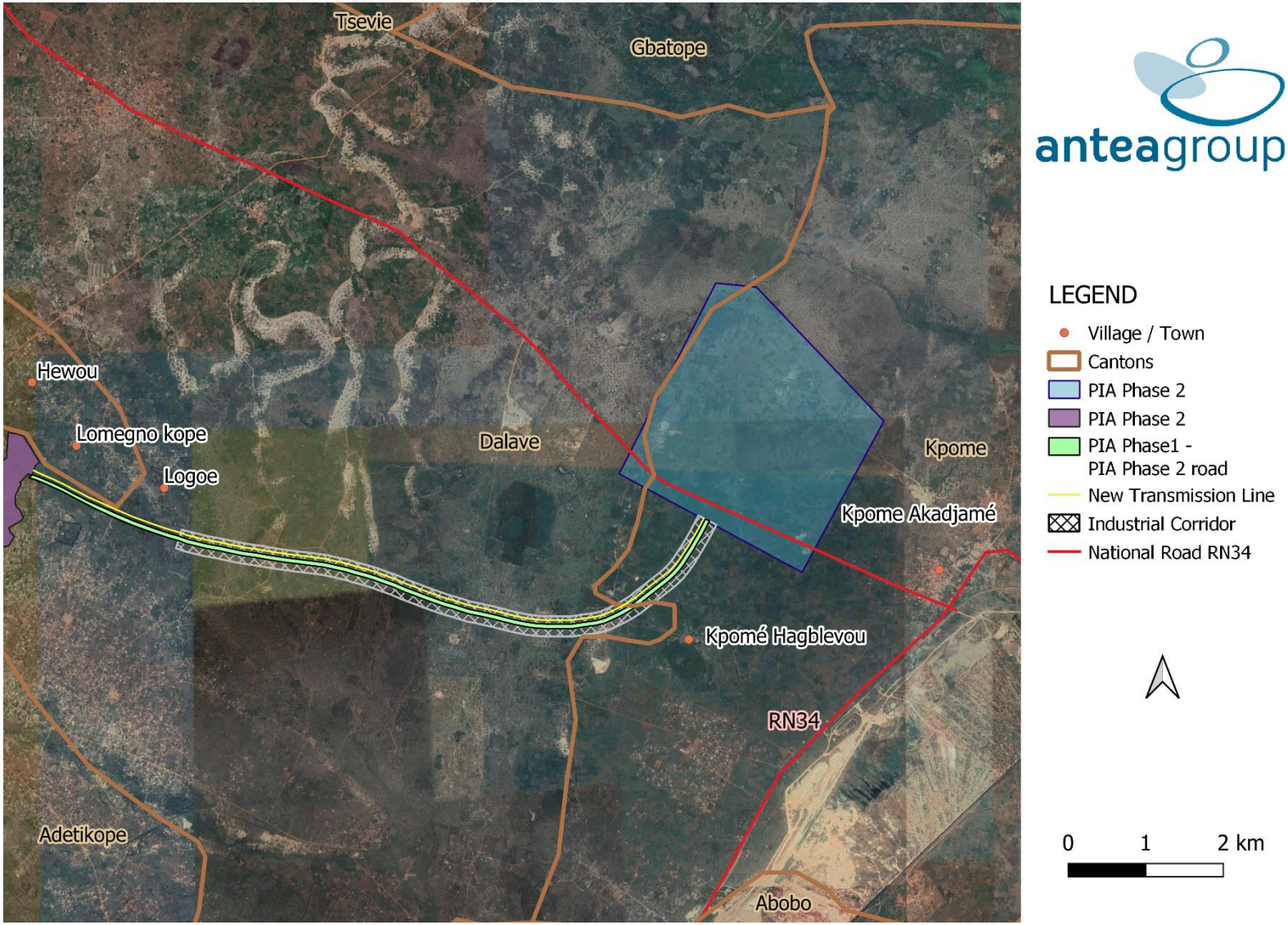


Figure 1 Administrative situation of the Project area

1.5. Presentation of promoters and developers

The Project is led by a public-private consortium formed by the company ARISE and the Republic of Togo. It will be placed under the free zone regime in Togo, under the management of the Society for the Administration of the Free Zone (SAZOF).

1.5.1. PIA

The industrial platform of Adetikope (PIA) is a public-private partnership between ARISE and the Republic of Togo. ARISE is a company owned by the Singaporean group OLAM and the private investment fund Africa Finance Corporation. ARISE is a pan-African industrial ecosystem developer who designs, creates, finances, and builds interconnected infrastructure and integrated industrial zones, in addition to providing logistical solutions. It started its activities in Gabon with the creation, in partnership with the Gabonese State, of the Nkok Special Economic Zone. Today, it wishes to implement other ambitious projects of industrial zones across the continent. To do so, ARISE has re-organised its business into three vertical organizations: ARISE Port & Logistics ("ARISE P&L"), ARISE Integrated Industrial Platforms ("ARISE IIP") and ARISE Infrastructure Services ("ARISE IS").

1.5.2. Presidential Unit for the execution and follow-up of priority projects

The Presidential Cell for Project Execution and Monitoring (CPES) was created by Presidential Decree in 2017 (Decree No. 2017-134/PR of November 23, 2017). Its mission is to ensure the monitoring of **projects** falling under the **presidentia**l **priorities** and to **facilitate their implementation** within the **set deadlines** and with the right level of **resource** consumption.

The CPES is :

- Composed of a national coordinator and a team of project managers;
- Attached to the Presidency and endowed with administrative and financial autonomy;
- Assisted by a Steering Committee which constitutes the body of strategic orientation and decisions;
- Supported by structures, institutions and partners involved in the development, implementation and monitoring of priority projects.

The Adetikope IZ Project is one of the 12 priority projects monitored by the CPES. It was selected because of the high number of jobs it will create (estimated 5000-7000 during the operation phase).

1.5.3. Free Zone Administration Company (SAZOF)

The Togolese Free Economic Zone was created by Law No. 89-14 of September 18, 1989. In 1994, the Societe d'Administration de la Zone Franche (SAZOF) was created to promote and manage the activities of the free zone.

The Togolese free zone is governed by law n ° 2011-018 of June 24, 2011. The main purpose of this law is to promote national and foreign investments in Togo, to issue and manage free zone approvals and to administer their status, among other responsibilities.

This kind of zone constitutes a favorable framework for export-oriented activities (agricultural, industrial and services) which use local and international labor. It offers a liberal framework

guaranteeing the best competitive conditions and simplifying the formalities for investors. In that sense, it is expected that PIA will notably attract and welcome international specialists for work.

SAZOF guides investors in identifying the best framework to benefit from all the advantages offered by the free zone, helps them understanding the conditions to apply and assist them in the various formalities needed.

1.6. Presentation of the environmental and social impact study

1.6.1. Legal framework of environmental assessment in Togo

The environmental assessment process is managed by the National Environmental Management Agency (ANGE) under the responsibility of the Ministry of the Environment, Sustainable Development and Nature Protection. The environmental assessment, which includes the environmental and social impact study (ESIA), is governed by decree n ° 2017-040 / PR of 23 March 2017 setting the procedure for environmental and social impact studies in Togo. The decree establishes the procedure for issuing the Environmental Compliance Certificate (ECC) by the Minister responsible for the environment.

According to article 3 of the decree, any project activities that are “likely to harm the environment must be subject to an environmental impact study”. The environmental impact study can be simplified or comprehensive "depending on the technical nature and scope of a project as well as the sensitivity of the affected environment".

According to national regulations, PIA Phase 2 belongs to the type of projects subject to environmental and social impact study as mentioned in the appendix of order n ° 0151 / MERF / CAB / ANGE of December 22, 2017. This order indicates that activities "of land use planning […] and works likely to have harmful consequences on the environment by their technical nature, their scope and the sensitivity of the setting up environment" must go through those procedures. The size of the land required for the Project (925 ha) and its agro-industrial vocation make it a project likely to significantly modify the environment, thus requiring an in-depth environmental impact assessment.

As part of the environmental assessment process, the Terms of Reference (ToR) is the first document prepared to scope the ESIA study. The ToR for the Project are presented in Annex I of this report. They were submitted for **approval to the ANGE on June 28, 2021, and the agreement was obtained on July 29, 2021**.

1.6.2. ESIA framework

This ESIA concerns the development of PIA Phase 2 of the Adetikope IZ by PIA, and associated land connecting both PIA phases. As such, it studies the specific impacts resulting from the servicing of land and the construction and operation of common infrastructure that will be made available to companies wishing to set up in the territory.

However, it does not constitute the impact study of companies and industries that will establish themselves in the industrial zone once it is operational. Each of these companies must therefore, in accordance with Decree No. 2017-040 / PR, carry out an ESIA adapted to the specific categorization of its project.

In addition, these companies will also have to comply with the General Operating Guidelines issued by ARISE. These guidlines cover health, safety and environmental requirements for participating companies in terms of:

- construction actvities;
- drainage and wastewater management;

- water supply and distribution;
- supply and distribution of electricity;
- solid waste management.

1.6.3. Objectives of the environmental and social impact study

The objectives of this ESIA report are to:

- apply Togo's regulatory obligations in order to obtain the environmental compliance certificate issued by the National Environmental Management Agency;
- meet international standards for the implementation of the Project;
- assess the risks and potential impacts resulting from the implementation of the Project in its study area;
- identify practical measures to avoid, reduce or compensate for significant negative impacts, as well as enhance positive impacts;
- Define requirements for management and monitoring;
- to consult the population affected by the Project to collect their views, concerns and suggestions in order to take them into account in the avoidance, reduction, compensation and improvement measures.

1.6.4. ESIA team

This ESIA was carried out by Antea Group, JAT Consulting and Insuco. Antea Group is an international environmental engineering and consulting company offering global solutions in the fields of the environment, infrastructure, land use and water. The main areas of activity of Antea France are the environment, water, infrastructure and waste management.

JAT Consulting is an environmental and legal Togolese consultancy firm, specialising in impact studies, audits and development studies in the field of the environment, industrial safety and occupational health.

Insuco is a consultancy firm specialized in social sciences and engineering, which conducts in the countries of the South all studies, technical assistance and monitoring of social safeguard policies and standards in the sectors of territorial planning and development.

The work team mobilized by Antea Group and JAT Consulting to carry out this study is made up of multidisciplinary profiles. More specifically, the team consisted of the following experts:

- Bastien SCHNELL, Project manager and environmental expert ;
- Lorenzo COLOMBO, expert in environmental assessments ;
- Lisa ROUESNEL, Social engineer ;
- An environmentalist, Joel AGBEMELO TSOMAFO, expert in environmental assessment, environmental lawyer;
- A team for physical environment investigations: Doucette AHIEKPOR, environmental biologist, Patrice SROUVI, water and depollution technician, Frank TOUDGJI, environmental expert
- Jean – Isamu TAGUCHI, social expert ;
- A team of sociologists made up of two experts: Kevin LAWSON and Eyram AMENYENOU;

- A team for natural environment investigations: Wouyo ATAKPAMA, expert ecologist in flora, team leader, Amétépé HOUNMAVO expert in fauna; Hodabalo EGBELOU, survey assistant.

1.6.5. Organization of the report

The report is structured as follows:

- Non-technical summary ;
- Chapter 1 : Introduction ;
- Chapter 2: Institutional, legislative and regulatory framework;
- Chapter 3: Description of the Project;
- Chapter 4 : Analysis of alternatives ;
- Chapter 5: Environmental and social baseline;
- Chapter 6: Analysis of impacts and identification of management measures;
- Chapter 7: Risk analysis of technological accidents;
- Chapter 9 : Public participation and consultation ;
- Chapter 10 : Environmental and social management plan.

As part of this study, Stakeholder Engagement Plan (SEP) has been developed to support the implementation stakeholder consultation strategy. This plan is presented in Annexe II.

1.6.6. Limitations and Assumptions

Several technical details were not, at the time of writing this report, available. These gaps have been mentioned when identified and listed here below.

- Logistics constraints affecting transportations between Togo and France prevented to fully comply with the COFRAC requirements for soil and water sampling and analysis.
- Due to safety concerns, it was not possible to carry out long-term noise measurements, which have been replaced by multiple 1 hour measurements to cover different periods of the day and night.
- Lack of available existing data to assess aquifers capacities, technical charachteristics and interconnections.
- A certain amount of information is only available at a "feasibility" level (stormwater sizing network, wastewater outfall point, access to services (electricity, water supply, wastewater collection, etc.) for the Industrial Corridor,…). A more detailed level of project description would have help to a more detailed analysis of the impacts.
- Requests for information concerning the uses of groundwater as well as waste management have been made the 21th of january to:
    - “Ministère de l’eau et de l’hydraulique villageoise, .
    - «Directeur des services techniques du district Autonome du Grand Lomé)
    - « Directeur général du centre d’enfouissement technique »

  We have not received any response to these requests to date.

Whenever possible, assumtpions have been made to fill these gaps.

Therefore, the impact assessment may present some limitations in its accuracy with reference to the above mentioned points.

2. Legal, normative and institutional framework

2.1. Policy framework

This section presents policies adopted by Togo whose axis or orientations are linked to the Project. These orientations or axis which correspond to the objectives of the Project are summarized in the form of a table. Policies are considered relevant either because they relate to the Project and its implementation directly, or because they are related to the impacts of the Project and their management.

Table 1 National policies relevant to the Project

Title of the text	Strategic axis / orientations / vision	Expectations from PIA
Sustainable Development Goals (SDGs), 2015	17 SDGs including the eradication of poverty in all its forms and everywhere in the world (goal 1); eradicating hunger, ensuring food security, improving nutrition and promoting sustainable agriculture (objective 2), building resilient infrastructure and sustainable industrialization that benefits all, the search for innovation (objective 9) and the fight against climate change (goal 13)	Establish a process that takes into account cross-cutting themes of these Goals, such as sustainability, the inclusion of vulnerable people including women and young people, the preservation of resources and in particular water, protection of the environment, and the consideration of future climate change and resilience..
ECOWAS environmental policy adopted on December 19, 2008	Strengthening of Environmental Governance and promotion of Capacities for this purpose; promotion of sustainable management of resources for the improvement of the sub-regional economy while respecting the environment; organized fight against Pollution and Nuisance, urban waste and for the control of the flow of dangerous products in the economy and the Promotion of Information, Education and Communication for a better environment.	Promote sustained, shared and sustainable economic growth; full and productive employment and decent work for all. Set up mechanisms for the sustainable management of water resources and waste and fight against pollution and nuisances. Help build Togo's resilience and adaptation capacity to climatic hazards.
New common agricultural policy of ECOWAS (PAC / ECOWAS) adopted in January 2005 in Accra	Ensure modern and sustainable agriculture, based on the effectiveness and efficiency of family farms and the promotion of agricultural enterprises through the involvement of the private sector.	Contribute to increasing the productivity and competitiveness of Togolese agriculture and promote sustainable agriculture
National Development Plan (PND) adopted on 04 August 2018	Structurally transform the economy, for strong, sustainable, resilient, inclusive growth, creating decent jobs and leading to improved social well-being	Promote the development of an agricultural transformation pole and the establishment of a manufacturing pole Promote results-based management, sustainability, equity, gender, social development and mechanisms for inclusion; etc.

Title of the text	Strategic axis / orientations / vision	Expectations from PIA
Energy development policy	Improve the institutional framework, open the sector to private participation, ensure the security of electricity supply, achieve the interconnection of the national grid with those of the sub-region, reduce the country's energy dependence, build with the peer participation, hydroelectric dams and the West African gas pipeline.	Promote the rational use of electric energy in the industrial sector.
Industrial development policy 2018-2022	*Develop and perpetuate by 2030, "an integrated national industry competitive on the international chain and capable of boosting development"*	Set up a dense and diversified, sustainable and competitive industrial fabric capable of meeting the needs of local consumption and conquering the international market.
Transport policy	Transport facilitation and the competitiveness of the Togolese corridor	Develop a roundabout and install luminous signs, vertical or horizontal) in order to make traffic flow smoothly at the site entrance and to avoid the risk of traffic accidents
National environmental policy adopted on December 23, 1998	Promotion of rational management of natural resources and the environment in all areas of activity and the consolidation of economic recovery measures intended to establish development on an ecologically viable basis	Perform an environmental assessment of the Project. Promote environmentally friendly technologies. Ecological waste management.
National hygiene and sanitation policy in Togo drawn up in 2006 and updated in 2009	Establishment of an appropriate institutional and legal framework to boost the hygiene and sanitation sub-sector and ensure its development	Encourage workers and populations to develop a culture of hygiene and sanitation with a view to the acquisition of sustainable and favorable behaviors for the improvement of their living environment and their health.
National health policy adopted in 2019	Increase the number of sanitation and drinking water supply structures and improve their operation, Develop advocacy with decision-makers and partners to place health at the heart of economic and social development	Ensure the health and safety of employees, Arrange sanitation works on the site Declare employees to the Social Security Fund Contribute to the development of the municipality's healthcare structures
National policy to fight HIV and AIDS in Togo: Vision 2020, 2012	Scale up interventions to prevent the transmission of HIV and STIs Improve care for people infected and affected by HIV / AIDS Reduce the socio-economic impact of HIV / AIDS	Facilitate access to prevention, care, treatment and support services for its staff and their families

Title of the text	Strategic axis / orientations / vision	Expectations from PIA
	Promote human rights in the national response Promote research in order to generate strategic information Strengthen the coordination of the multisectoral response and good governance	
National policy to fight HIV and AIDS in the workplace in 2010	Combating stigma and discrimination by protecting the rights of workers living with HIV / AIDS HIV prevention through the behavior change communication program Treatment with ARVs and care for opportunistic infections Social protection support Coordination through capacity building of institutions of the world of work and workplaces	Implement HIV / AIDS prevention measures in the workplace Fight against discrimination and stigma against workers living with HIV / AIDS Encourage and facilitate access to voluntary and confidential counseling and testing services for all workers Conduct awareness and education campaigns to educate workers about HIV and AIDS and help them protect themselves and others.
National water policy adopted in 2010	Contribute to the fight against poverty and sustainable development by providing appropriate solutions to water-related problems, so that it does not become a limiting factor in socio-economic development	Improve equitable and sustainable access to drinking water and sanitation. Ensure health, public safety and the conservation of ecosystems and biodiversity.
National water and sanitation policy	Contribute to the sustainable socio-economic development of the country, by meeting the needs of all water uses, in a healthy living environment, and taking into account the preservation of the environment, social equity and mitigation effects of climate change	Rational management of water resources. Minimize all forms of pollution, improve the quality of life and contribute to the fight against climate change.
National policy for gender equity and equality in Togo in 2011	Establish an institutional, socio-cultural, legal and economic environment conducive to the achievement of equity and gender equality in Togo Ensure the effective integration of gender in development interventions in all sectors of economic and social life.	Support the application of the principle of gender equality in recruitment and promote the employment of women with equal skills Improve the reception conditions of women in the workplace to take into account the specific situations of women
Strategy to combat gender-based violence (GBV) in 2012	Reduce socio-cultural and economic inequalities within families and in society Establish a legal and institutional environment conducive to non-violence	Put in place a strategy to reduce gender-based violence in the workplace

Title of the text	Strategic axis / orientations / vision	Expectations from PIA
Togo's Agricultural Policy Document (DPAT) 2015-2030	Promote modern, sustainable agriculture with high added value in the service of national and regional food security, a strong, inclusive, competitive economy that generates decent and stable jobs by 2030	Promote sustainable agriculture and the use of organic products
National Spatial Planning Policy (PONAT)	*Improve national governance of environmental management; align policies, plans, development programs and environmental policy, promote environmental ethics by raising the awareness of populations, in particular, grassroots communities on environmental problems and the protection of natural resources*	Support local development committees in their process of drawing up and implementing local development plans. Make them aware of the need to place the environment at the center of all development action.
Urbanization and housing policy	*Control urban land, make spaces viable to facilitate private investment*	Secure the Project land Make the site viable
National Strategy for the Implementation of the United Nations Framework Convention on Climate Change	*Mobilize the different categories of actors around development strategies taking into account climate change issues*	Use less polluting techniques. Improve energy efficiency. Create carbon sinks. Promote education, training and awareness on the climate issue. Contribute to mitigating climate change;
Intended Nationally Determined Contributions (INDCs)	Confirms Togo's commitment to contribute to the objectives of the UNFCCC in order to limit the temperature increase to 2 ° C by 2030. Priority gases: CO2, CH4 and N2O	
Third national communication on climate change	Highlights national circumstances, national greenhouse gas inventories, measures, integrated programming approach, technology transfer; systematic research and observation; education, training and public awareness etc.	
First biennial update report	Composed of an inventory of Greenhouse Gas (GHG) which takes into account the energy sector; the national measurement, reporting and verification system (MRV / MRV) as well as information on technical, capacity building and financial needs required and received.	
Strategic investment framework for the management of the environment and natural resources (CSIGERN)	Sustainably manage the environment and natural resources in order to help improve food security, the country's economic growth and poverty reduction.	Promote good management practices for the environment and natural resources; Mitigate the effects of climate change and the risk of natural disasters, etc.
National action plan for the environment adopted in June 2001	Ensure economic and social growth based on models of production and consumption that respect the environment.	Develop positive attitudes towards the environment, take environmental concerns into account; healthy and sustainable management of natural resources and the

Title of the text	Strategic axis / orientations / vision	Expectations from PIA
		environment; build the capacity of workers on the environment.
National action plan for integrated water resources management	Contribute to the gradual establishment of a water management framework, adapted to the national context, in accordance with the legal, political and strategic orientations defined by the Togolese Government and respecting the internationally recognized principles in terms of rational management and sustainable water resources and the environment	Promote the IWRM approach; ensure equitable and sustainable access to drinking water and sanitation for the populations; take into account health, public safety and the conservation of ecosystems and biodiversity.
National Implementation Plan for the Stockholm Convention on POPs	Ensure better management of persistent organic pollutants for the protection of human health and the environment against their harmful effects	Label and take a periodic inventory of detected PCB equipment; Installation of temporary storage platforms, and transporting them to organizations specializing in their management.
National Capacity Building and State Modernization Program for Sustainable Development (PNRCME-DD).	Create an environment conducive to a better transition to the green economy, promote a green economy for inclusive growth, increase the capacity for resilience to the impacts of climate change and natural disasters, preserve terrestrial and marine ecosystems and promote sustainable management of biodiversity.	Promote participatory and sustainable management of the environment and take into account the environmental parameter in all processes.

2.2. Institutional framework

For a sustainable implementation of the Project in compliance with legal and regulatory requirements, PIA will have to collaborate with a certain number of institutions, the list of which is summarized in the table below:

Table 2 Institutions involved in the Project

Name of the institution	Attributions
Ministry of the Environment, Sustainable Development and Nature Protection	The MEDDPN's mission is to: - implement state policy in the management of the environment and forest resources; - develop rules relating to the safeguard and protection of the environment, the prevention against pollution and nuisances and the prevention of risks and natural disasters; - monitor the implementation of and compliance with international environmental conventions, as well as the provisions of the framework law on the environment, the forest code and the law on the prevention of biotechnological risksmonitor the integration of environmental concerns into the various sectoral policies and national development strategies;

Name of the institution	Attributions
	- develop means of support and supervision of populations and other stakeholders in the context of reforestation and forest management; - ensure the cross-border police movement of chemicals and dangerous substances. - The MEDDPN therefore plays an essential role in the protection and management of the environment. In charge of drawing up the national sustainable development policy, he ensures that the programs and Projects planned or underway on the national territory are carried out in accordance with the laws and regulations in force. - In this Project, the MEDDPN has the prerogative to issue the certificate of **environmental compliance** of a Project subject to ESIA, based on ANGE's evaluation of the document and opinion on environmental compliance.
Prefectural Directorate of Environment and Forest Resources	The role of this decentralized state service is to control and prevent pollution and nuisances, in particular by informing and raising awareness among the populations concerned about the environmental assessment procedure. It will **monitor the ESMP** in collaboration with the ANGE.
National Environment Management Agency (ANGE)	Article 15 of the framework law entrusts the ANGE with the promotion and implementation of the national environmental assessment system, in particular environmental impact studies, strategic environmental assessments and environmental audits. The ANGE is a public institution with legal personality and financial autonomy placed under the supervision of the Minister responsible for the environment. **Environmental assessments are submitted** to the ANGE who will decide on the issuance of the Environmental Compliance Certificate (ECC). This is the body that is in charge of **organizing the public consultation process** and **monitoring the implementation of the environmental and social management plan** and ensuring its follow-up.
Forest Resources Inspectorate (IRF)	This is another of the three institutions attached to the Ministry of the Environment involved in forest resource management. It works to control deforestation, land clearing or reforestation activities on the Project site. Ensures the monitoring and evaluation of **the implementation of deforestation and reforestation activities.**
Ministry of Trade, Industry, Private Sector Development and Promotion of Local Consumption	Involved in several activities related to the economic growth of the country, he is in particular in charge of setting up, strengthening and promoting the structures and mechanisms of support to the private sector in order to increase local and foreign private investments.
Free Zone Administration Company	**SAZOF**, a public establishment under the supervision of the Ministry of Commerce, is a semi-public limited company responsible for promoting and administering the Togolese free zone, to which **the industrial zone will be attached.**
Ministry of Water, Equipment, Rural Equipment and Village Hydraulics	It is responsible for the coordination and control of all state activities relating to water resources, drinking water and wastewater treatment. **The Water Resources Department**, responsible for the qualitative and quantitative monitoring of the resource, the **Sanitation Department**, which manages all issues related to sanitation, are two of these technical departments.
Ministry of Health and Public Hygiene	- Develops programs to improve health coverage as well as prevention and control strategies against major endemics

Name of the institution	Attributions
	- Ensures the permanence and continuity of the functioning of health services and ensures easy and equitable access to health care The Ministry of Health has several directorates that can intervene directly in the implementation or monitoring of ESMP measures, such as **the HIV / AIDS health sector committee** or the **Disease Control Department** responsible for monitoring communicable and non-communicable diseases.
Ministry of Civil Service, Labor, Administrative Reform and Social Protection	- Prepare legislation and regulations relating to labor relations and ensure their application. - Ensures the quality of relations between workers and employers and promotes social dialogue - Promotes fundamental principles and rights at work, labor migration and conflict management in the workplace - Implement a policy to develop workers' social coverage. **The National Social Security Fund** (CNSS), in charge of workers' health coverage, the National Employment Agency (**ANPE)** in charge of supporting job seekers, and **the Labor Inspectorate** which monitors the application of Togolese labor law at the enterprise level, there are organizations attached to this ministry which will intervene in the framework of the Project.
Ministry of Territorial Administration, Decentralization and Local Communities	- Develops, implements, conducts and executes government policy in the areas of territorial administration, the conduct of the decentralization process and in the management of local authorities - Ensures that the distribution of powers between the State and local authorities is respected and works to protect the general interest and the rule of law. The Department of Decentralization and Local Authorities is responsible for organizing and ensuring the exercise of State supervision over local authorities and the proper application of the country's political guidelines at the level of the departments.
Ministry of Social Action, Promotion of Women and Literacy	- Organizes state assistance to vulnerable or destitute persons and coordinates, in concert with the ministries and agencies concerned The Directorate for the Protection and Promotion of Persons with Disabilities and the Directorate General for Gender and the Promotion of Women are two entities involved in strategies to promote two vulnerable groups who will be affected by the Project.
Ministry of Culture, Tourism and Recreation	- Carry out and ensure the inventory, collection and safeguarding of cultural goods, the protection, conservation and promotion of monuments, historical and archaeological sites. **The Directorate of Cultural Heritage**, within the Ministry, deals more particularly with missions relating to archaeological heritage, the remains of which could be uncovered on the Project site.

2.3. Legal framework

2.3.1. Togolese constitution

The preamble to the Togolese Constitution of the 4th Republic of October 14, 1992 underlines the people's resolution "to build a rule of law in which fundamental human rights, public freedoms, [...]

must be guaranteed and protected". The constitution thus recognizes citizens in its article 41 "the right to a healthy environment" while imposing on the state the obligation to ensure the protection of this one. Environmental management is therefore brought to the rank of a standard with constitutional value, which imposes on the State specific obligations to translate into all documents relating to national policy and legal acts the taking into account of the environmental dimension. Several provisions of this fundamental law relate to the management and protection of the environment: the right to development (art. 12), the right to property (art. 27), the right to health (art. 34), the right to education (art. 35) for the benefit of Togolese.

The constitution also takes into account the rights and duties, relating to the environment, set out in the Universal Declaration of Human Rights of 1945 and in the international instruments relating to these rights ratified by

2.3.2. Environmental assessment legislation

2.3.2.1. Framework law on the environment

The framework law on the environment no. 2008-005 of May 30, 2008 sets the general legal framework for environmental management in Togo. It aims to preserve and sustainably manage the environment; to guarantee all citizens an ecologically healthy and balanced living environment; create the conditions for a rational and sustainable management of natural resources for present and future generations; fight against all kinds of pollution and nuisances and sustainably improve the living conditions of populations while respecting the balance with the surrounding environment (Article 1).

Article 38 obliges project promoters to carry out an environmental and social impact study. It provides: "activities, projects, programs and development plans which, by virtue of their size or their impact on the natural and human environments, are likely to harm the environment are subject to prior authorization from the Minister. responsible for the environment".

Article 41 defines environmental audit as a tool used to periodically assess the impact of an activity on the environment. Article 42 distinguishes internal audit from external audit and makes it an obligation under the responsibility of the company. The audit activities are also affected by the provisions on quality standards contained in Articles 46 to 49 of the Framework Law on the Environment. Indeed, Article 46 instituted environmental quality control which is often carried out through audits or environmental monitoring. It follows that the provisions of the framework law on the protection of the atmosphere, on the protection of human settlements, on waste, on chemicals and on discharges must be scrupulously observed by the promoters.

Article 108 requires anyone who produces or holds waste under conditions that produce harmful effects on the soil, flora or fauna, degrade the landscapes, pollute the air or water, generate odors and in general harm thehealth of humans, domestic animals and the environment, to ensure its elimination or recycling in accordance with the provisions of the Public Hygiene Code and the implementing texts of this framework law.

2.3.2.2. Environmental and social assessment process

Decree No. 2017-040 / PR of 23 March 2017 setting the procedure for environmental and social impact studies specifies the procedure, methodology and content of environmental and social impact studies (ESIA) in application of article 39 of Law No. 2008-005 of May 30, 2008 on the framework law on the environment. In accordance with Article 3, "public or private projects likely to harm the environment must be subject to an ESIA, prior to any decision, approval or authorization by the competent authority". "The ESIA is carried out by the promoter who assumes full responsibility (Article 5).

The text also fixes the list of projects that must be submitted to ESIA. Among these activities, article 6 lists, among other things, "the developments, structures and works which, by virtue of their technical nature, their scope and the sensitivity of the setting up environment, may have harmful consequences on the environment and developments, structures and works that may affect sensitive areas…".

The Environmental and Social Impact Study is carried out by the promoter who assumes full responsibility for the content of the report. It is obliged to take into account the persons affected by the project in the ESIA. The evaluation of the interim ESIA report is then made under the coordination of the ANGE, with the involvement of the institutions concerned in the participation process. As for the methods of surveillance, control and monitoring of the implementation of the Environmental Management Plan (EMP), the Risk Management Plan and the RAP, they are provided for in Articles 53 to 55.

This ESIA has been carried out in accordance with the provisions and requirements of this decree.

The environmental audit is defined in **decree No. 2011-041 / PR of March 16, 2011 setting out the procedures for implementing the environmental audit** (article 1). Article 2 defines the audit as: "a systematic, periodic and documented verification process of the environmental management of an equipment or an institution in order to objectively monitor the performance of the measures implemented to eliminate or mitigate the" impact and ensure environmental protection". In accordance with Article 3, the environmental audit has among other objectives, to ensure compliance with standards and technical regulations, facilitate the operational control of practices likely to have an impact on the environment, prescribe corrective measures, contribute maintaining environmental compliance, improving technical performance and business productivity, etc. There are two types of environmental audit: internal audit and external audit. Internal audit is the responsibility of the organization. It is carried out by the body's structures according to its own procedure (Article 7). On the other hand, the environmental compliance verification audit (external audit) is carried out by the Minister of the Environment (Article 9).

Any project that has been the subject of an ESIA is systematically subject to an environmental audit (Article 4). Audits must be carried out at least every 4 years (Article 5). The decree also deals with the types and forms of environmental audits, the procedure for preparing and content of the audit report and the procedure for evaluating the audit report.

The Project, its practices and facilities will be subject to an environmental compliance audit every four years. This period is flexible and can be shortened depending on the results of the monitoring of the ESMP implementation. PIA has signed a convention with ANGE stating that monitoring through audit would take place every quarter for PIA Phase 1. There will be the same agreement for PIA Phase 2. There will be then four audit every year.

In accordance with the provisions of decree n ° 040-17 / PR of 23 March 2017 setting the procedure for environmental and social impact studies, **the procedures for public participation** in environmental and social impact studies have been defined in **decree no. ° 0150 / MERF / CAB / ANGE of 22 December 2017**. In its article 2, it defines public participation in ESIAs as the involvement of the public in the ESIA process aimed at obtaining its opinion on the project in order to provide the necessary elements to decision making.

This decree declines two forms of public participation in the ESIA process, namely consultation of the population concerned or their representatives on the project and consultation by public hearing, which takes place after submission of the ESIA under the responsibility of the Minister of the Environment.

The purpose of this participation is to inform the public concerned about the existence of a project and to obtain its opinion on the various aspects of the design and execution of said project. This was one of the main methods used in carrying out this study.

2.3.3. Environmental legislation

2.3.3.1. Water code

Law n ° 2010-004 of June 14, 2010 on the water code fixes in its article 1 "the general legal framework and the basic principles of the integrated management of water resources (IWRM) in Togo" and "determines the fundamental principles and rules applicable to the allocation, use, protection and management of water resources. ".

In its Title III: of the water protection regime of installations and hydraulic works and its section 4 of the fight against water pollution, article 57, it specifies, among other things, that the discharge, flow and discharge of polluting substances in surface or groundwater, directly or indirectly, are either prohibited or subject to prior authorization in accordance with the laws and regulations in force in Togo. Likewise, any groundwater withdrawal activity is subject to authorization.

Article 59 states that wastewater must be treated and comes from appropriate purification systems in accordance with standards or discharge standards set by joint decree of the ministers responsible for health, the environment and water. Note that these decrees do not seem to be published yet.

The implementation of this Project will ensure compliance with these requirements for the sustainable use of water resources. Thus, prior authorizations for water use and wastewater discharge will be requested. The authorization is given for a fixed period and is renewable (art. 17) and is provided after Promoter payment. Note the related decree does not seem to be published yet.

2.3.3.2. Forest code

According to law n ° 2008-009 of June 19, 2008 relating to the forestry code, “forest resources include forests of all origins and land under a protective regime, wood and non-wood forest products, harvested products from the fauna and its habitats, natural sites of scientific, ecological, cultural or recreational interest located in the aforementioned environments and lands under special protection regimes ”These forest resources are subject to a protection regime that ensures their management sustainable.

The forest code also defines the development of wildlife reserves and the activities authorized in these areas and divides the species into fully protected, partially protected and unprotected categories. The list of fully and partially protected species is set out in the ordinance described in the following paragraph

In addition, it defines the methods of clearing and indicates in article 68 that "the clearing of forests or cutting of trees for purposes of urban development, industrial, mining, installation of infrastructure or others, are subject, prior authorization from the minister responsible for forest resources”.

Any clearing activity for the Project must be subject to a prior authorization request. Note the related decree does not seem to be published yet.

2.3.3.3. Biodiversity, fauna and flora

Law n ° 96 - 007 / PR on plant protection aims to protect the health of plants and plant products by preventing and combating harmful organisms both at the level of their introduction and that of their spread on the National territory. To this end, it determines in its article 7, through additional decrees, the conditions under which plants and plant products, soil, manure, compost and growing media, as well as packaging, other forms, may circulate on the territory. packaging and any other object or material of any kind likely to harbor or spread harmful organisms. In addition, it is forbidden to import,

manufacture, package or repackage, store, experiment, use or place on the market, any unauthorized or unapproved plant protection product (art 15).

Ordinance No. 4 of January 16, 1968 regulating the protection of wildlife and the practice of hunting in Togo defines the process of wildlife protection and provides the list of protected species. It distinguishes in its annex I:

- Class A protected species, fully protected wild animals, the hunting and capture of which, including those of their young or their eggs, is prohibited, except for holders of scientific permits.

Table 3 Fully protected species of fauna

Common name (English)	Scientific name
Mammals	
Dwarf hippopotamus	*Choeropsis liberiensis*
Elephant (young accompanying its mother and followed female)	*Loxodonta africana*
Lamantin	*Trichechus senegalensis*
Chimpanzee	*Pansatyrus verus*
Cheetah	*Acinonyx jubatus*
Birds	
Sagittarius Messenger	*Sagittarius serpentarius*
White breasted guineafowl	*Agelastes meleagrides*

- Class B protected species :
  - Group I: partially protected so-called specific wild animals, the hunting and capture of which, including those of their young or of their eggs, are only allowed to holders of a capture permit within the limits and with the means specified in the permit and to holders of special sport hunting permits, but only individually, as a trophy or collector's item.
  - Group II: partially protected animals known as hunting, for which the hunting of only adult individuals excluding the following females is authorized to holders of special sport hunting permits within the limits of the table set for each degree and with the means authorized by the law and the capture of which, including that of their young, may be authorized by holders of a capture permit within the limits and with the means specified in the permit

2.3.4. Legislation relating to HIV / AIDS

Togo is one of the first countries to have put in place a law aimed at protecting persons living with HIV (PLHIV) from all forms of discrimination: **law n ° 2010-018 of December 31, 2010 amending law n ° 2005-012 of December 14, 2005 on the protection of persons with regard to HIV / AIDS.**

This law regulates HIV / AIDS testing and lists a set of measures aimed at protecting PLWHIV from acts of discrimination and stigmatization. In particular, the law stresses that “the hiring of a worker cannot be made conditional on an HIV test” (article 30) and that “every worker living with HIV has the right to remain in his job with all related benefits” (Article 31). The employer must also ensure that PLHIV are not rejected or stigmatized in their workplace (Article 32). Finally, the law encourages the establishment of prevention programs for women and sex workers.

2.3.5. Construction and industry legislation

Interministerial Order No. 1723 / MUHCV / MATDCL OF 12/21/2017 laying down rules for the progress of the construction site provides the mandatory directives to be implemented to ensure the good management of the sites and minimize the nuisance on the surrounding populations. This decree asks in particular:

- good performance of the site and reasoned lighting,
- the application of working hours and days as defined in article 4. It is forbidden to work on the site on Saturdays and Sundays, and noisy activities can only take place between 7 am - 12 noon and 3 p.m. - 6 p.m. on weekdays,
- proper rehabilitation of sites affected by the works,
- proper maintenance of machinery and equipment,
- minimization of atmospheric emissions and noise pollution.

The management of plastic waste is ensured by **decree 2011-003 setting the management methods for plastic bags and packaging** in Togo which (i) requires the establishment of a system allowing the collection and proper orientation of waste towards reuse units, recovery and disposal, (ii) prohibits burning, burying or throwing away biodegradable or non-biodegradable packaging, and (iii) any establishment that uses and produces more than 5kg per day of biodegradable or non-biodegradable packaging “is required to register with the environment department and communicate to it every six months the resulting waste treatment methods ”.

The framework law on the environment indicates in its article 90 the release into the atmosphere of certain substances, fumes, dust, vapors, gases or liquids is subject to prior authorization. Note that this decree does not seem to be published yet

2.3.6. Land legislation

2.3.6.1. Land and state code

The Togolese land system is governed by Law No. 005-2018 of June 5, 2018 on the land and state land code.

The purpose of the land and property code is to determine the rules and fundamental principles applicable in land and property matters and to govern the organization and functioning of the land and property system in the Togolese Republic (Article 3). It applies to various real and immovable rights and "to the public and private domains of the State and local authorities; to the national land domain… and to the real estate of private persons”, (article 4).

The code enshrines a panoply of general principles, including:

- the guarantee of the property rights of individuals and communities acquired according to customary rules;
- equitable access to land ;
- securing real property rights established or acquired according to custom;
- the fight against land speculation;
- the fight against the anarchic and abusive fragmentation of land; etc.

The code recognizes the right to transfer land ownership by sale (article 156), by exchange (article 165) or by accession (article 172).

Title 8 also recognizes the existence of customary land rights, held personally or collectively and giving rise to the right to ascertain and affirm with regard to third parties but not to official land registration with the land conservation authority. The establishment of land rights is based on the following steps:

- Submission of a request to the mayor
- Site visit by the mayor or his representative to ascertain the characteristics of the land and any opposable rights claimed by third parties
- Within 3 months, demarcation of the land by a sworn surveyor attached to land conservation and mandated by the mayor
- Registration of the property in a special register at the town hall, which takes the value of a private deed and confirms the owner in the rights he lists. These rights are valid as long as the occupation of the land by the owner or his beneficiary's lasts.

A person holding land under customary tenure may be forced to cede it for public utility with fair and prior compensation.

Subtitle 6 of the code regulates the right to expropriation for public utility. This is pronounced in the absence of an amicable agreement between all the parties (article 359) and in return for compensation. It comes into force following a public inquiry leading to a declaration of public utility (DUP). It requires conducting a plot investigation (different from a public inquiry) which leads to the publication of a transferability document listing the properties subject to expropriation.

The act of transferability is notified to the owners concerned who must then declare any tenant or operator of their land in order to benefit them from part of the compensation due to them. They then receive a proposal for the amount of compensation within three months which they are entitled to challenge. Upon publication of the decree listing the proposed compensation, the Expropriation Commission (COMEX) is created in order to record the agreement of the parties on the compensation or to proceed to conciliations. The agreements are recorded in an amicable agreement report.

The parties may in particular "agree on compensation by means of the exchange of a building belonging to the expropriating authority, of equivalent value" (article 372), which is equivalent to proposing a replacement in kind of the lost property.

In accordance with sub-title 5 of the code, administrative recognition of the right to property is carried out primarily by registration of the building. Registration consists of the following stages (article 254) :

- the entry in the deposit register of a note confirming the completion of the procedure;
- the establishment of a land title on the land books, the drafting of an analytical slip for each of the real rights subject to publication and recognized during the procedure;
- cancellation of old property titles replaced by the land title;
- the establishment of a copy of the land title to be given to the owner and registration certificates to the holders of real rights liable to transfer.

Contradictory demarcation of the building to be registered is mandatory (article 230). Registration is done with the Directorate of Cadastre, Land Conservation and Registration.

PIA must take the necessary measures to comply with the obligations inherent in this law, among other things through compliance with the land lease, acquisition and registration regime.

2.3.6.2. Territory development

Law n ° 2016-002 of 04 January 2016 on the framework law on spatial planning sets the legal framework for all interventions by the State and other actors having the effect of structuring,

occupying, using of the national territory and its resources. It determines the rules and institutions of regional planning at different scales (Article 1).

The framework law on spatial planning governs, among other things:

- the harmonious distribution of populations over the national space (Articles 7 to 10);
- management of land resources and environmental protection (Articles 21 to 23);
- the definition of spatial planning strategies based on the spatial planning policy (Articles 26 and 27);
- the definition of land use planning tools (SNAT, SRAT and SLAT) (Articles 26 to 40).

PIA will have to adhere to the vision of this law by carrying out its activities in accordance with the resulting obligations and in compliance with the established principles.

2.3.7. Labor, health and safety legislation

2.3.7.1. Labor code

Labor law is defined by Law No. 2006-010 of December 13, 2006 on the labor code of the Togolese Republic.

The labor code governs labor relations between workers and employers carrying out their professional activities in the territory of the Togolese Republic, as well as between the latter and apprentices placed under their authority.

The labor code prohibits all discrimination in employment as well as forced labor. The minimum legal working age is set at 15 (for light tasks). The worst forms of child labor (slavery, forced labor, etc.) are prohibited. The labor code also regulates the form and termination of the employment contract, working hours, weekly rest, public holidays and holidays. It also details the labor inspection systems and the various trade union rights open to workers (strike, collective agreement, professional unions, etc.).

Title 8 of the code includes the provisions relating to the safety and health of workers. Article 170 provides that when there are working conditions that are dangerous for the safety or health of workers and not covered by the texts provided for in Article 169 of this code, the employer is notified by the inspector. labor and social laws to remedy it in the forms and conditions provided for in the previous article. The employer is required to report to the labor and social law inspector within forty-eight (48) working hours any work accident or occupational disease observed in the company.

In addition, an occupational health and safety committee is set up in all establishments or companies. It is specified in article 175 that any company or establishment, of whatever nature, must provide a safety and health service to its workers. Article 176 stipulates that the employer must make available to nursing staff suitable premises, medical equipment, drugs and biomedical consumables, in accordance with the list set by joint order of the Minister responsible for labor and the Minister responsible for health after consulting the technical advisory committee on occupational safety and health.

To guarantee the right of its workers to decent and fair work, PIA must ensure that the provisions of this labor code are strictly observed.

2.3.7.2. Social security code

Law n ° 2011-006 of February 21, 2011 on the social security code in Togo defines the provisions governing the general compulsory social security system. According to the provisions of article 2 of this law, "the general social security system includes a branch of family and maternity benefits, a branch

of pensions; a branch of occupational risks and all other branches which may subsequently be created by law".

The law subjects all employees to the provisions of the labor code, state employees, self-employed workers, religious ministries and students of vocational schools to the general social security scheme.

PIA must take all necessary measures so that workers can operate under optimum safety conditions in the course of their activities.

2.3.7.3. Public health code

Law No2009-007 of May 15, 2009 relating to the public health code in the Togolese Republic defines the rights and duties inherent in the promotion and protection of the health of the population (article 1). The code presents measure to protect the health of the living environment, which deals with water and air pollution, atmospheric pollution, and the fight against waste.

Section 1 of Chapter II of the Code is devoted to water and air pollution. In particular, it is emphasized that any entity delivering water intended for human consumption must ensure that this water complies with regulatory drinking standards. It also condemns any act that could lead to the pollution of feedwater.

In accordance with article 16, atmospheric pollution is understood to mean: "the presence in the air and in the atmosphere of smoke, dust, toxic, corrosive, odorous or radioactive gases due to chance of nature or to the fact of human and likely to harm environmental hygiene and the health of the population". Article 17 provides for measures to be taken to combat all these polluting elements in order to protect the natural environment, the environment and public health. Articles 23 and 24 of this code also specify that the dumping and burying of industrial toxic waste are prohibited and that they must be eliminated, in accordance with the provisions of national and international texts applicable in Togo.

The code also sets out hygiene measures. With regard to food hygiene, Article 34 provides that establishments or places where food is prepared, sold and stored must be clean, ventilated, lighted and installed in a healthy environment.

Protection of health in the workplace is also taken into account by Articles 113 and 114 of Chapter III. In doing so, Article 113 stipulates that the protection of health in the workplace is ensured in accordance with national and international legislation on occupational health.

PIA will take care to protect the health of workers and not to discharge into nature any waste liable to harm the health of the population.

2.3.7.4. Interprofessional collective agreement of Togo

The collective agreement was signed in Lome on November 30, 2011 between the National Employers' Council of Togo "CNP-TOGO", bringing together professional organizations and associations from the private and parapublic sector and the following trade union centers: the National Confederation of Workers of Togo "CNTT", the Confederation Syndicale des Travailleurs du Togo "CSTT", the General Confederation of Cadres du Togo "CGCT", the National Union of Independent Trade Unions of Togo "UNSIT", the General Union of Free Trade Unions "UGSL" and the "GSA" Autonomous Trade Union Group.

It regulates the working relationship between employers and workers, as defined in Title I of the Labor Code, in all companies operating throughout the territory of the Togolese Republic.

Article 5 highlights freedom of association in these terms: "the contracting parties recognize in each of them the freedom of opinion, the freedom to act freely for the collective defense of their professional interests within the framework of the regulations in force. force". The following titles are devoted,

among other things, to union communication (article 6 of title 1), to the employment contract (title 3); pay and classifications (title 4), health and safety at work (title 6); to staff representatives and union representatives (section 7).

The rights conferred on workers by this agreement must be respected by PIA.

2.3.7.5. Other texts relating to workers' rights

The other texts relating to workers' rights applicable to this Project are among others:

- Decree No. 2012-043 / PR of June 27, 2012 revising the tables of occupational diseases.
- Decree No. 70-164 of October 2, 1970 establishing, in application of the provisions of Article 134 of the Labor Code, general health and safety measures applicable to workers in establishments of all kinds.
- Interministerial order N ° 004/2011 / MTESS / MS of October 07, 2011 establishing the occupational health and safety service, made in accordance with articles 175 and 178 of the labor code.
- Interministerial decree № 005/2011 / MTESS / MS of 07 October 2011 setting the conditions under which the various monitoring of workers' health, the working environment, prevention and improvement of working conditions are carried out.
- Order No. 008/2011 / MTESS / DGTLS of May 26, 2011 on the composition and functioning of the advisory technical committee on occupational safety and health (CTCSST), made in accordance with article 168 of the Labor Code.
- Order No. 009/2011 / MTESS / DGTLS of May 26, 2011 setting the organizational and operating procedures of the advisory technical committee on occupational safety and health, made in accordance with article 174 of the Labor Code.

2.3.8. Legislation on the protection of cultural heritage

Law n ° 90-24 of 23 November 1990 relating to the protection of the national cultural heritage sets out the main principles of the protection of Togolese cultural heritage, the main one being the registration of any cultural heritage property of major importance for the national community on the national list of cultural goods.

The law also deals with archaeological excavations, the regulation of which must be specified by decree. It establishes a joint authorization from the ministers responsible for culture and scientific research for any excavation or archaeological prospecting on Togolese territory (article 33). It requires that any feasibility study or preparatory investigation relating to the construction of works of great national or regional importance include a section devoted to the archaeological and historical inventory of the places concerned (Article 34).

2.3.9. Legislation on the fight against HIV/AIDS

Togo is one of the first countries that put in place a law to protect persons living with HIV (PLHIV) from all forms of discrimination: Law No. 2010-018 of December 31, 2010 amending Law No. 2005-012 of December 14, 2005 on the protection of persons living with HIV/AIDS.

This law provides a framework for HIV/AIDS testing and lists a set of measures to protect PLHA from acts of discrimination and stigmatization. In particular, the law emphasizes that "the hiring of a worker may not be subject to an HIV test" (article 30) and that "every worker living with HIV has the right to maintain his or her employment with all related benefits" (article 31). Furthermore, the employer must

ensure that PLHIV are not rejected or stigmatized in the workplace (Article 32). Finally, the law encourages the implementation of prevention programs for women and sex workers.

2.3.10. Legislation on local collectivities

The functioning of Togolese local authorities is governed by the law of June 25, 2019 amending law n ° 2007-011 of March 13, 2007 relating to decentralization and local freedoms, modified by law n ° 2018-003 of January 31, 2018.

This law enshrines the free administration of local communities via elected councils (article 6). It clearly defines the powers specific to the municipality (article 82), including those relating to the Project:

The development and implementation of the municipality's development program;

- issuance of type A (low risk building) and B (medium risk building) building permits and issuance of demolition permits;
- the issuance of permits to occupy the municipal public domain for commercial activities, the issuance of advisory opinions on projects to create or modify national, regional and prefectural roads crossing the municipal territory;
- the organization of road signs (directional signs, traffic lights, pedestrian crossings, etc.);
- issuing advisory opinions on water supply plans as well as on electrification plans concerning the municipal territory;
- the establishment and implementation of garbage and household waste disposal plans, industrial, plant and agricultural waste, in part through ANASAP;
- the organization of the collection, transport, treatment and final disposal of waste partly through ANASAP;
- maintenance and upkeep of gutters and other sewerage networks for secondary and tertiary roads on the municipal territory, partly through ANASAP;
- the fight against insalubrity, pollution and various nuisances, partly through ANASAP; etc.

In accordance with Article 83, the following environmental competences are among others shared between the State and the municipality:

- collection and treatment of wastewater shared with ANASAP;
- regulations relating to the protection of the environment within the jurisdiction of the municipality;
- management of forest and fishery resources in municipal territory;
- prevention and fight against the excessive cutting of wood.

PIA will have to take this text into account by collaborating with local authorities, especially with regard to environmental management and support for local development.

2.4. International conventions, treaties and agreements

Togo has ratified a number of conventions relating to environmental and social/labour protection. The most important are summarized in the table below:

Table 4 International conventions ratified by Togo and of relevant to the Project

Title and adoption date	Scope
United Nations Framework Convention on Climate Change (UNFCCC) adopted in Rio in June 1992 and ratified by Togo on 8 March 1995.	Stabilize, in accordance with the relevant provisions of the Convention, greenhouse gas concentrations in the atmosphere at a level that prevents dangerous anthropogenic interference with the climate system
Kyoto Protocol adopted on December 11, 1997 and ratified by Togo on July 2, 2004.	Establishment of a Clean Development Mechanism to assist developing countries to achieve sustainable development and to contribute to the ultimate objective of the UNFCCC.
Paris Agreement adopted on December 13, 2015, entered into force on November 4, 2016 and ratified by Togo on September 19, 2016.	Contain global warming "well below 2°C compared to pre-industrial levels" and if possible "continue efforts to limit temperature increases to 1.5°C".
United Nations Convention on Biological Diversity (Rio 92)	Reduce biodiversity loss at the global and national levels through, among other things, the development of a monograph and the adoption of procedures to require the assessment of impacts of projects that are likely to significantly affect biodiversity.
Vienna Convention for the Protection of the Ozone Layer	Protect human health and the environment from adverse effects resulting or likely to result from human activities that alter or are likely to alter the ozone layer
Algiers Convention (1968) and Maputo Convention (July 2003) on the Conservation of Nature and Natural Resources	To improve environmental protection; to promote the conservation and sustainable use of natural resources; to harmonize and coordinate policies in this field with a view to establishing development policies and programs that are environmentally sound, economically sound and socially acceptable.
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal adopted in 1989 and entered into force in 1992.	To protect human health and the environment from harmful effects resulting from the production, transboundary movement and management of toxic, explosive, corrosive, flammable, ecotoxic and infectious wastes.
Convention No. 187 on the Promotional Framework for Occupational Safety and Health adopted on June 158, 2006 and entered into force on February 20, 2009.	To promote, in consultation with the most representative employee and worker organizations, the continuous improvement of safety and health at work to prevent occupational injuries and illnesses and deaths attributable to development.

Table 5 International labour conventions ratified by Togo

Title and adoption date	Signature	Ratification	Scope
Forced Labour Convention Fundamental convention C029 1930	28 June 1930	7 June 1960	The Convention concerning Forced or Compulsory Labour entered into force on 1 May 1932. This Convention commits Togo to eliminating the use of forced or compulsory labour in all its forms as soon as possible.
Freedom of Association and Protection of the Right to Organise Convention Fundamental convention C087 - 1948	29 July 1948	7 June 1960	This Convention concerning Freedom of Association and Protection of the Right to Organise entered into force on 4 July 1950. Workers' and employers' organizations have the right to draw up their statutes and by-laws, freely elect their representatives, organize their management and activities, and formulate their programs of action. The public authorities shall refrain from any intervention liable to limit this right or hinder its lawful exercise.
Right to Organise and Collective Bargaining Agreement Fundamental convention – C098 1949	1 July 1949	8 November 1983	This is the Right to Organise and Collective Bargaining Convention, 1949. Workers shall enjoy adequate protection against all acts of discrimination tending to impair freedom of association in respect of employment.
Equal Remuneration Convention Fundamental convention C100 1951	29 June 1951	8 November 1983	This is the Equal Remuneration Convention, 1951. For the purposes of this Convention: (a) the term remuneration includes the ordinary basic or minimum wage or salary and any other consideration, whether in cash or in kind, which the worker receives directly or indirectly, in respect of the employment of the worker by the employer; (b) the term equal remuneration for men and women workers for work of equal value refers to rates of pay set without discrimination based on sex. This convention reinforces gender requirements in labour agreements and law.
Abolition of Forced Labour Convention Fundamental convention C105 1957	25 June 1957	10 July 1999	This is the Convention concerning the Abolition of Forced Labour, which entered into on force 17 January 1959. Each Member of the International Labour Organisation which ratifies this Convention undertakes to take effective measures with a view to the immediate and complete abolition of forced or compulsory labour as described in Article 1 of this Convention. This Convention shows that Togo has abolished forced labour.
Discrimination (Employment and Occupation) Convention Fundamental convention C111 1958	25 June 1958	8 November 1983	This Convention covers discrimination in respect of employment and occupation and entered into force on 15 June 1960. Each Member for which this Convention is in force undertakes to formulate and pursue a national policy designed to promote, by methods appropriate to national conditions and practice, equality of opportunity and treatment in

Title and adoption date	Signature	Ratification	Scope
			respect of employment and occupation, with a view to eliminating discrimination in respect thereof.
Minimum Age Convention (specified minimum age: 14 years) Fundamental convention C138 1973	26 juin 1973	16 March 1984	Article 4 provides that notwithstanding the provisions of paragraph 3 of this Article, any Member whose economy and educational institutions are not sufficiently developed may, after consultation with the organizations of employers and workers concerned, if any, specify, as a first step, a minimum age of 14 years. Under this Convention, no person below this minimum age shall be admitted to employment or work in any occupation.
Worst Forms of Child Labour Convention Fundamental convention C182 1999	17 June 1999	19 September 2000	This is Convention No. C182. This convention deals with the prohibition and immediate action for the elimination of the worst forms of child labour. It entered into force on 19 November 2000.
Convention on the Elimination of All Forms of Discrimination against Women (CEDAW)	11 September 1981	26 September 1983	This gender-related Convention stipulates in Article 3 that States Parties shall take in all fields, in particular in the political, social, economic and cultural fields, all appropriate measures, including legislation, to ensure the full development and advancement of women, for the purpose of guaranteeing them the exercise and enjoyment of human rights and fundamental freedoms on a basis of equality with men.
Labour Inspection Convention	11 July 1947	30 March 2012	This is the Labour Inspection Convention (No. 81), which brings Togo into the International Labour Organization (ILO). This convention obliges each member of the International Labour Organization for which this convention is in force to have a system of labour inspection in industrial establishments.
Night Work of Children (Industry) Convention	29 october 1919	7 June 1960	Children under the age of 18 years shall not be employed or work at night in industrial undertakings, whether public or private, or in their dependencies, except where the needs of their apprenticeship or vocational training so require in specified industries or occupations requiring continuous work, the competent authority, after consultation with the organizations of employers and workers concerned, may authorize the employment at night of children who have attained the age of 16 years but are under the age of 18 years.

2.5. Environmental Standards applicable to the Project

2.5.1. Air quality

2.5.1.1. Ambient air

The baseline survey of ambient air quality carried out on the site and its immediate vicinity will serve as a basis for monitoring air quality during Project construction and operational phases.

In the absence of national ambient air quality standards, IFC's EHS guidelines apply. The parameters defined for the ambient air quality are summarized in the following table:

Table 6 IFC Environmental Health and Safety guidelines for ambient air quality

Polluants	Average duration	Limit / Directive (in µg / m³)
Sulfur dioxide (SO_2)	24 hours	20 (directive)
	10 minutes	500 (directive)
Nitrogen dioxide (NO_2)	1 year	40 (directive)
	1 hour	200 (directive)
Ozone	8 hours per day maximum	100 (directive)
Suspended particles PM10	1 year	20 (directive)
	24 hours	50 (directive)
Suspended particles PM 2.5	1 year	10 (directive)
	24 hours	25 (directive)

Source: Environmental, health and safety guidelines, general EHS guidelines. IFC, 2007

2.5.1.2. Industrial emissions

The operation of industrial units may include major sources of atmospheric emissions, however unknown at the time of writing of this document and not falling within the scope of this study.

The construction phase and operation of the common infrastructure of the IZ will involve generators.

Due to the size of such equipments, no guideline exists for their emissions. We therefore adopt the thresholds provided by the General EHS Guidelines: environmental (IFC, 2007) for air emissions and ambient air quality.

Table 7 Environmental Health and Safety guidelines for industrial emissions

Fuel type / fuel	Particulate matter (mg / Nm³)	Sulfur dioxide (SO_2)	Nitrogen oxides (NOx) (mg / Nm³)	Dry gases, O_2 (%)
Gaseous	Not available	Not available	200 (spark ignition) 400 (dual fuel) 1,600 (compression ignition)	15
Liquid	50 or up to 100 if justified by the specifics of the Project (e.g. economic feasibility of using low ash fuel or applying secondary treatment to reach the standard of 50 and the environmental capacity of the site)	1.5% sulfur or up to 3% sulfur if justified by the specifics of the Project (e.g. economic feasibility of using fuel with reduced sulfur content or installing secondary treatment to achieve the 1.5% sulfur standard and environmental capacity of the site)	If bore size diameter [mm] <400: 1,460 (or up to 1,600 if justified to maintain high energy efficiency) If bore size diameter [mm] ≥ 400: 1,850	15
Notes: Not available subject = no emission standard. Higher performance levels than those shown in the table should be required for installations located in urban or industrial areas with degraded airsheds or close to environmentally sensitive areas where tighter emission control may be required. Nm3 is established at 1 atmosphere and 0 ° C. These guidelines apply to installations operating more than 500 hours per year, with an annual capacity utilization coefficient of more than 30%				

Source : Environmental, health and safety guidelines, general EHS guidelines. IFC, 2007

2.5.2. Noise

The Project will be a source of noise during the construction and operation phases. In the absence of the national noise standards, the WHO and IFC EHS guidelines apply.

Table 8 Environmental Health and Safety guidelines for noise thresholds

Period	Industrial	Residential (1)
Day (7 a.m. to 10 p.m.)	70 dBA	55 dBA
Night (10:00 p.m. to 7:00 a.m.)	70 dBA	45 dBA

(1) In particular educational, care and rest establishments
Source: IFC General EHS Guidelines, 2007, based on WHO recommendations

The impact of a project must not exceed the levels presented in the table above, or result in a maximum increase in ambient levels of 3 dB at nearest off-site reception location.

Regarding occupational exposure, IFC gives the following limits:

Table 9 Environmental Health and Safety guidelines for noise in workplaces

Location / activities	LAeq equivalent level, 8h (dB (A))	Maximum LAmax, fast (dB (A))
Heavy industry (without oral communication request)	85 50-65	110
Light industry (decreasing demand for oral communication)	45-50	110
Open-plan offices, control rooms, service counters or equivalent	45-50	-
Individual offices (without disturbing noise)	40-45	-
Classrooms, conference rooms	35-40	-
Hospitals	30-35	40

Source: IFC General EHS Guidelines, 2007, based on WHO recommendations

2.5.3. Liquid releases to the environment

The Project will generate, both during construction and operation, liquid discharges into the environment linked to the production of domestic effluents (gray and black water), drainage water (runoff) and industrial effluents.

National standards for effluent discharges are set out in interministerial order n°010/MER/MS/MERF fixing the norms for the discharge of wastewater into the natural environment (March 30th of 2015). On the other hand, the general environmental, health and safety guidelines of the IFC specify discharge thresholds for sanitary wastewaters. The Project will adopt the most stringent values between national and international standards, as demonstrated in Table 10.

Table 10 Limit values retained for the discharge of sanitary wastewater after treatment

N°	Parameter	National admissible limits	IFC, 2007 *	Most stringent value – applicable to project
1	pH	5.5 - 9	6 – 9	6 – 9
2	Temperature (°C)	> or = 35	/	> or = 35

N°	Parameter	National admissible limits	IFC, 2007 *	Most stringent value – applicable to project
3	Color	the discharge does not cause any colouring of the receptor environment	/	/
4	Odor	must cause no change in the environment	/	/
5	Floating material (> 1cm)	None	/	0
6	Settling matter (mg/l)	< 0.5 or after 2 hours of settling	/	< 0.5 or after 2 hours of settling
7	Suspended solids (mg/l)	< or = 50	50	50
8	BOD((mg/l)	< or = 100	30	30
9	COD(mg/l)	< or = 300	125	125
10	THC (mg/l)	< or = 5	10	5
11	Iron + Aluminium (mg/l)	< or = 5	/	< or = 5
12	Arsenic (mg/l)	< or = 0.1	/	< or = 0.1
13	Cadmium (mg/l)	< or = 0.2	/	< or = 0.2
14	Total chromium (mg/l)	< or = 2	/	< or = 2
15	VI Chromium (mg/l)	< or = 0.2	/	< or = 0.2
16	Manganese (mg/l)	< or = 1	/	< or = 1
17	Mercury (mg/l)	< or = 0.05	/	< or = 0.05
18	Nickel (mg/l)	< or = 0.5	/	< or = 0.5
19	Lead (mg/l)	< or = 0.5	/	< or = 0.5
20	Copper (mg/l)	< or = 0.5	/	< or = 0.5
21	Tin (mg/l)	< or = 2	/	< or = 2
22	Zinc (mg/l)	< or = 2	/	< or = 2
23	Cyanide (mg/l)	< or = 0.1	/	< or = 0.1
24	Sulphides (mg/l)	< or = 1	/	< or = 1
25	Sulphites (mg/l)	< or = 1	/	< or = 1
26	Sulphates (mg/l)	< or = 1000	/	< or = 1000
27	Chlorides(mg/l)	< or = 1200	/	< or = 1200
28	Fluorides (mg/l)	< or = 15	/	< or = 15
29	Phosphorus (mg/l)	< or = 10	2	< or = 10
30	NO3-N (mg/l)	< or =20	/	< or =20
31	NO2-N (mg/l)	< or = 2	/	< or = 2
32	Oils (animal + plant) (mg/l)	< or = 30	/	< or = 30
33	Mineral oils (mg/l)	< or = 5	/	< or = 5
34	Phenols (mg/l)	< or = 0.3	/	< or = 0.3
35	Aromatic solvents (mg/l)	< or = 0.2	/	< or = 0.2
36	Nitrogenous solvents (mg/l)	< or = 0.1	/	< or = 0.1
37	Chlorinated solvents (mg/l)	< or = 1	/	< or = 1
38	Surfactants (mg/l)	< or = 2	/	< or = 2
39	faecal coliforms/ 100 ml	< or = 2000	/	< or = 2000

N°	Parameter	National admissible limits	IFC, 2007 *	Most stringent value – applicable to project
40	faecal streptococci (MNP/100 ml)	< or = 1000	/	< or = 1000
41	Salmonella/100 ml	None	/	0
42	Clostridium/100 ml	None	/	0
43	Conductivity	< or = 2500 µ S/cm	/	< or = 2500 µ S/cm
44	Total Nitrogen (mg/l)	/	10	10
45	Total residual chlorine (mg/l)	/	0.2	0.2

* Source: Environmental, health and safety guidelines, general EHS guidelines, Indicative Values for Treated Sanitary Sewage Discharges. IFC, 2007

2.5.4. Potable water

The government adopted decree n ° 2012 -258 / PR of October 17, 2012 defining the national standards and the control procedures for the potability of water intended for human consumption. This decree adopted the full list of the WHO drinking water quality directive of 2006. WHO threshold values have been updated in 2017 and are therefore indicated here below for comparison. National values appear to be more stringent than 2017 WHO values and they are therefore adopted in the present study.

Table 11 Specification of water intended for human consumption

Parameters	Unit	Limit	WHO (2017)
Metals			
Aluminum	mg/l	0.2	-
Antimony	µg/l	5	20
Arsenic	µg/l	10	10
Barium	µg/l	700	1300
Bore	µg/l	500	2400
Cadmium	µg/l	3	3
Chrome	µg/l	50	50
Copper	µg/l	2000	2000
iron	mg/l	0.3	-
Lead	µg/l	10	10
Manganese	mg/l	0.4	-
Mercury	µg/l	1	6
Nickel	µg/l	20	70
Selenium	µg/l	10	40
Uranium	µg/l	-	30
Zinc	mg/l	3	-
Organic substances			
Benzene	µg/l	10	10
Benzo (a) pyrene	µg/l	0.7	0.7
Pesticides	µg/l	0.1	-
Total pesticides	µg/l	0.5	-
Polycyclic aromatic hydrocarbons (PAHs)	µg/l	0.1	
Total trihalomethanes (THMs)	µg/l	100	-

2.5.5. Soil and sediments

In the context of this project, the quality of the soil is characterised in order to determine :

- Whether there is a risk to the human health of site users.
- Whether management measures are necessary, independently of the health risk.

For each objective, the methodology used is described below.

Risk to the health of site users

The reference systems used to interpret the soil results are, in order of priority

- Existing Togolese standards,
- French standards, for information purposes,
- International references, particularly the Netherlands in the United States (US EPA Region 9).

There is no benchmark (regulatory management value or quality objective) defined for soils in either Togo or France.

For the purposes of the study, the Groundwater Target Values and soil and groundwater Intervention Values, Soil remediation circular of 2010 from the Dutch legislation and the RSLs (Regional Screening Levels) of the US EPA Region 9 (Western US Environmental Protection Agency) were used. The UPA Values values are references used in other regions of the US.

The standards from the Groundwater Target Values and soil and groundwater Intervention Values, Soil remediation circular 2010 (Dutchland regulation) are presented in the table below.

Table 12 Soil target values from the Dutch legislation

Parameters	Units	Target values[)]
Antimony (Sb)	mg/kg DM	3
Arsenic (As)	mg/kg DM	29
Barium (Ba)	mg/kg DM	160
Cadmium (Cd)	mg/kg DM	0.8
Chromium (Cr)	mg/kg DM	100
Cobalt	mg/kg DM	9
Copper (Cu)	mg/kg DM	36
Lead (Pb)	mg/kg DM	85
Mercury (Hg)	mg/kg DM	0.3
Molybdenum (Mo)	mg/kg DM	3
Nickel (Ni)	mg/kg DM	35
Selenium	mg/kg DM	0.7
Zinc (Zn)	mg/kg DM	140

The RSLs are very conservative, protective values for human health (ecological risks are not considered) for a lifetime exposure corresponding to an excess individual risk of 10-6 and/or hazard quotient (HQ) of 1. Exposure routes include inhalation for volatile compounds and ingestion/skin contact for non-volatile compounds. They have been developed for residential and industrial land uses for a wide range of compounds, including PCBs, HCTs, metals, some PAHs and some petroleum hydrocarbons (notably BTEX). The values for industrial use have been retained for the purposes of this report.

For arsenic, the USEPA RSL was chosen with a THQ of 1.0 (30 mg/kg) because the RSL with a THQ of 0.1 (3 mg/kg) is equivalent to background. It is not relevant to choose a guide value close to background. Moreover, 3 mg/kg is very safe. For information, the Australian equivalent guide value is 100 mg/kg.

The RSLs were developed for Superfund purposes in the USA. Use for other purposes must be adapted to the context and needs.

The following points are noted:

- Exceeding the RSLs does not always mean that there is a risk to human health. The conceptual scheme should be evaluated in this case,
- RSLs are not clean-up targets,
- If the criteria are exceeded, a quantitative risk analysis is usually carried out to determine whether action is required.

The comparison criteria used are presented in the following table:

Table 13 Selected comparison criteria for soil quality

Parameter	Selected comparison criteria (mg/kg) [1]
Metals	
Arsenic	30 [2]
Cadmium	98 [3]
Total chromium	180 000 [4]
Copper	4700
Nickel	1200
Mercury	4.6 [5]
Lead	800
Zinc	35000
PCBs	
PCB 28	0.49 [6]
PCB 52	
PCB 101	
PCB 116	
PCB 138	
PCB 153	
PCB 180	
PAHs	
Naphthalene	17
Acenaphthylene	No data
Acenaphthene	4500
Fluorene	3000
Phenanthrene	No data
Anthracene	23000
Fluoranthene	3000
Pyrene	2300
Benzo(a)anthracene	21
Chrysene	2100
Benzo(b)fluoranthene	21
Benzo(k)fluoranthene	210
Benzo(a)pyrene	2.1
Dibenzo(ah)anthracene	2.1
Indeno(123-cd)pyrene	21
Benzo(ghi)perylene	No data
Total hydrocarbons (THC)	

Parameter	Selected comparison criteria (mg/kg) (1)
THC C_{10} - C_{12}	44 (7)
THC C_{12} - C_{16}	44 (7)
THC C_{16} – C_{21}	3300 (8)
THC C_{21} – C_{35}	3300 (8)
THC C_{35} - C_{40}	350000 (9)

(1) RSL US EPA Region 9, Industrial Soil, Total Hazard Quotient (THQ) = 0.1, risk level (TR) = 10^{-6}, unless otherwise stated
(2) THQ = 1.0, retained, more representative of the local background. Assumption of 60% bioavailability of arsenic
(3) 'Diet' value retained
(4) Chromium III, insoluble salts
(5) Elemental mercury
(6) PCB 118 value retained, for each congener PCB 28, 52, 101, 118, 138, 153, 180
(7) (7) Lower value between "medium aliphatic" (44 mg/kg) and "medium aromatic" (60 mg/kg)
(8) Value 'high aromatic' retained
(9) Value 'high aliphatic' retained

General management measures

The objective is to identify the impacted areas potentially requiring management measures, regardless of the health risk. In this case, it is a question of determining a possible disturbance of the environment linked to the activities of the site. In order to determine it, the concentrations measured are compared with each other (analysis of their spatial distribution) and with the characteristic concentrations of the environment assessed (characteristics that can be determined from the initial state of the environment, from a local control environment or environmental quality data).

The Dutch regulation values are to be used for the parameters missing in the UES EPA standards.

2.5.6. Sludge

The following table presents the main elements of the World Health Organisation (WHO) and US EPA recommendations on pathogen limits for biosolids for agricultural use.

Table 14 WHO and US EPA recommendations on pathogens for biosolids reuse (Kevin Tayler, 2018)

Parameter	Limit value	Source
Helminth eggs (number per gram total solids or per litre)	<1/g total solids	Guidelines for the safe use of wastewater, excreta and greywater - Volume 1, WHO, 2013
E. coli (number per 100 ml)	<1000/g total solids	
Class A biosolids: faecal coliform density	≤ 1 000/g DM	US Environmental Protection Agency (US EPA) (Part 503 of the Biosolids Regulations),1994
Class A biosolids : Salmonella subspecies (spp) density	≤ 3 per 4 g DM	
Class B biosolids: faecal coliform density	≤ 2 000 000/g DM	

Source : Kevin Tayler, Faecal Sludge Treatment - A Guide for Low and Middle Income Countries, 2018

The WHO guidance values presented in the table are precautionary values. WHO now advocates the use of quantitative microbial risk assessment (QMRA) to assess health risks. WHO now recognises that health risks can be controlled by reducing the level of treatment.

Where it is not possible to collect the information necessary to conduct a QMRA, it is generally easier to define acceptable levels of pathogens in relation to the intended end use of the treated biosolids, as recommended in Part 503 of the US Biosolids Regulations (US EPA, 1994). A distinction is made between Class A biosolids, which can be applied without restriction, and Class B biosolids, which can be applied to arable land intended for crops that cannot be consumed raw, and for which public access is prohibited for more than one year after application. Biosolids that meet the requirements of Class B can also be applied to woodland, which can be a good outlet for the small quantities of biosolids produced by sludge treatment plants. The following table summarizes the requirements for biosolids to be accepted in classes A and B.

For them to be considered as Class A, the analyses must comply with the values given in the table below. This can be achieved by heat treatment of at least 50°C for a time period t (days) that is not less than either 20 minutes or the time given by this equation:

$$t = 131\,700\,000/(100.14T)$$

where : T = temperature in degrees Celsius (US EPA, 1994).

Table 15 US EPA Biosolids Rule Part 503 Requirements for Class A and Class B Biosolids (Kevin Tayler, 2018)

Element	Class A biosolid requirements	Class B biosolid requirements
Pathogens	Fecal coliform density ≤ 1 000/g of DM (dry weight basis)	Fecal coliform density ≤ 2 000 000 000/g DM
	Density of Salmonella ≤ 3 Most Probable Number (MPN)/4 g DM (dry weight basis)	
	Enteric virus density ≤ 1 PFU (plaque forming unit)/4 g DM (dry weight basis)	
	Viable helminth egg density ≤ 1/4 g DM (on a dry weight basis)	

Source : Kevin Tayler, Faecal Sludge Treatment - A Guide for Low and Middle Income Countries, 2018

The US EPA requirements for land application are presented in the table below.

Table 16 Pollutant limits (US – EPA, Land application of sewage sludge, A guide for land appliers on the requirements of the federal standards for the use or disposal of sewage sludge, 40 CFR Part 503, 1994)

Pollutant	Ceiling Concentration limits for all biosolids applied to land (mg/kg – dry weight basis)
Arsenic	75
Cadmium	85
Chromium	3 000
Copper	4 300
Lead	840
Mercury	57
Nickel	420

Pollutant	Ceiling Concentration limits for all biosolids applied to land (mg/kg – dry weight basis)
Selenium	100
Zinc	7 500

2.6. Environmental and social responsibility of the promoter

ARISE believes that maintaining high environmental and social governance (ESG) standards is the best method for mitigating business risks, protecting the environment and generating social values. ARISE is therefore committed to respect the International Finance Corporation (IFC) Performance Standards for Environmental and Social Sustainability across its corporate and project level practices. It also has a clear and well-structured set of environmental and social policies and standards to which it abides by, which are gathered in the company Environmental and Social Management System (ESMS) Manual (see following section 2.6.1).

2.6.1. ARISE corporate environmental and social policies

PIA's Environmental, Social and Governance (ESG) approach is outlines by a document called Environmental and Social Management System (ESMS) Manual. This ESMS manual identifies and presents the framework and the strategy for implementing the ESMS of PIA; the manual has been developed in accordance with ARISE IIP policies as well as national & international legislation, environmental and social regulations and performance requirements. The document is aligned with the IFC Performance Standards and relevant Good International Industry Practice (GIIP) guidelines. The purpose of this document is to provide a cohesive framework that ensures ARISE IIP's policies, vision and values are met by the PIA project.

ARISE ESG performance objectives are supported by several associated corporate policies which include, but not limited to:

- Ethical Recruitment Policy
- Code of conduct
- Environmental Sustainability Policy (ESP)
- Health and Safety Policy (HSP)

2.6.2. IFC Performance Standards

ARISE has committed to comply with the World Bank Group IFC Performance Standards across majority of its projects. IFC is an international organization whose mission is to promote sustainable private sector development in developing and transition countries.

In 2012, IFC published a series of 8 performance standards that have become an international benchmark for the social and environmental assessment process in which IFC and other international donors have been involved. These standards provide guidance for identifying risks and impacts, helping to avoid, mitigate, and manage risks and impacts so that planned activities can continue in a sustainable manner.

These standards are accompanied by guidance notes, which include provisions for the effective consideration of gender and social inclusion issues. The integration of these guidelines by client

enterprises is aimed in particular at ensuring that individuals or communities, whether poor, disadvantaged or vulnerable in the current situation, are not disproportionately affected and will not suffer more than other social categories from the disruptions and negative impacts of the project. Their systematic consultation by client enterprises is a first step in ensuring the inclusion of vulnerable groups represented by women and persons with disabilities (PWDs). These performance standards are detailed in the table below.

Table 17 IFC Performance Standards

Performance Standards	Objectives	Applicability to the Project
PS1 Assessment and Management of Environmental and Social Risks and Impacts	PS 1 emphasizes the importance of good management of a project's environmental and social performance throughout its life cycle. PS 1 also requires that proponents must be aware of and respect the human rights of the communities in which they operate and its workforce. The client, in collaboration with other responsible government agencies and appropriate third parties, will conduct an environmental and social assessment process, implement and maintain an E&S management system (ESMS) appropriate to the nature and scale of the project and commensurate with the environmental and social risks and impacts. The ESMS includes the following elements : (i) policy statement ; (ii) identification of risks and impacts; (iii) management program: (iv) organizational capacity and competencies; (v) emergency preparedness and response; (vi) stakeholder engagement; and (vii) monitoring and evaluation.	Triggered This Project is undergoing an ESIA to address its environmental and social impacts and risks and to ensure that feasible mitigation measures are proposed. Moreover, the stakeholders of this project will be identified, informed, consulted and involved; this will be included in the stakeholder engagement plan.
PS2 Workforce and Working Conditions	This standard works towards several objectives: to promote equality of opportunity for workers as well as compliance with national labor and employment law, to establish-maintain-improve relations between workers and management, to protect workers (children, migrants, etc.), to promote safe and healthy working conditions, to protect the health of workers and to avoid the use of forced labor. The applicability of this standard is defined in the completion of the ESMS defined in Standard No. 1. The standard applies to workers directly employed by the client and to workers employed through third parties and workers employed by the client's primary suppliers.	Triggered The recruitment of workers for construction and operations will require the writing and implementation of human resource management policies and procedures to provide optimal occupational health and safety conditions and ensure compliance with international best practice.
PS3 Rational Use of Resources and Pollution Prevention	This Standard defines an approach to resource efficiency, pollution prevention and control at the project level. The objectives of this Standard are to avoid or reduce negative impacts on human health and the environment by avoiding or reducing pollution from the project, to promote sustainable use of resources and to reduce project-related GHG emissions. To meet these objectives, measures must be taken regarding	Triggered The construction and operation of the Project will require the input of raw materials and will

Performance Standards	Objectives	Applicability to the Project
	GHGs, water consumption, management of waste, hazardous materials and pesticides, among others.	also be a source of pollution.
PS4 Community Health, Safety and Security	This Standard recognizes that the activities, equipment and infrastructure associated with a project may increase the risks and impacts to which communities are exposed. It covers the client's responsibility to prevent and/or minimize the risks or effects on the health, safety and security of communities that may result from project activities, with particular attention to vulnerable groups and human rights. Achieving these objectives involves taking risks into account when designing and securing infrastructure and equipment, safely managing hazardous materials, identifying potential risks and impacts on ecosystems, exposing communities to disease, and preparing for emergency situations.	Triggered Workforce influx can result in varieous safety and health issues for communities. Moreover, the works may create dangerous situations related for example to the use of hazardous products or to the traffic induced by the construction site. Finally, noise and light pollution or even odours could affect the surrounding communities.
PS5 Land Acquisition and Involuntary Resettlement	Involuntary resettlement is recognized when the affected persons or Communities do not have the right to refuse the acquisition of their land, or restrictions on its use result in physical or economic displacement. The objectives are to avoid or limit involuntary resettlement and forced eviction, but also to anticipate, avoid or limit the negative social and economic impacts resulting from the acquisition or restriction of land use. With regard to the latter, compensation as well as appropriate communication, consultation and participation of those affected is necessary. In addition, improvements are also called for regarding the restoration of the livelihoods and living conditions of displaced persons. From the project design stage, the client must explore all possible alternatives to limit or avoid physical or economic displacement. Where displacement cannot be avoided, compensation and benefits for the displaced should be put in place. In addition, the client shall interact with the affected communities through the stakeholder engagement process (see Standard 1) and shall put in place the grievance mechanism. Finally, the planning and implementation of resettlement and livelihood restoration shall be implemented by the client through the identification of baseline socio-economic data. Physical relocation must be differentiated from economic relocation.	Triggered Even though the developer already owns the land, both physical and economic displacement are expected.
PS6 Biodiversity Conservation and Sustainable Management of Living Natural Resources	This standard aims to protect and conserve biodiversity, maintain the benefits derived from ecosystem services, and promote the sustainable management of living natural resources. The implementation of the measures necessary to meet these objectives is carried out through the ESMS defined in Standard No. 1. Standard No. 6 applies to projects with a potential impact on ecosystem services.	Triggered The Project can potentially affect natural habitats and biodiversity.

Performance Standards	Objectives	Applicability to the Project
PS7 Aboriginal Peoples	The purpose of the standard is to ensure that the culture, knowledge and practices of Indigenous Peoples are respected and preserved and to anticipate and avoid negative impacts of the project on Indigenous Peoples' communities or to reduce, restore or compensate for them. During the project, maintain an ongoing relationship with the Peoples, based on Informed Consultation and Participation (IPC).	Not applicable There is no indigenous population in the Project area.
PS8 Cultural Heritage	To protect cultural heritage that may be affected in the course of project activities. PS8 is applicable wherever a project undertakes any earth movement activities on undisturbed ground. It draws on international conventions and best practices. PS8 requires consultation with affected communities to identify cultural heritage of importance and to incorporate the views of affected communities on cultural heritage into project decision-making. The objectives of this PS include ensuring development proponents take the necessary steps to protect cultural heritage from adverse project impacts and to take actions to support its preservation. Also, where appropriate, PS8 requires the equitable sharing of benefits from the use of cultural heritage.	Triggered The area is not known for important tangible or nontangible heritage, nevertheless the protection of the cultural heritage has to be ensured through measures applicable in case of accidental discovery.

2.6.3. IFC Environmental, Health and Safety (EHS) guidelines, World Bank Group

The EHS directives are technical reference documents containing general and specific examples of international good industrial practice. The EHS Guidelines contain performance levels and measures that are normally acceptable to the World Bank Group and are generally considered achievable for new facilities at reasonable costs using existing technology.

The World Bank Group requires borrowers/clients to apply the relevant levels or measures of the EHS Guidelines. Different guidelines apply depending on the industry sector concerned. For this Project the applicable guidelines are as follows:

- Environmental, Health and Safety (EHS) General Guidelines. IFC, 2007;
- Environmental, Health and Safety Guidelines for Waste Management Facilities. IFC, 2007;
- Environmental, Health and Safety Guidelines for Water and Sanitation. IFC, 2007
- Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution. IFC, 2007.

2.7. Gap analysis between the national legal framework and the IFC standards

The Togolese legal framework responds in many aspects to the requirements of international donors in terms of environmental and social assessment. Nevertheless, some divergences are to be noted and mainly lie in:

- the implementation of a management system for social and environmental impacts;
- the establishment of a complaint management mechanism for communities;

- the obligation to maintain constant stakeholder engagement in the Project.

Where host country regulations differ from the levels and measures outlined in EHS standards and guidelines, projects will need to achieve the most stringent. The following table summarizes the comparison between the different national and international standards.

Table 18 Comparative analysis of IFC Performance Standards versus Togolese regulations

IFC Performance Standards	Objectives	National regulations	Gaps identified
PS 1 - Assessment and Management of Environmental and Social Risks and Impacts	* Assessment and management of environmental and social risks and impacts; * Identify and evaluate the social and environmental impacts, both negative and positive, in the project's area of influence; * Avoid or, when this is not possible, minimize, mitigate or compensate for negative impacts on workers, affected communities and the environment; * Ensure that affected communities are appropriately engaged in the resolution of issues that may affect them; * Promote better social and environmental performance of companies through the effective use of management systems.	Article 38 et seq. of the law N°2008-005 of May 30, 2008 on the framework law on the Environment Decree N°2017-040/PR fixing the procedure for Environmental and Social Impact Studies Order N° 0151/MERF/CAB/ANGE fixing the list of activities and projects subject to environmental and social impact study. Decree n°2011-041/PR of March 16, 2011 setting the terms of implementation of the environmental audit Order 0150 / MERF /CAB / ANGE setting the terms and conditions for public participation in environmental and social impact studies	The regulatory framework applied in Togo is appropriate for the identification of impacts, their evaluation, and the definition of measures. However, the subject of environmental performance involving the notion of monitoring through the implementation of an E&S management system for the Project is not developed and required. In addition, the commitment of the stakeholders through the collection of their expectations and concerns presents some shortcomings. Therefore, to address these shortcomings, the SEP, the grievance mechanism and the communication measures defined in the ESMP will be implemented.
PS2 - Workforce and Working Conditions	* Promote the fair treatment, non-discrimination and equal opportunity of workers; * Establish, maintain and improve relations between workers and management; * To promote respect for national labor and employment law; * Protect workers, including vulnerable categories of workers such as children, migrant workers, workers recruited by third parties, and workers in the client's supply chain; * Promote safe and healthy working conditions and protect the health of workers; * Avoid the use of forced labor;	Law No. 2006-010 of December 13, 2006 on the Labor Code of the Togolese Republic Decree no. 70-164 of October 2, 1970 setting, in application of the provisions of article 134 of the labor code, the general health and safety measures applicable to workers in establishments of all kinds. Interministerial Order Nº 005/2011/MTESS/MS establishing the conditions under which the various monitoring of workers' health, the work environment, prevention, improvement of working conditions are carried out. Interprofessional collective agreement of Togo	**No gaps identified** The Togolese labor code addresses all the key points of the PS2 and also outlaws forced labor, vulnerable categories and integrates the notion of health and safety in the protection of workers and the management of workers' complaints**.**

IFC Performance Standards	Objectives	National regulations	Gaps identified
	*Existence of a complaints management mechanism; * Existence of a complaint management mechanism	Law No. 2011-006 of February 21, 2011 on the Social Security Code in Togo	
PS3 - Resource Efficiency and Pollution Prevention	* Minimize negative impacts on human health and the environment; * Reduce project-related GHG emissions; * Promote more sustainable use of resources, including energy and water.	Law N°2008-005 of May 30, 2008 on the framework law on the Environment & Consecration of the principle of responsibility and polluter-payer Order n°002 /MERF/MCPSP/MEF OF MAY 23, 2013 regulating the import and re-export of hydro chlorofluorocarbons and equipment containing them Decree No. 2011-003/PR setting the terms of management of plastic packaging in Togo	**No gaps identified** The general principles defined by this law aim to protect the environment and stop all pollution and degradation on all environmental compartments. On the other hand, the notion of sustainable consumption is only weakly addressed and climate change is totally absent**.**
PS 4 - Community Health, Safety and Security	* Anticipate and avoid, during the life of the project, negative impacts on the health and safety of the affected communities that may result from ordinary or non-ordinary circumstances; * Ensure that the protection of personnel and property is provided in accordance with applicable human rights principles and in a manner that avoids or minimizes risk to the affected Communities.	Law No. 2008-005 of May 30, 2008 on the framework law on the Environment	**No gaps identified** The general principles defined by this law aim to protect the environment, in particular to prevent and anticipate actions likely to have negative effects on the environment in order to improve the living environment. In particular, it indicates the need to deposit hazardous materials in authorized locations, and to control and monitor discharges.
PS5 - Land Acquisition and Involuntary Resettlement	* Avoid, and whenever not possible, limit relocation involuntary by considering alternative designs to projects. * Avoid forced eviction. * Anticipate and avoid, or where it is not possible to avoid, limit the negative social and economic impacts resulting from the acquisition of land or restrictions on its use by: (i) providing compensation for the loss of assets at replacement cost, and (ii) ensuring that	Law N°2008-005 of May 30, 2008 on the Environment Framework Law Decree N°2017-040/PR fixing the procedure for Environmental and Social Impact Studies Law n°005-2018 of June 05, 2018 on the State Land Code	Laws and decrees set out the legal provisions related to access to property, procedures and deadlines related to land operations, the procedure for confirming rights and expropriation for reasons of public utility. It also indicates the right to expropriate any holder of land rights for reasons of public utility in exchange for fair and preliminary compensation. The terms

IFC Performance Standards	Objectives	National regulations	Gaps identified
	resettlement activities are accompanied by appropriate communication of information and informed consultation and participation of affected persons. * Improving or at least restoring the livelihoods and living conditions of displaced persons. * Improve the living conditions of physically displaced persons through the provision of adequate housing with security of tenure in resettlement sites.		and conditions of compensation for expropriation are set out in the Land Code. The decree mentions the need to draft a RAP beyond 50 PAPs but does not make a precise distinction between the different PAPs.
PS6 - Conservation of Biodiversity and Sustainable Management of Living Natural Resources	* Protecting and conserving biodiversity; * Sustaining the benefits of ecosystem services; * Promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.	Law n°2008-005 of May 30, 2008 on the framework law on the environment Law N°96-007/PR OF 3 JULY 1996 relating to plant protection and its implementing texts Ordinance No. 4 of 16 January 1968 regulating the protection of wildlife and the practice of hunting in Togo (list of protected species) Decree No. 2003 237/ PR OF September 26, 2003 on the establishment of a standardized framework for the management of protected areas. Decree of 5 February 1938 on the organisation of the forest regime in Togo	Although the notion of ecosystem service is not addressed in Togolese regulations, no major gap was identified.
PS7 - Indiginous Peoples	* Ensure that the development process promotes full respect for the human rights, dignity, aspirations, cultures and resource-based livelihoods of Indigenous Peoples. * Anticipate and avoid negative impacts of projects on Indigenous Peoples' communities or, if this is not possible, reduce, restore and/or compensate for such impacts.	None	Such legislative provisions do not exist in Togolese law. **Not concerned by the Project.**

IFC Performance Standards	Objectives	National regulations	Gaps identified
	* Promote benefits and opportunities related to sustainable development for Indigenous Peoples that are culturally appropriate. * Establish and maintain an ongoing relationship with Indigenous Peoples affected by a project throughout its duration based on Informed Consultation and Participation (IPC). * Obtain the Free, Prior and Informed Consent (FPIC) of Indigenous Peoples where the circumstances described in this Performance Note exist. * Respect and preserve the culture, knowledge and practices of Aboriginal Peoples.		
PS8 - Cultural Heritage	* Protect cultural heritage from the negative impacts of project activities and support its preservation. * Promote the equitable distribution of benefits from the use of cultural heritage.	Law n°2008-005 of May 30, 2008 on the framework law on the environment Law 90 -24 on the protection of the national cultural heritage of 23 November 1990, Order N°037/MCCSFC/CNPC/2017 of 23/03/17 on the inscription of Sites and Monuments of Togo on the national list of inventories of cultural property Decree No. 2009-175/PR of August 12, 2009 establishing a general inventory of the cultural heritage of Togo	**No gaps identified.** The law integrates the protection and safeguarding of cultural property by establishing a classification of the property.

3. Project description

3.1. The Project

The development of PIA site as Phase 1 and Phase 2 interconnected areas aims to achieve the objectives assigned to the Project, which are among others:

- Contribution to the implementation of a large national economic development plan transcribed in the National Development Plan (PND) 2018-2022 through 3 axis:
  - Axis 1: The establishment of a logistics platform and a financial hub of excellence.
  - Axis 2: The development of centers for agricultural processing, manufacturing and extractive industries.
  - Axis 3: The consolidation of social development and the strengthening of inclusion mechanisms.
- Development of an integrated industrial zone that will host a business park focused mainly on textile manufacturing and agribusiness by providing serviced land, common infrastructure and shared utilities (water, electricity and wastewater treatment), plug-and-play facilities and privileged access to Togo's natural resources
- Incentive of an economic transition by supporting the development of an industrial sector based on Togo's abundant agricultural resources.
- Contribution to the national strategy aimed at tackling climate change by increasing the production of renewable energy through the installation of a solar park.

In addition, PIA industrial zone will contribute to developing an urban and economic hub in the northern suburbs of the city of Lome.

3.2. Description of Project characteristics

3.2.1. Phased development

The PIA site is developed across two sites referred to as phases, and a connecting land as shown in the PIA Masterplan, Figure 2:

- PIA Phase 1, covering 129,47 ha
- PIA Phase 2, covering 716 ha, and comprising of the industrial zone, general infrustructure, including 552,56 ha for a solar park.
- Industrial Corridor, covering 209.18ha with :
  - comprising of connecting road and HT transmission line within 60 meters Right of Way (RoW) ,
  - light industry and commercial developments within a 100 meters right of Way both part of the road.

The road and the transmission line will involve shared responsibilities among PIA and the Togolese Government. PIA will be responsible for its construction and maintenance. It is therefore considered as an element that belongs to the scope of the present ESIA.

The present ESIA covers the PIA Phase 2 and Industrial Corridor (925.18 ha in total).

3.2.2. Master plan of the Project

3.2.2.1. Site development and land uses

The location and general master plan of PIA site (Phase 1 and Phase 2) is presented in the figure below. It includes the Project components and their estimated area.

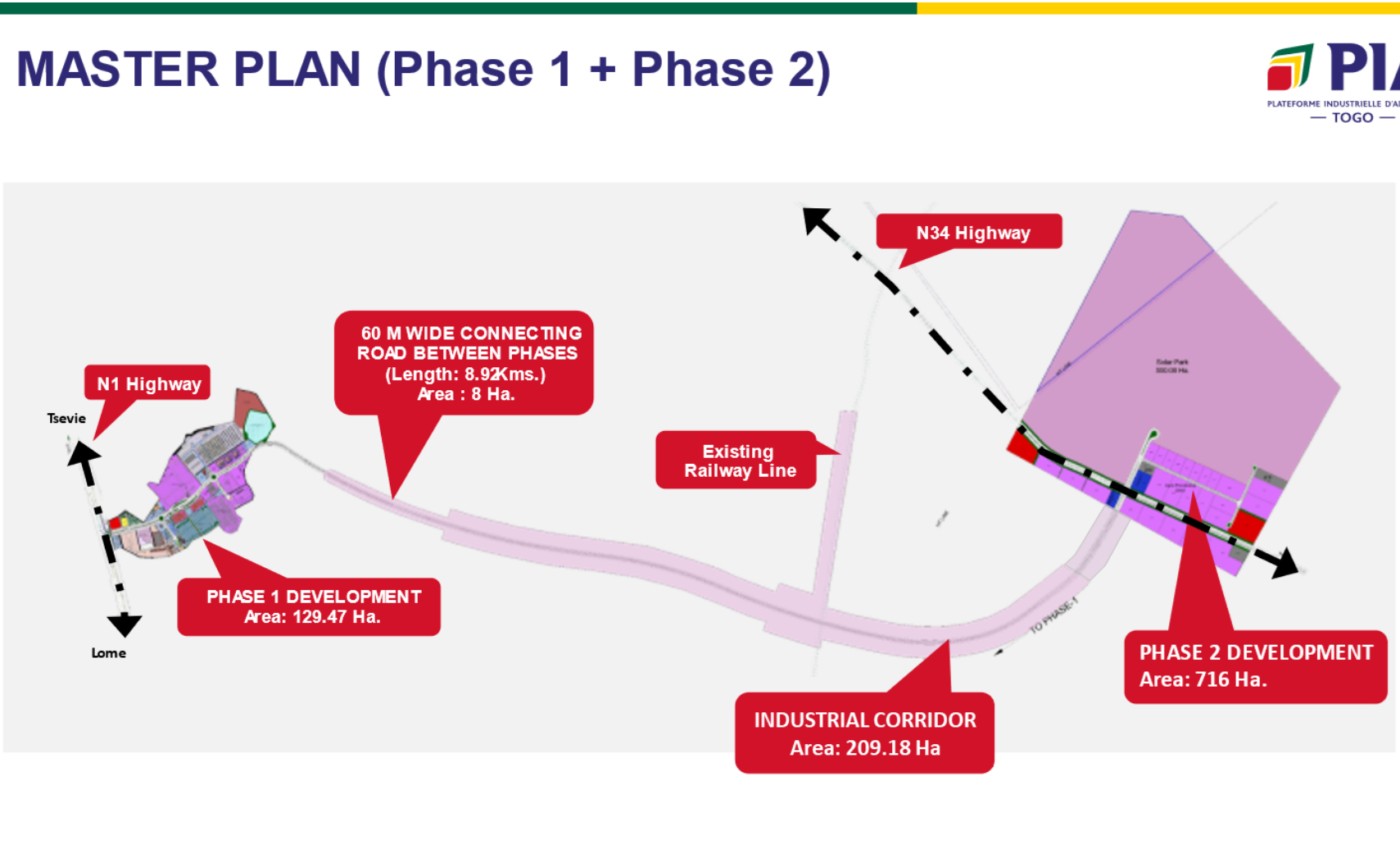


Figure 2 PIA Masterplan including the Project components (Source : PIA, 2022)

The PIA Phase 2 area will comprise different types of spaces according to their uses, as presented in Figure 2 and Table 17. The site will be crossed by several access roads and punctuated by green spaces. The largest part of the site area will be taken by the solar park. Similarly, the land use within the Industrial Corridor is summarised in Figure 3 andTable 20.

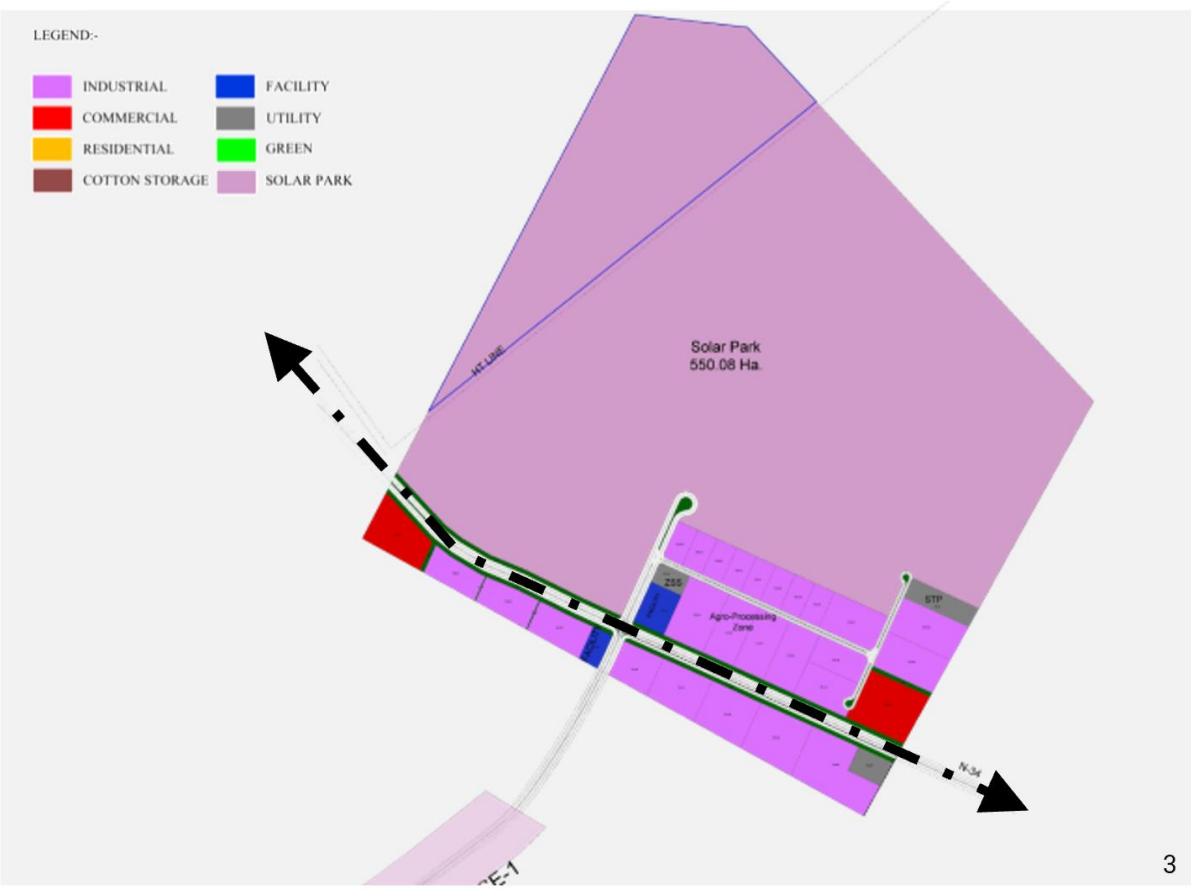


Figure 2 PIA Phase 2 land use (Source: PIA, 2022)

Table 19 Land use typology for PIA Phase 2

Occupation	Area (Ha)	Area (%)
Solar park	552.56	77%
Industrial	99.01	14%
Commercial	13.19	2%
Facilities	4.80	1%
Utilities	7.00	1%
Green spaces	11.71	2%
Road	27.73	4%
TOTAL	**716**	**100**

(Source: PIA Area Statement, 2021)

The Industrial Corridor will include mainly industrial plots and road. It will also comprise areas for facilities and green spaces.

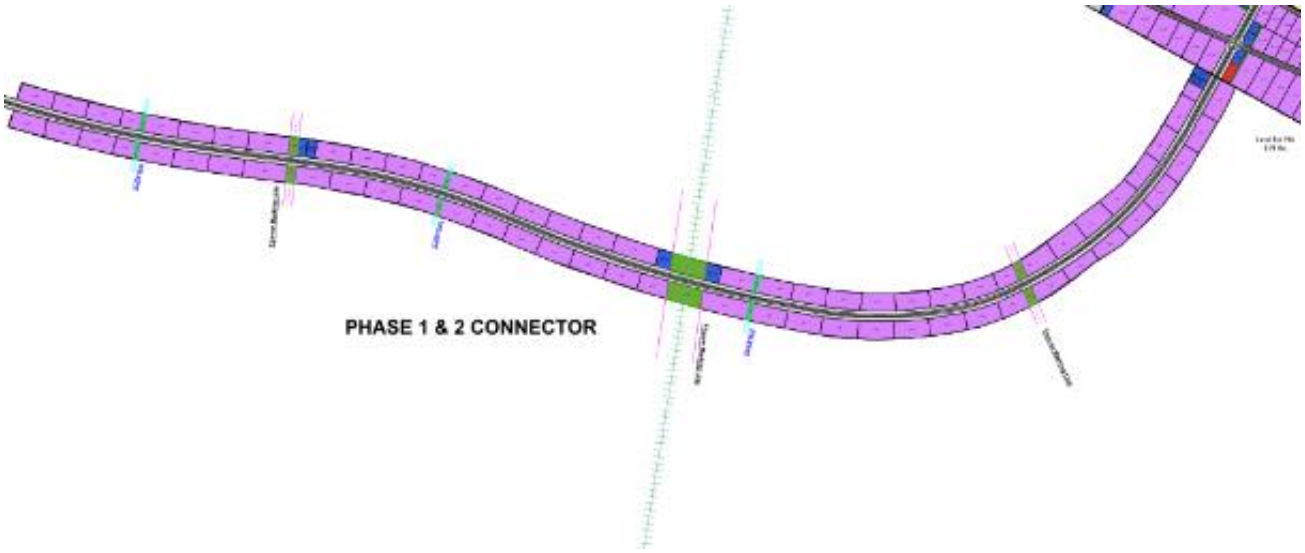


Figure 3 Industrial corridor land use (Source: PIA, 2022)

Table 20 Land use typology for Industrial Corridor (Source: PIA, 2022)

Table

Occupation	Area (Ha)	Area (%)
Industrial	139.92	
Facilities	3.75	
Green	7.22	
Road (within 260 m corridor)	45.25	
Road (beyond 260 m corridor)	13.05	
Total Area	**209.18**	100

3.2.2.2. Employment

The Project is estimated to generate approximately :

- 1500 jobs during construction phase ;
- 5000 to 7000 direct jobs during operation phase.

The ratio of skilled / unskilled jobs is estimated at 70/30.

The job profiles offered will be versatile between the positions to be filled at the level of the development company and those offered by the industries located in the IZ:

- Administrative staff for the management of the area (one-stop shop, reception buildings);
- Security and rescue personnel (police station and fire station);
- Maintenance personnel for buildings and green spaces;
- Employees and managers ;
- Workers, technicians and managers of processing plants and other industrial units.

PIA has a policy to create jobs for local population and foresee that 70% of the jobs created will be for local staff.

3.2.2.3. Proposed infrastructure

Project Area will include different types of facilities to offer a variety of services to companies and industries setting up there:

- Shared services: water supply network, wastewater collection network and treatment plant, drainage system, waste management facilities, and communication services
- Common administrative, reception and residential buildings
- Roads and logistics infrastructure (internal routes)
- 260 MW solar farm, electricity distribution network and a power transmission line connecting PIA Phase 1 and PIA Phase 2 sites

The details of these project components are presented in the following sections.

It should be noted that certain common facilities, including electrical station, a police station and a fire brigade, have been established as part of Phase I, and will utilized by the Project.

3.2.3. Electricity distribution system

The energy demand of PIA (30MW for Phase 1 and 30 MW for PIA Phase 2) will be met by the 260 MW Solar Park that will be built in two stages at PIA Phase 2 site, as well as 20MW rooftop solar plant constructed at Phase 1 site.

The energy produced by the solar farm will be used for PIA Phase 1 via a power transmission line built along the route connecting PIA Phase 1 to PIA Phase 2. It's important to note that the energy produced will directly flow into the Togolese electric network, and PIA will obtain electricity from the national grid. PIA power demand of 60MW is much lower than the generated solar power production, hence a substantial excess of power (220MW) will remain in the national electric grid.

The electricity distribution system on PIA Phase 2 site will be developed in a similar way as that for PIA Phase 1 and it will include:

- A main receiving substation (MRSS).
- One or more zonal switching substations (ZSS)
- Power transmission lines connecting MRSS to (each) ZSS
- A distribution network on site with power poles and power trays to install transformers to ensure the distribution of electricity at adequate voltage levels to the operators in the area
- A road lighting system equipped with timers or astronomical switches[2] for lighting the area only when needed, reducing energy consumption.

3.2.4. Water supply and distribution system

The Project water supply system will comprise the following elements:

- a total of 6 boreholes drawing water from the Maastrichtien aquifer, with respective flow rates of 65 m^3/hour for a potential daily water supply estimated at 5300 m^3/day.
- 4 water reservoirs – 2 ELSR (elevated level service reservoir) and 2 GLSR (ground level service reservoir) having a total capacity of 6240 m^3 and used for collecting and storing fresh waters

[2] Automatic Time-Switch Control that controls lighting based on the time of day and astronomical events such as sunset and sunrise, accounting for geographic location and calendar date.

pumped from the boreholes. Water will be pumped from GLSR to ELSR via a pumping house an into the water supply network.

- 6,25 km water supply network for distribution and 1,14 km for pumping (connecting borewells to reservoirs). All pipes will be buried.

Total Project water demand during operational phase (including the industrial corridor) is estimated at 6000 m³ per day. When considering re-used water, the total daily industrial water demand is 5300 m³ per day.

Table 21 Estimated water demand (Source: PIA)

Use of groundwater	Total daily water demand (m3/day)	Total daily water demand minus re-used water (m3/day)
General site needs, including solar farm and excluding industries	2600	2600
All industries located within PIA Phase 2 and the connecting corridor	3400	2700
Total	**6000**	**5300**

As a reminder, water demand for Phase I is 3250 m³/day based on the in-built design water recycling rates.

The location of 3 boreholes within PIA Phase 2 site and water reservoirs is illustrated in the following figure. Other 3 boreholes will be installed as and when required during the gradual expansion of the industrial zone.

Figure 4 : Location of zones, borewells, ELSR and GLSR (Source PIA, 2021)

To minimize the effect of drawdown in the cone of concentration area, borewells are distanced at least 425 m from each other.

Drinking water will be provided in bottles. However, the results of the borehole water quality tests regularly carried out by the Togolese Government may prove water quality suitability for drinking use according to national standards (It is already proven to be suitable for domestic use).

The need to install water purification units for specific industrial plants (for exemple for agro-industrial activities) will be assessed by each industry according to its process needs.

3.2.5. Wastewater management system

Overview

The Project sewage and industrial wastewater will be conveyed to a common effluent treatment plant (CETP) for the treatment, followed by a discharge into the natural environment. The common wastewater treatment system may requires pre-treatment of the majority of process wastewaters, particularly from large scale polluting industries. All industries will be able to discharge their wastewaters into the common sewage network only after achieving pollutant levels within the prescribed limits (seeTable 22) and removing industry specific pollutants not designed to be treated in the CETP. Mainly light industries are planned for the Industrial Corridor.

It is estimated that about 5300 m^3 of wastewater will be generated daily from the Project area.

The main facilities location and wastewater network plan are illustrated below.

Due to the site topography, wastewater coming from the south-western part of the site will flow by gravity till a lifting/pumping station, where they will be pumped to the treatment plant.

No detail has been provided concerning the wastewater produced by industries that will be implanted on the Industrial Corridor along the road connecting PIA Phase 1 to PIA Phase 2. We assume used water will be pumped to the CETP.

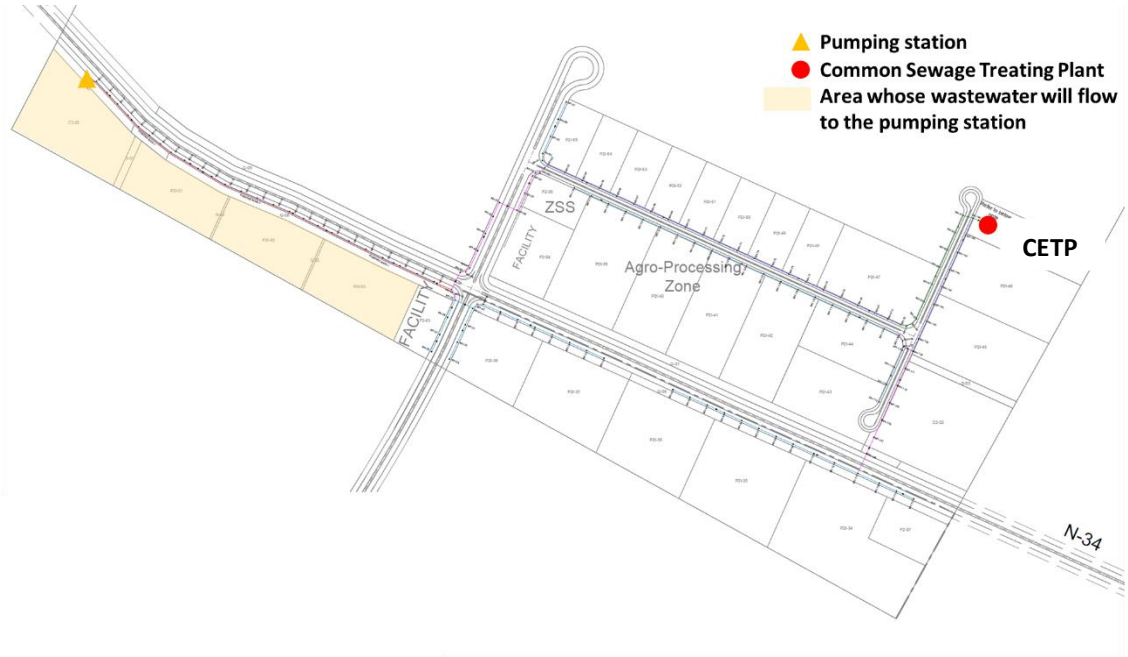


Figure 5 : Wastewater Collection System (Source PIA 2021)

Use of septic tanks during construction phase

Until the CETP becomes operational, especially during the construction phase, septic tanks are used to collect grey and black effluents (wastewater from the kitchen and toilet facilities)These are directed to underground concrete septic tanks, which are periodically emptied by an approved vendor (ETS

Idrissou et Frères) using trucks. These trucks then discharge the untreated effluent in location approved by Togolese government (Attiegou-Kelegouga).

Septic tanks will be partially in use until both treatment plants are commissioned, and after that will be on standby as a contingency option for events of treatment plant malfunctioning or other emergency situations.

Collection network

The collection network comprises a total of 6,6 km of pipelines (pipes diameter of 160, 225, 250 or 280 mm) and 147 manholes. Manholes are the inlets which receive flows into the network system from the individual plots, whereas the pipelines convey the flows to the CETP.

The treated effluents will be discharged into the environment via the natural drainage channel. Discharged water will then reach Lake Togo, as illustrated in the figure below.

Figure 6 Discharge points and drainage channels

Treatment Facilities

The objective of treatment of wastewater through a combination of physical, chemical and/or biological processes is to stabilize decomposable organic matter and remove other harmful contaminants prior to discharge onto a land or waterway or water body.

The degree of treatment depends on the desired wastewater quality. Typically wastewater is processed through a series of operations, in order to meet regulatory discharge standards. The common treatment stages include the following:

- Primary treatment is the first stage where sizable solids are removed through screening, primary settling and through degritting. The removal of most of the large floating materials

takes place in the screen chamber, and most of the heavy suspended solids are separated in the grit chamber.

- Secondary treatment removes pollutants through biological decomposition of degradable organic matter using aerobic or anaerobic process or both. It also removes colloidal and soluble organic matter present in the wastewater.
- Tertiary treatment process comprises disinfection of treated sewage and removal of residual or excessive nutrients such as nitrogen and phosphorous. Tertiary treatment as filtration is also deployed when the concentration of residual pollutants requires further reduction or complete removal for specific water reuse or recycling .

To assure the proper treatment of both industrial effluents and domestic sewage, one Common Effluent Treatment Plant is planned. In the short term, it is planned to build a 200 m^3/day plant using Membrane Bioreactor (MBR) technology (modular – packaged/ container-based model). The capacity of the CETP will be gradually expanded using additional modules to meet the growth pattern of the PIA.

The CETP will include the following components: pumping station, equalization tank, oil & grease separator, coagulation tank, flocculation tank, primary clarifier, neutralization tank, anoxic tank, MBR, sludge holding tank, sludge thickener, etc.

The plant will include an emergency storage tank to store raw effluent in the event of emergency or breakdown of CETP operation.

Finally, the Project will include the construction of an administration room (10m x 10m) to accommodate office space, laboratory, toilets, electrical panels, storage space, including plumping, electrical wiring, furniture, lab testing equipment to meet the operation requirements of the CETP plant.

An indicative CETP process design in the form of flow chart is provided below for reference.

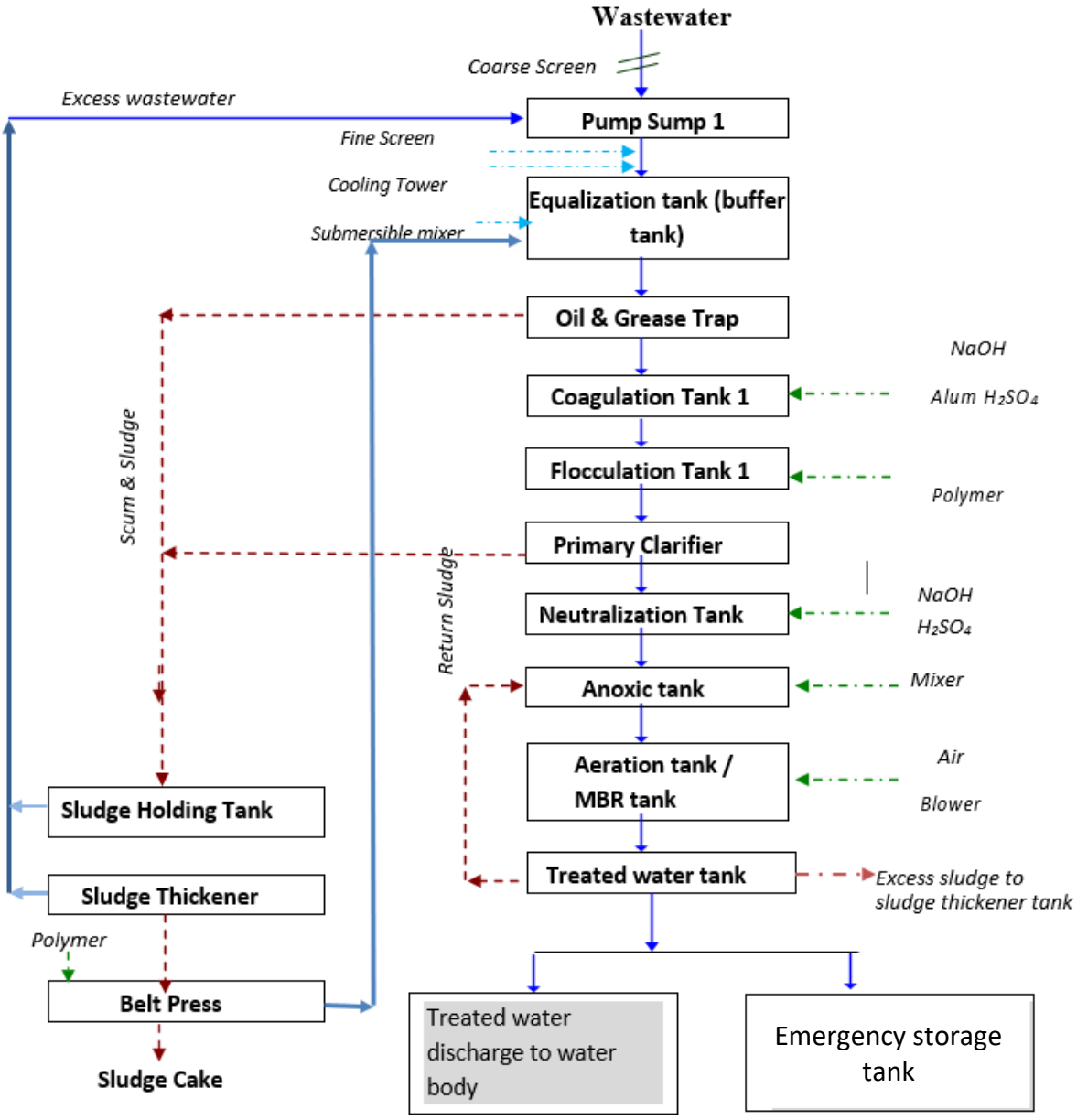


Figure 7 indicative CETP process design

The CETP will be designed to treat a mix of industrial effluent and domestic sewage and it will adopt the best of the industry practices that are being followed by other successful projects of similar nature.

Common wastewater treatment system at the PIA Phase 2 site requires pre-treatment of the majority of process wastewaters, particularly from polluting industries. They will discharge into the common sewage network only after achieving pollutant levels within the prescribed limits (see Table 20) and removing industry specific pollutants not designed to be treated in the CETP.

The wastewater treatment system is designed to comply with the national discharge criteria and relevant IFC EHS guidelines (Environmental, Health and Safety (EHS) guidelines, general EHS guidelines: Environmental wastewater and ambient water quality. IFC, 2007). The most stringent thresholds are to be adopted by the Project discharges into the environment (Cf. Table 10 Limit values retained for the discharge of sanitary wastewater after treatment).

CETP is to be designed to withstand the shock loads that are expected up to 25% more polluted than the prescribed inlet parameters.

Based on the information provided by PIA, reference values for the inlets and outlets of the CSTP are presented in Table 22. For non specified parameters, the inlet thresholds are the same as national standards (refer to section 2.5.3).

Table 22 Design Intel Threshold for CETP (Source : PIA, 2022)

N°	Parameter	PIA Design Inlet Threshold	Allowed shock load
1	pH	**5.5 to 8.0**	
2	Temperature (°C)	**/**	
7	Suspended solids (mg/l)	**250**	350
8	BOD((mg/l)	**250-350**	400
9	COD(mg/l)	**400-600**	800
33	Total oil and grease (mg/l)	**50**	55
46	Total Kjeldahl Nitrogen (mg/l)	**45**	50

PIA will monitor effluent quality throughout the exploitation of the IZ using a 3rd party laboratory. In the long term, PIA may set up an in-situ laboratory with all necessary equipment and automation support to check both the inlet and outlet effluent parameters to ensure the treatment process is adhering the set norms.

3.2.6. Stormwater management system

The stormwater management system for PIA Phase 2 will rely on:

- two outfalls (1 on the western part of the site and one on the eastern part) evacuating runoff from 2 different catchment areas towards the existing natural channels;
    - outfall OF-1, located north-east of the site, will collect waters coming from the zone north of the N-34 route; treated effleunt discharged by CEPT will also be collected at this outfall.
    - outfall OF-2, located at the west border of the site, will collect runoff from the N-34 route, crossing east to west the whole PIA Phase 2 site, as well as stormwater from the zone south of the N-34 route.
    - a network of drains collecting stormwater and leading it to the 2 outfalls, depending on the affected zone.

Outfall locations will be informed by the topography. The 2 catchments, outfalls and drains are illustred in Figure 10.

Stormwaters will be discharged into the environment via two natural drainage channels collecting waters at outfall points. Discharged water will then reach the existing natural streams, as illustrated in

the figure below. Based on the information provided, no modification of the existing natural streams will be implemented.

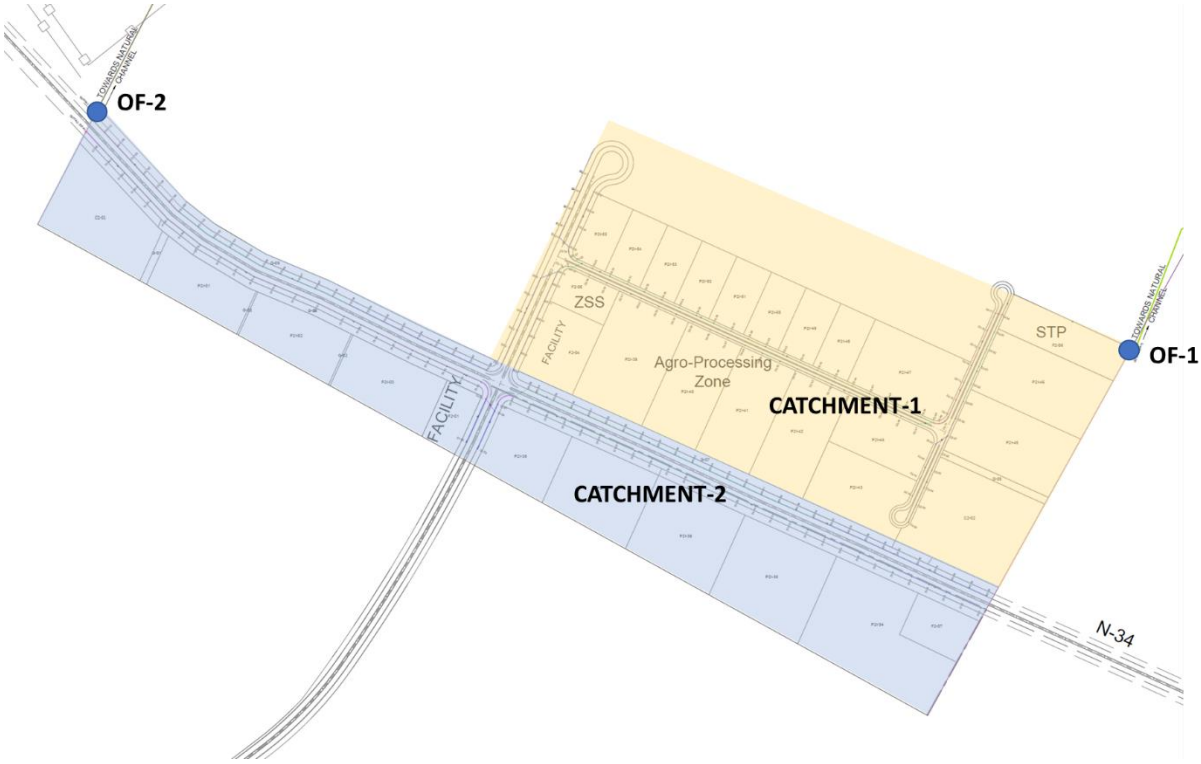


Figure 8 Catchment and outfall location

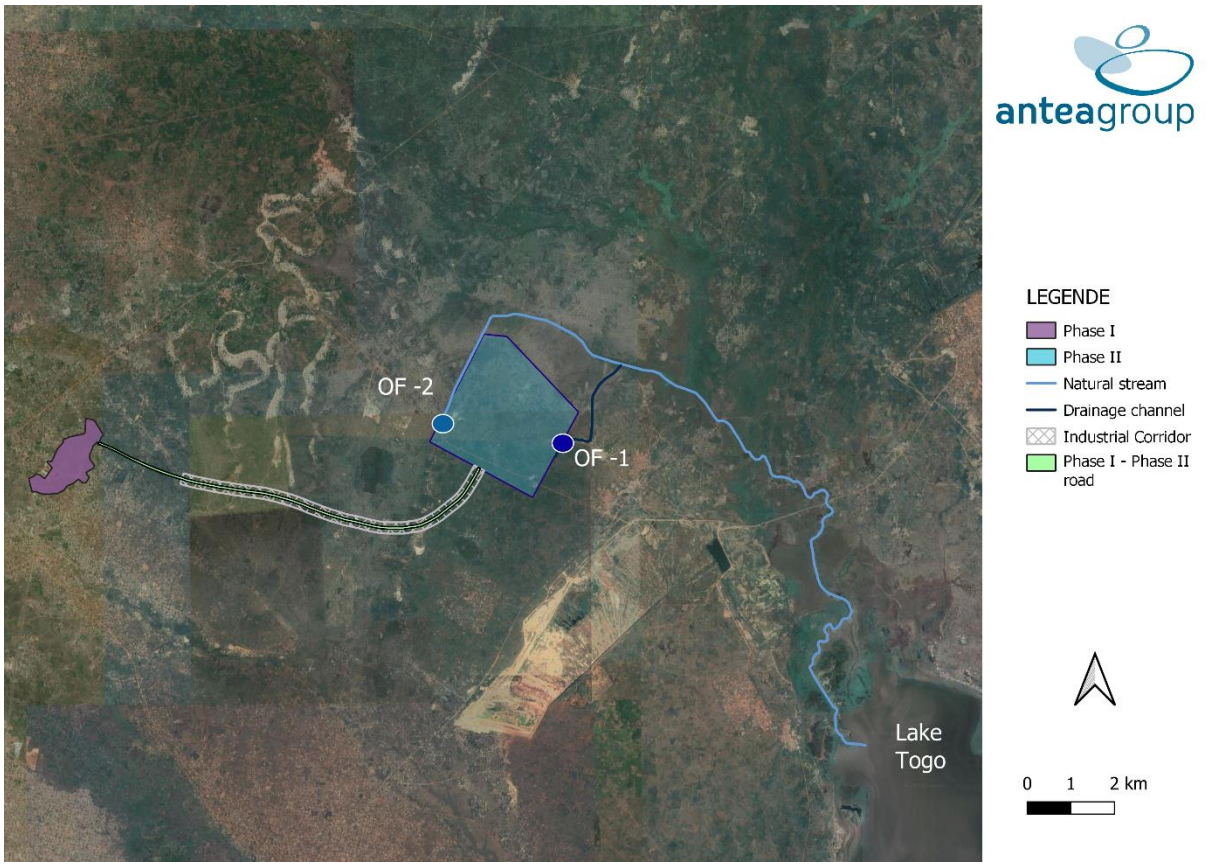


Figure 9 Drainage channels at outfall locations

No detail has been provided concerning the drainage system of the solar park apart for the realisation of a drainage system designed to avoid any water logging. According to the design configuration of the solar park (based on rows of solar panels on piles), the construction of the solar park will not result in the impermeabilization of large areas. On the other hand, rainwater falling on the ground after hitting the PV modules may concentrate and result in the formation of preferential drainage lines, which justifies the need for a drainage network.

This drainage network will be built in the natural ground (grassed drainage channel) to allow collection and partial infiltration of the water.

In relation to the Industrial Corridor, drainage system will rely on outfalls determined by the topography. Stormwaters will be discharged into the environment via natural drainage channels collecting waters at outfall points. No information has been provided concerning the design of these drainage channels.

The design basis of the stormwater network is presented in Annex XIII.

Outfalls

No details have been provided concerning the outfalls typology. Each outfall location shall be designed to allow free flow with necessary bed protection measures to avoid soil erosion and related problems. Grates or nets shall be fixed where appropriate to arrest the debris, other solid entering the central drain.

Figure 10 : Possible Proposals at Outfall Location to trap the solid waste entering the waterbody

The figures below present the stormwater network.

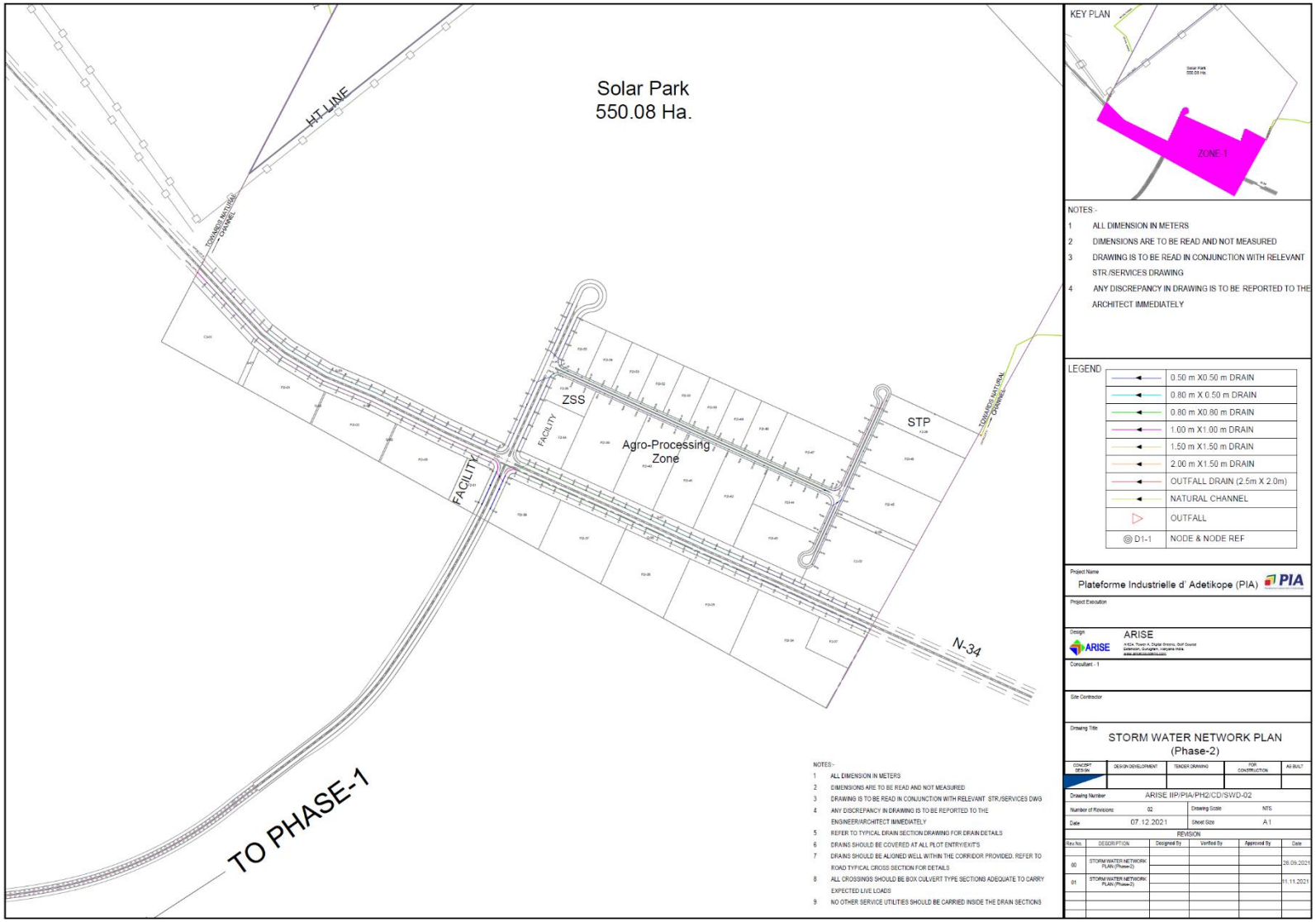


Figure 11 Stormwater management system

3.2.7. Waste management system

3.2.7.1. Overview

PIA has developed a Waste Management Plan to facilitate the effective management of wastes generated at the PIA Phase 2 IZ. The plan aims at:

- Describing the practices and procedures that will be used to ensure that the waste- related impacts are prevented and minimised.
- Providing a means for fulfilling PIA environmental commitments.
- Detailing the monitoring procedures associated with the waste management to ensure that the intended objectives of the proposed impact avoidance and mitigation measures are achieved.

PIA has also developed a Project and Operation Waste Management Procedure that guides project contractors, workers activities and Operational facilities to reduce and manage waste in all forms to prevent health related problems and any damage to the environment.

PIA will rely on the regional waste infrastructure detailed in section

3.2.7.2. Strategy and main principles

PIA waste management relies on a global waste strategy ensuring the protection of the natural environment and the health and safety of personnel and the community. The strategy may be graphically issultrated as follows :

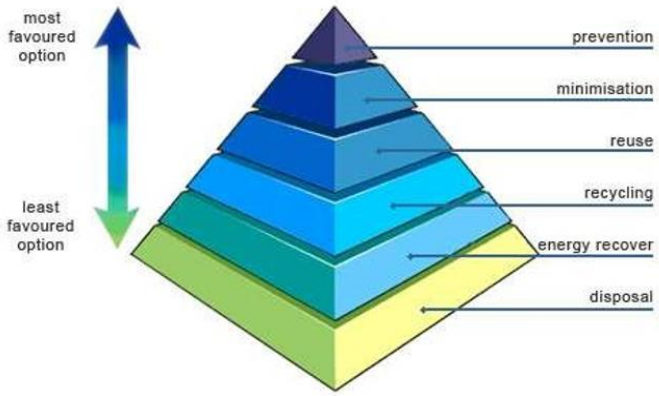


Figure 12 Waste Management Hierarchy (Source PIA Waste Management Plan, 2021)

In order to ensure a proper management, all wastes need to be classified at the point of production to determine appropriate segregation, storage, handling and disposal procedures. Wastes will be classified as follows :

- Inert: waste from construction, rehabilitation (renovation) and demolition activities linked to the building sector as well as activities linked to the construction and maintenance of public works (roads, bridges, networks, etc.). The inert waste produced by the construction includes excavation and rubble from construction sites such as concrete, bricks, ceramics, tiles, concrete blocks, stones.
- Non-hazardous: also referred-to as Ordinary Industrial Waste (OIW), it includes all non-hazardous waste consisting of materials such as wood, paper and cardboard, plastics, metals, tires, glass, textiles, leather or even organic materials. OIWs are defined as non-inert and, as opposed to hazardous industrial waste, they do not have a toxic character.

- Hazardous: Hazardous industrial waste is waste that can cause harm to humans or the environment and which requires appropriate treatment. Exemples are: paints and varnishes containing organic solvents and other dangerous substances, asbestos construction or insulation materials, waste contaminated with dangerous substances, bituminous mixtures containing tar, used oils, batteries, soiled and absorbent rags, filters, print cartridge, packaging that contained paints.

Generic waste streams that can be generated at PIA Industrial Zone and their treatment and disposal routes can be categorized as follows:

Table 23 : Waste stream inventory and management routes (based on PIA, Waste Management Plan, 2021)

Waste Streams	Classification	Treatment/Disposal Route
General household waste	GEN	Disposal at Aképé Technical Landfill Center
Kitchen Grease/Oil	GEN/REC	Disposal at Aképé Technical Landfill Center
Food	GEN	Disposal at Aképé Technical Landfill Center
Metals (waste drums, scrap metal)	GEN/REC	Recycling via Africa Global Recycling (AGR)
Wood	GEN/REC	Recycling via UTRADER and Davie Mayor Office for community use
Plastics	GEN/REC	Recycling via UTRADER
Paper and carboard	GEN/REC	Recycling via Africa Global Recycling (AGR)
Tyres	GEN/REC	Recycling via UTRADER
Oily water	HAZ	Disposal/recycling via METTOGO
Waste Electrical and Electronic Equipment (WEEE)	HAZ/REC	Disposal at the Akepe Landfill
Waste oils	HAZ/REC	Disposal/recycling via METTOGO
Oily Solids	HAZ	Disposal/recycling via METTOGO
Chemicals, solvents and paints	HAZ/REC	Disposal/recycling via METTOGO
Contaminated Containers	HAZ	Disposal/recycling via METTOGO
Fluorescent tubes	HAZ/REC	Disposal at the Akepe Landfill
Medical Waste	HAZ	Disposal at CSM -Adetikope
Flammable Liquids	HAZ/REC	Disposal/recycling via METTOGO
Batteries	HAZ/REC	Disposal/recycling via METTOGO
Concrete, bricks, aggregates, tiles and ceramics	INERT/REC	Reused at PIA sites
Soils containing hazardous substances	HAZ	To be identified

For certain waste streams, no treatment or disposal contractor have been identified by PIA, who will be responsible to fill this gap. Inert waste and soils containing hazardous substances will be disposed of upon direction of ANGE whenever necessary.

Industry specific waste will be assessed in respective ESIAs/EIAs. However, it is PIA's responsibility to ensure duty of care for all wastes generated at PIA site and not ending up inappropriately stored, treated or disposed.

The first step of the strategy is to reduce the amount of wastes generated. This can be accomplished by:

- Reducing material consumption at all levels (including packaging);

- Reducing the volume of waste and using non-hazardous materials rather than hazardous ones where practicable. While not affecting the amount of waste, these measures facilitate the management of wastes and reduce the risk of impact at disposal

Wastes will be handled by trained personnel, who will be in charge of the different activities:

- Identification;
- Labelling: waste containers will be clearly labelled to facilitate the safe and appropriate handling of wastes. Unidentified wastes will be treated as hazardous.
- Handling;
- Segregation and storage
  - Different wastes will be segregated, thus requiring segregation areas and appropriate containers (depending on the volume and the typology of the collected waste), designated by a colour coding system and protected from the direct effects of sunlight, wind or rain. This area will be identified taking into account site acces and drainage.
  - Hazardous wastes will not be mixed, so as to avoid potential chemical reaction. Hazardous liquid wastes will be stored in bunded areas with a secondary containment capability of no less than 110% of the entire volume of waste stored to reduce the risk of pollution resulting from spillage.
  - All storage areas will be marked to indicate the hazards of the stored waste. Hazardous waste areas will be made secure through fencing and other measures to prevent unauthorized intrusions. Toxic or very toxic products will be separated from other products and stored in a room or in a locked cabinet. Access to these areas will be limited to trained employees. A hazardous materials storage plan including the exact location of the different classes of products as well as an inventory register must be kept up to date, thus, in the event of a leak or fire, the nature of the products stored will be quickly known and their quantities.
  - Volume of wastes stored will be kept to a minimum where practicable. Waste will be kept on-site for the minimum amount of time possible given logistical constraints and stored in a way to prevent scavenging by animals and pests. When containers are ¾ full, the environmental representative must be notified to initiate the collection procedure.
  - All waste collection points should have spill response kits and fire-fighting equipment as appropriate. Certain waste collection points may also have areas for washing and temporary storage of waste containers. Designated areas may be required for storage of non-compliant waste, or waste with special handling requirements.
- Transport: only approved contractors (responsible for holding the appropriate operating licences and regularly monitored) will be used to transport wastes from the collection points to the final disposal site. Additionally, PIA will require contractors to:
  - Transport wastes in an environmentally safe and responsible manner, using the appropriate level of protection and containment for the wastes concerned.
  - Use appropriate vehicles for transportation with suitable specifications including compartments or undercover storage to prevent loss of waste.
  - Use designated routes to minimise impact.
  - Use safe loading and unloading procedures to protect workforce and prevent loss of waste.
  - Provide means for emergency response and train employees in spill procedures.

- Ensure wastes and vehicles are labelled accordingly.

- Treatment and disposal:
  - All waste transfers will require proper documentation (Waste Transfer Notes, WTN), allowing third parties to know the content of the shipment and ensure its proper management. In the event of collection by a supplier, the supplier's form (BSD) must be received and specify the final destination of the waste and keep a register describing the operations carried out on the waste. Checklists will be used to verify that the waste is clearly documented and labelled, that containers are appropriate to the waste they contain, are in good condition and are sealed and not leaking.
  - As for the final disposal of wastes, PIA will only use third party waste contractors and facilities approved based on their ability to meet the requirements set in the PIA Waste Management Plan. Currently an officially registered Aképé Technical Landfill Center (TLC) is used by PIA and their contractors to dispose majority of non- recyclable waste. The TLC will have to be audited to ensure it can adequately handle all PIA waste streams. Current possibilities for off-site disposal of hazardous wastes will be investigated by PIA.

3.2.7.3. Waste collection, transportation, treatment and disposal

In order to properly carry out the collection, transportation, treatment (if necessary) and disposal of its waste, PIA has identified several licensed and qualified waste management contractors among which: the Aképé Technical Landfill Center (TLC), Africa Global Recycling, UTRADER, and METTOGO. PIA will audit these contractors regularly to ensure the Duty of Care for a safe waste lifecycle from its origin to disposal.

Organic waste

The respective waste volume of domestic waste produced by the Project during operation phase is estimated at 1500 tons per year.

According to PIA Waste Management Procedure, part of the organic domestic waste (waste from food) will be used by PIA Cleaning and Landscaping staff as compost fertilizer to support PIA green projects. The rest will be sent to the Aképé TLC. Based on the amount of organic waste produced (~4 tons/day), we assume only a small part of the total organic waste produced by PIA will be used by PIA Cleaning and Landscaping staff.

Figure 13 Organic waste disposal to produce compost (PIA, 2022)

Non-hazardous waste

The Project will be responsible for the production of 2105 ton/year of non-hazardous waste.

Non-recyclable ordinary industrial waste (non-hazardous) will be periodically evacuated to the Aképé TLC.

In May 2021 PIA has signed a contract with UTRADER to collect all types of non-hazardous waste from the site. UTRADER uses tricycles and trains local community workers to collect waste from the site three days in a week per contract. UTRADER delivers collected waste to their sorting site in Davie, where it implements recycling of plastics, wooden boards, metals and tires in the context of their circularity community project. UTRADER as an NGO employs youth with innovative skills to produce plastic bags, leather shoes, slippers, beds, chairs, cocktail stands, door mats from the plastics and other waste to earn a living.

PIA has equally engaged with African Global Recycling (AGR) that collects plastics, metals, papers, delivers them to their factory site for sorting and for recycling purposes.

Hazardous waste

The Project will be responsible for the production of 280,39 ton/year of hazardous waste.

The main vendor identified by PIA to manage and recycle used oils and batteries waste resulting from PIA operations is METTOGO.

PIA Medical waste will be sent to Adétikopé medical center ("Centre de Spécialités Médicales" or CSM) to be incinerated, according to the national regulatory requirements. This waste is handled by PIA under direction of CSM.

Should additional hazardous waste be identified, PIA environmental department is responsible of identifying a vendor who has the capacity to treat the waste and, if this is not possible, to implement the suitable procedure for export according to international standards.

Summary of waste contractors

Table 24 : Summary of Waste stream inventory and management routes (based on PIA, Waste Management Plan, 2021)

Type of solid waste	System set up	Périodicity	Vendor
Scraps	Sale or Re-usable	3 days in a week	UTRADER / AGR
Empty réfrigération gas cylinders	Storage then collection by the approved structure	Monthly	METTOGO
Defective IT tools (computers, printers, photocopiers, network cables, etc.)	Sale, reuse	After 5 years	METTOGO
Hazardous solid waste: Empty ink cartridges and ink toners	Storage then collection	Monthly	METTOGO
Hazardous solid waste: Rags soiled with grease, oil, gasoline or diesel fuel	Storage in a barrel or drum and collection	When needed	METTOGO
Hazardous solid waste: used batteries, damaged batteries and bulbs, fuses, etc.	Storage then collection	When needed	METTOGO
Hazardous solid waste: empty bottles of cleaning products, empty aerosols (deodorants, insecticides)	Storage in Cans	Monthly	METTOGO
Hazardous waste: oil filters, rags soaked in used oil or grease	Storage in a barrel or drum and collection	Monthly	METTOGO
Used tires from trucks and equipment	Stored in the garage (outside)	Monthly	UTRADER
Kitchen waste (food scraps, food waste)	Reuse for compost in the garden and storage in bins then collection	Everyday	UTRADER

Type of solid waste	System set up	Périodicity	Vendor
Administrative waste: paper, plastics and others	Storage in bins then collection	Every 3 days	UTRADER / AGR
Empty plastic water bottles	Storage then collection	Everyday	UTRADER / AGR
Dispenser Water bottles	Takeover by the water supplier	Weekly	VOLTIC OR "VITAL"
Packing boxes, boxes of toilet pap	Reuse / Storage in bins then collection	Every 3 days	UTRADER

3.2.7.4. Roles and responsibilities

PIA HSE Department will be responsible for ensuring that the waste management procedures described in this Plan are followed and are fully communicated to PIA personnel, the main Contractor, sub-contractors and any other personnel.

Generally, waste management will be handled by the operators located on the site, while PIA will manage the waste generated by the common infrastructure.

As waste generators, any contractors and sub-contractors will be responsible for:

- Developing Waste Management Plans for their specific operations
- Ensuring compliance with applicable international, national, regional, and local regulations and guidelines;
- Integrating the principles of waste reduction into their waste management (reduce, reuse, recover and recycle);
- Fully identifying, characterizing and classifying all generated waste streams;
- Fully understanding the relevant waste management requirements and decide the most appropriate reduction, handling, storage, treatment and disposal methods;
- Training of all personnel;
- Document control and record keeping;
- Ensuring that only approved waste contractors and handling and disposal facilities are used;
- Ensuring that waste carriers and/or receivers perform the necessary work to a satisfactory standard;
- Tracking the waste to its ultimate disposition and implementing all reasonable care to minimise impacts to the environment or human health.

3.2.7.5. Verification and monitoring programme

The aim of the verification and monitoring programme is to provide assurance that all activities generating waste within the PIA development are in accordance with this Waste Management Plan, but also comply with national and international standards.

The monitoring includes audit, informal site inspections and action tracking system. Frequency is determined by PIA HSE department. The programme applies the principle of the Plan – Do – Check – Improve method.

Audits will use site visits, personnel interviews and document reviews. A standard proforma approach will be used to allow comparison of non-conformances, exceptional performances and areas for improvement. All formal HSE audits shall be conducted in three phases with meetings before and after the main audit. The audit report shall be distributed to corporate ESG Lead and will be fed into management system where corrective actions will be recorded, and a future schedule for repeat audits will be determined. Major corrective actions shall be dealt with immediately.

External third-party audits will also be conducted by stakeholders. Informal site inspections will be regularly undertaken by Association SH-FCP HSE personnel to assess the implementation of waste management procedures, these visits will detail the waste handling, segregation, storage, documentation, transport and disposal procedures.

An Action Tracking System (ATS) will be initiated to track the implementation of corrective actions resulting from audits or routine site inspections. It will detail, among other things what corrective action is required and who is responsible for its implementation.

- Key performance indicators or the following :
- Annual targets for waste minimisation/recycling/re-use;
- Development of waste infrastructure and waste disposal options;
- Levels of waste management training;
- Number of corrective actions required at waste facilities as a result of verification program (internal and external);
- Number of corrective actions required at third party facilities as a result of verification program (internal and external).

3.2.7.6. Reporting, documentation and record-keeping

The reporting will address the following perimeters:

- Waste types and volumes produced;
- Hazardous wastes disposed off-site;
- Details of waste facilities used;
- Audit and site inspection findings;
- Performance against KPIs

The PIA HSE Department will be responsible for deciding the frequency and schedule of the reporting parameters.

3.2.7.7. Vegetation dumping site

A dedicated dumping site will be established by PIA for the disposal of green waste generated from the land clearing activities. This is futher detailed in section 3.4.1.

3.2.7.8. Sludge treatment

3.2.7.8.1. Sludge production

The treatment of wastewater at the CETP will result in the production of sludge. According to the European Waste classification, this waste belongs to EWC-Stat code 03.2 Industrial effluent sludges. It includes hazardous and non-hazardous waste based on the substances involved. Upon preliminary consideration, the sludge is considered here to be a hazardous waste. It will be the treatment of

domestic wastewater from communal buildings and the residential area, but also industrial wastewater from the industries present on PIA Phase 2 and Industrial Corridor, which makes the management of these sludges a sensitive issue. The category of the sludge expected to be produced from the treatment is mostly organic but could contain residual hazardous substances such as heavy metals, pesticides, oil etc. Concentrations of these substances are expected to be minimal to deem sludge hazardous. This will be ensured by all PIA industries strictly adhering to the effluent acceptance criteria for the CETP (see Table 22). To ensure compliance, PIA will monitor and audit investor businesses compliance on a regular basis.

3.2.7.8.2. Sludge treatment

The primary objective of the sludge treatment is to ensure that the treated material can be safely reused or disposed in the environment.

For sludge treatment PIA will install the following equipment:

- Air compressor ;
- Filter presses machine ;
- Filter press feed pump.

The options for sludge application will be explored as part of the overall waste management strategy by PIA. The most commonly applied alternatives that can be effectively adopted include:

- Sanitary landfill: disposal of the sludges with compaction and soil covering, after which they are sealed;
- Landfarming: sludges are transported to a specific landfarming site, mixed into the soil surface and periodically turned over (tilled) to aerate the mixture. These land farming activities cultivate and enhance microbial degradation of hazardous compounds;
- Agricultural application: use of the sludge on agricultural soils, in association with the development of crops;
- Land reclamation: disposal of sludge in areas that have been drastically altered, such as mining areas, where the soil does not offer conditions for development due to lack of organic matter and nutrients;
- Landscaping purposes : composted sludges used for landscaping.

For each option considered by PIA for sludge application and disposal, there is a specificity of treatment and associated threshold requirements and constraints. They are presented with recommendation in Annexe XIV.

3.2.8. Common administrative or technical buildings

A limited number of common administrative or technical buildings is anticipated to be constructed on PIA Phase 2 site. The majority of them will be metal Pre-Engineered Buildings (PEB), easy to install and maintain, as done on PIA Phase 1.

3.2.9. Road infrastructure within PIA Phase 2 site

Logistics infrastructure developments will include:

- a direct access from the road connecting PIA Phase 1 to PIA Phase 2;
- a direct access from the N34, which will be controlled;

- a network of main and secondary roads to the different zones of the IZ. These roads will be paved and will have variable widths;
- 3 areas for reverting direction;
- Parking lots for administrative buildings

The figures below present the location of these features.

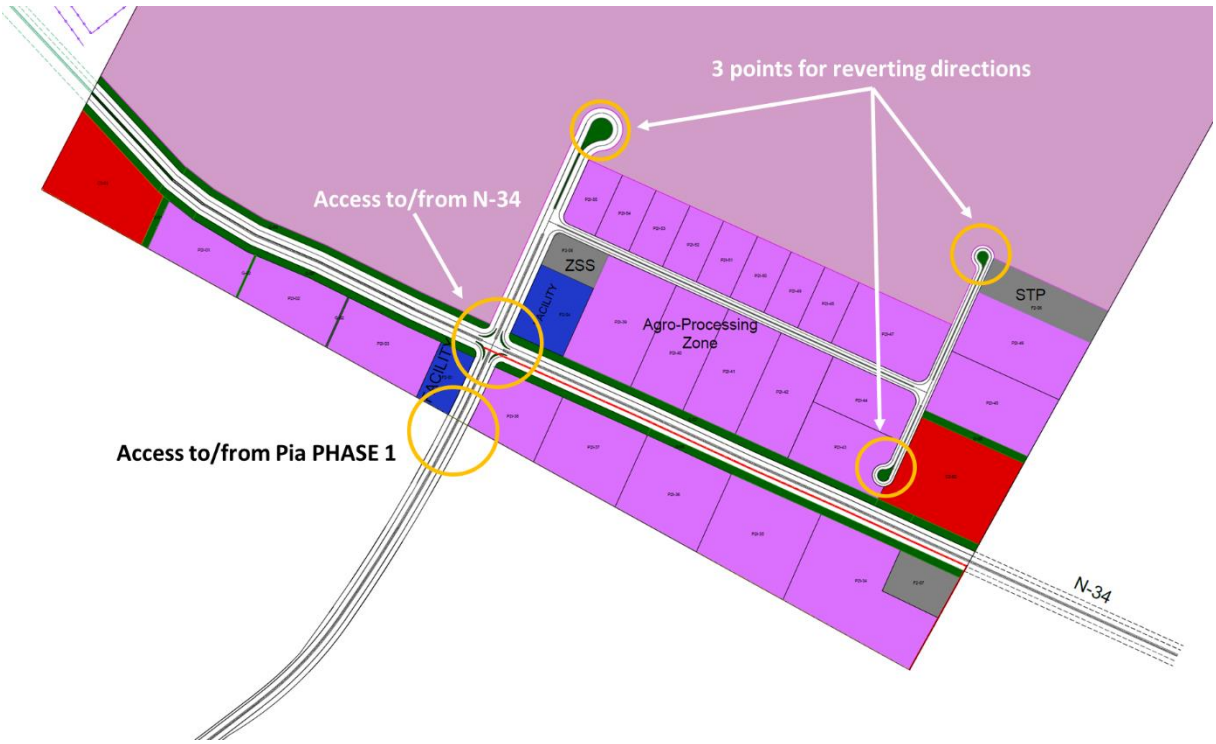


Figure 14 Road network for Phase 2 areae

3.2.10. Connecting road infrastructure

The access to the PIA Phase 2 site from PIA Phase 1 will be assured by the creation of a new road, connecting the two sites (refer to Figure 1).

The road will involve shared responsibilities among PIA and the Togolese Government. PIA will be responsible for its construction and maintenance.

Based on the preliminary technical data, this road will have a total length of approximately 9,6 km and total RoW of 60 metres, of which 15 meters will be dedicated to the road and 45 meters to the installation of all the necessary utilities and infrastructures (stormwater drainage channel, optical fibers, etc) including the power transmission line connecting PIA Phase 2 to Phase 1.

4 underpasses and 4 overpassess will be realised to prevent the interruption of existing roads that will be crossed by the new connection road. Their localisation is illustrated in Figure 15.

The road design has not been elaborated at the time of writing of this report. It is assumed that it will be constructed in 3 layers: a sub-base (earth graded to the desired elevation), a base course (strengthening layer, similar material as the sub-base but the size of particles is more uniform) and a wearing (top layer, possibly concrete or asphalt for durability).

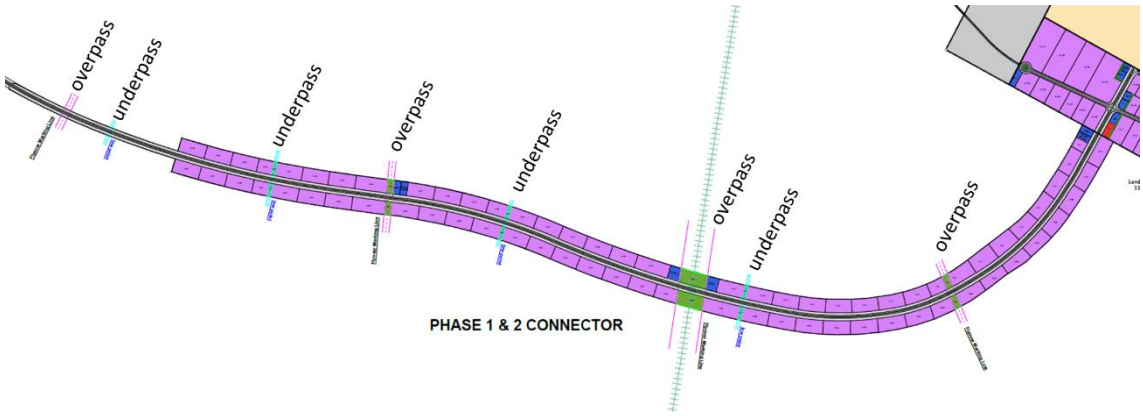


Figure 15 Localisation of the connection road underpasses

3.2.11. Industrial Corridor

The 260 m industrial corridor will be set up, fenced out and used to house "light industries". The type of businesses to be established alongside the road will vary and similar to those within Phases 1 & 2, but predominantly small scale (i.e. no "heavy industries").

The Industrial Corridor will be supplied with the same basic infrastructure as Phase 2 main site (electricity, water supply, wastewater collection, etc.). Details concerning the design of such infrastructures were not made available at the time of writing. Assumptions has been made whenever possible. Therefore, as for this Industrial Corridor , the impact analysis is limited to land clearing activities. Additional studies may be required to assure the compliance of the Project development to IFC standards.

The industrial corridor is shown in Figure 15.

3.2.12. Power transmission line

A power transmission line will be constructed to supply power produced by the solar farm on PIA Phase 2 to the industries located in PIA Phase 1 site.

The power transmission line will follow the road connecting PIA hase 1 to PIA hase 2.

The right of way of the connection road includes the right of way for the installation of the power transmission line. The information on the tension, number and location of pylons and/or substations is not known at this stage. It is assumed the transmission line will be aerial, adopting 5 m high poles.

3.2.13. Solar park

To meet the load demand of the Industrial Park (which is expected to be 260MW), PIA aims at developing a solar PV (photovoltaic) plant of capacity 260MWAC. This plant will cover a total surface of 550 ha.

It is worth noting that this solar par wil be one of the largest in Africa, overrunning Solar Capital'sDe Aar project in South Africa (473 ha, 175MW), and second to Noor Solar Complex in Morocco (concentrated solar power plant, 510MW)[3].

All the power produced by the solar farm will be injected into the Togolese national grid and PIA will absorb the power for its needs. The potential surplus of power will then remain available to the national consumption.

[3] https://www.power-technology.com/features/the-biggest-solar-projects-in-africa/ as of 25/01/2022

SgurrEnergy India Private Limited (SgurrEnergy) was comissioned by PIA to provide technical advisory services on the conceptual design. More information has been provided in Annexe XV. The information presented in the Annexe has been extracted from the prefeasibility report issued by SgurrEnergy in June 2021.

3.2.13.1. Configuration choice and long term yield assessment

SgurrEnergy has performed a detailed analysis to select the best-suited Solar PV technology for Project site conditions. Both crystalline and CdTe solar PV technology are considered to be commercially established. Both these technologies have their own pros and cons and have been performing well globally. For CdTe solar PV technology, limited module manufacturers are a key bottle neck for ensuring supplies.

Further, recent trend suggests a shift from polycrystalline module to Mono PERC modules in the market. Hence with an aim to reduce the life time risk lower cost to benefit ratio and specific yield, SgurrEnergy has selected Mono PERC and Bifacial PV module technologies for the Project.

With regard to inverters, SgurrEnergy opted for Sungrow central inverters for the proposed site in consultation with the Developer.

SgurrEnergy has also conducted a comparison between the irradiation gain between fixed tilt and HSAT configurations; the additional gain obtained from the two configurations are 0.55% and 13.1% from GHI respectively. Due to the appreciable gain noted from the two systems, SgurrEnergy has considered HSAT configuration for the 260MWAC Hybrid Project.

The annual energy yield for the proposed 260MWAC PV plant has been evaluated by SgurrEnergy in 653547,02 MWh (First year P50 Energy yield).

3.2.13.2. Contruction methodology

The construction of the solar park will include:

1. Land clearing of all the vegetation and trees
2. Drilling of approximately 65000 holes (1,5 to 2 m deep, 300 mm diameter) and filling with concrete
3. Excavation of trenches for the transmission of DC power and AC power. All the cables will be buried in these trenches
4. Excavation of foundations for the pumps required by the module washing system
5. Excavation of drainage across the field to avoid any water logging
6. Construction of internal paths to grant technical access all over the plant

3.3. Transportation and use of natural resources

The construction and operation of the IZ involves the procurement, supply and consumption of raw materials, among which:

- Construction materials: wood, steel, concrete, glass, plastics etc.
- Water
- Other materials (chemicals, petroleum, solvent, etc.)

The site will be levelled using existing soil. However, should it be needed, existing licensed quarries may supply aggregate construction materials for concrete production. Other materials may be supplied by the registered national suppliers. Petroluem and diesel will be supplied by Togo Oil.

We may assume that PIA will implement on PIA Phase 2 the same supply chain of PIA Phase 1.

Estimates of the volume of traffic induced by the construction phase are not available. We may assume that this traffic will be intense in particular during certain construction phases. However, the Project will be developed by steps, thus distributing over time the activities and, consequently, the traffic induced.

Once the IZ will be fully operational, the traffic for transportation of materials and goods in and out of the industrial zone will be very significant. A traffic study shall be conducted to investigate in detail the volume of traffic thus allowing a better understanding of its impact on the existing infrastructure.

3.4. Associated Facilities

IFC defines in the Performance Standard 1 "Associated Facilities" as those that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable. Those facilities may include railways, roads, power plants or transmission lines, pipelines, utilities, warehouses, and logistics terminals. Project developers, depending on the degree of their influence and control of such associated facilities, will aim to ensure compliance with international standards.

The key Associated Facility for this project is a dumping site for the disposal of the vegetation waste expected from the area clearance.

3.4.1. Vegetation dumping site

PIA will establish an external dumping site to store green waste produced during land clearance. This dumping site will be located within a 102,1 ha land owned by the State, and situated approximately 3 km north of PIA Phase 2. The government has authorized PIA to use a 2 ha site within the boundaries of this land for the specified purpuse.

The assessment of impacts from land clearance and storage of green waste are presented in the section 6.

As this 2 ha area has not been identified and located yet, an approach to select its location based on minimizing the environmental and social impacts is presented in section 4.4.

3.5. Project development phases

3.5.1. Preparation phase

The early stages of the Project consist in the pre-design, feasibility and design. The result of these phases is a detailed project design which is authorized by the national/local authorities for its implementation.

The preparation phase does not involve the realization of any activity on site (such as land clearing, fencing, etc.). However, this phase may result in full and permanent attribution of land access to PIA as well as a modification of land use/affectation.

Therefore, for example, the impacts resulting from the expropriation of land to current users will be assessed in this phase and not in the construction phase when the access to land will be physically prevented.

3.5.2. Construction phase

3.5.2.1. Site preparation and civil works

Before proceeding with the development of the site, any existing structures will have to be demolished. Waste from demolition will be removed, including polluted soil – if present.

A construction base as well as access roads allowing all the logistics related to the construction works will be set up.

Clearing, excavation and earthworks are planned throughout the site. The construction machinery to be mobilized for these activities is presented in the table below.

Table 25 : Construction machinery on site

Equipment	Quantity
Wheel Loader	5
Excavator	20
Grader	5
Dozer	8
Compactor	8
Trucks	50
TOTAL	**96**

The volume of earth to be excavated is estimated at 2 500 000 m^3. All of the excavated earth will be reused for backfilling. Hence the final cut / backfill balance will be zero. No additional soil or aggregates will need to be provided from external sources.

Concrete will be produced by a concrete batching plant, already existing on PIA Phase I site. No concrete batching plant will therefore be installed on PIA Phase 2 area. Cement, sand and other materials will be sourced from well established and registered suppliers.

Once the earthworks are finished, the roads, parking zone, as well as other service areas (i.e. waste and chemical storage, areas for general infrastructure, etc.) will be paved using concrete or asphalt.

The drainage system, wastewater and water supply network, and electricity distribution network will be built and connected to the site's facilities, and also to the parcels of land for the future industrial units.

The construction works will be conducted according to national standards, and similar to those implemented on PIA Phase 1 site. With the majority of the buildings being Pre-Engineered Buildings (PEB) much less construction materials and workforce will be required.

Finally, the Project site will be secured by a wall made of concrete blocks. This fence will shield the activities at the whole site. We assume the same approach will be adopted for the Industrial Corridor.

3.5.2.1. Construction camp and site organization

During construction phase, workers will not be housed on site, precluding the presence of residential housing. The works will be carried out by contractors and some workers' accommodation (outside the Project area) will be under their responsibility and will be defined during the selection phase of contractors. The workers will be transported by bus by their employers from their home base.

A certain proportion of the workforce will be based at the residential area established within Phase 1 site, as well as at the accomodtion quarters established by PIA at a 10 ha site few kilometers away from the Project area.

However, a construction base, comprising of portar cabins and containers, will be set up within the PIA Phase 2 site to accommodate the offices of construction contractors as well as workers' health structures. The work area will also include a storage area, equipment and an engine maintenance and washing area.

3.5.2.2. Employment

During the construction phase, which is expected to last 12 months, the main jobs will comprise:

- workers for land preparation activities and construction of different types of buildings;
- skilled craftspeople (electricians, masons, plumbers, carpenters) for the construction of buildings and the installation of water and electrical supply systems;
- drivers of construction machines;
- guards and security guards to secure the work site during and outside of work periods;
- civil engineers and technicians;
- site management personnel (site supervisors, HSE supervisor, construction manager, technical director, etc.).

The number of jobs created for the construction phase is estimated at 1500.

The profiles sought will require different levels of qualification ranging from lack of qualification for general workers, to specialized craftsmen and engineers and higher education executives.

The jobs of unskilled and semi-skilled personnel will be the most numerous. Most of these jobs will be filled by locals, while some of the jobs (mainly supervisory) will be filled by expatriate / national staff, depending on deployed contractors.

3.5.3. Operation phase

This phase involves the operation of all the shared utilities and common infrastructure of the IZ as needed by the daily operation of the various industries that will lease a plot to PIA. In the operation phase, the industries will operate normally as well as the shared utilities (electric system, water supply system and wastewater treatment plant, etc.).

The common buildings will be used by different types of clients and the roads will be used by both PIA's and industries' cars and trucks. The police and fire station installed on PIA Phase 1 will be available to respond to security or emergency situations. PIA and industrial staff will have access to dispensary and schools.

The number of jobs created for the operation phase is estimated at 5000-7000.

External and site staff will have access to green spaces and commercial areas.

In the operational phase of the solar park, the supervisory staff is significantly reduced. Around 10 people will be present permanently on the site, maintenance and security personnel combined.

As a first estimate and given the climate, a dry cleaning of the modules is recommended with a weekly frequency – approx. 3 times a month – and wet cleaning with monthly frequency – approx. 1 time per month. These frequencies may be modified in favor of dry cleaning to save water resources. Note that a volume of 0.3 to 0.5 liters of water per m² of panels can be estimated at first glance.

In practice, cleaning operations may be carried out at PIA's discretion, depending on the fouling of the modules observed visually on site.

The plant maintenance of the site will be carried out by means of a regular cutting of the vegetation by mechanical mowing probably in order to guarantee a reasoned use of phytosanitary products.

3.5.4. Decomissioning phase

This phase involves the end of operation of some or all the shared utilities and common infrastructure of the IZ (electric system, water supply system and wastewater treatment plant, etc.) as well as the various industries that will lease a plot to PIA.

The main activities involved include the dismantlement of building comonents, specifically for reuse, repurposing, recycling and waste management. Deconstruction is followed by demolition of the remaining buildings, the decontamination of the site, the management of waste material and the clearing of the site coherently with the future identified purpose it will recover.

The recycling of photovoltaic panels is entirely possible. Different technologies exist, according to the type of panel. At present, no specific PV recycling plant exist in Africa but by the end of the life cycle of the Project, it's likely such a plant will exist.

A summary of the waste produced during the deconstruction phase is preented here below:

Table 26 Summary of deconstruction waste

Waste category	Potential treatment or management strategy
Soil and excavated sol	Reuse on site
Concrete and cement	Recycling
Metals	Recycling
Batteries	Recycling
Plastics	Reuse or burning in a unit equipped with a exhaust treatment unit
Wood	Reuse or burning (if not treated)
Glass	Recycling
Silicon waste	Treatment
Liquid discharges	Treatment

3.6. Calendar

Construction will begin in June 2022. It will last 12 months (until july 2023). No additional detail has been provided concerning the project phasing and the activities schedule.

3.7. Key Project features

A summary of the main quantified characteristics of the Project are presented in the following table, along with an estimate of the Project main consumption and emissions.

Table 27 Main quantified characteristics of the Project during the construction and operation phase

Themes	Data
Construction phase	
Duration	12 months (June 2022 – July 2023)
Employment	1500
Volume of excavated soil	2 500 000 m^3
Estimated water consumption	13 860 m^3
Wastewater Collection	Septic Tanks
Estimated production of waste	Non-hazardous waste - 175 m^3; Hazardous waste : Unknown
Operation phase	
PIA Phase 2 area: - Solar park - Industrial - Commercial - Facilities - Utilities - Green areas - Road (internal to IZ) Industrial Corridor area connecting Phase 1 to Phase 2 (road and industrial zones): - Industrial - Road (within 206 m corridor - Road (beyond 260m corridor)) - Green - Facilities	716 ha 552.56 ha (77%) 99.01 (14%) 13.19 (2%) 4.80 (1%) 7 (1%) 11.71 (2%) 27.73 (4%) 209.18 ha 139.92 ha 43.25 ha 13.05 ha 7.22 ha 3.75 ha
Characteristics of the road system	Road connecting PIA Phase 1 to PIA Phase 2: 15 m width + 45 m width for the right of way and 8.92 km lenght
Asphalt surface	232 500 m^2
Power Demand	30 MW
Fuel consumption	170 m^3/year (generators and other equipments on site running on fuel)
Volume of groundwater supply	5300 m^3 /day
Number of boreholes	6 of 65 m^3/h
Number of reservoirs	4 : 2 ELSR (elevated level service reservoir) and 2 GLSR (ground level service reservoir), total capacity of 6240 m3
Length of water supply networks	1.14 km (pumping) + 6.25 km (distribution)
Wastewater treatment	1 Common Effluent Treatment Plant
Estimated wastewater production (domestic sewage and industrial effluent)	5300 m^3 /day
Length of wastewater systems	20 km
Length of drainage systems (without Industrial Corridor)	30 km
Estimation of waste production	Organic waste = 1500 Ton / year Non Haz waste = 2105 ton/ Year Haz waste = 280.39 ton / Year – concrete substances , more of Used Oil etc
Employment	5000 to 7000

Table 28 Estimation of consumption, emissions and discharges during the Project construction and operation phase

Category	Construction	Operation
Water and energy	The water requirements for the work activities (manufacture of concrete, washing vehicles, watering the tracks, drinking water, etc.) are estimated at 13860 m^3. Diesel will be used for the operation of machines (vehicles, generators). The volumes of diesel required is estimated to 4 500 m3 for all work field activity (1 year).	Water consumption estimated at 5300m^3/day Energy consumption 30MW Diesel/petrol consumption 170 m3/year
Atmospheric emissions	The expected atmospheric emissions are those generally observed for civil engineering activities and are: - dust caused by earthworks , and the circulation of construction machinery; - exhaust emissions from construction machinery; - asphalt production unit producing volatile compounds	Atmospheric emissions are expected from the transit of vehicles on the road, the operation of common and administrative buildings. VOCs from the operation of the wastewater treatment facility and waste, chemical storage areas. Generators and other equipments will be responsible of exhaust emissions resulting from burning 170106 liters of fuel (diesel) per year.
Noise, light and odour emissions	The nuisances identified for the construction phase are mainly related to nuisances typical of civil engineering activities. They mainly come from - Traffic noise; - Noise from construction activities and machinery; - light if working at night or in limited daylight conditions	Light emissions will come from the night-time lighting on the site during the operation phase. Noise will mainly be related to traffic and operations inherent to the future industrial units on site. Odor emissions could be generated by the wastewater treatment process (common and/or specific to the industrial units) and by waste management.
Liquid discharges and waste water	The liquid discharges expected during the construction phase are: - domestic effluents from sanitary installations, stored in septic tanks; - water collected from washed vehicles and treated via a sediment trap and an oil separator Contractors will wash vehicles and equipments on their base outside the project site, PIA washes the vehicles at public washing areas outside the project site. Servicing and maintenance of vehicles /equipment will be done at manufacturers/contractors bases	Wastewater during operation phase will mainly be the result of industrial activities, resulting in an estimated volume of 5300 m^3 /day. Wastewater will be treated at the CETP before being released to the environment. Stormwater will be collected via the drainage system and conveyed to the environment.

Category	Construction	Operation
	outside the project site. Wastewater from concrete/asphalt production will be contained in drums and disposed of by contractors (METTOGO). The whole procedure has been successfully tested on PIA Phase 1 construction site	
Waste production	During construction, two main sources of waste are identified: - construction waste, related to earthworks, packaging, etc. - household waste linked to the presence of workers on the site, considering a production of 0.62 kg / person / day and a density of around 700 kg / m^3. Construction waste is generated by construction / demolition activities. These wastes are mainly made up of inert and non-biodegradable materials and they generally take up considerable storage space, either on the road or in municipal waste containers / bins. The other expected construction waste is presented below: canteen waste, green and agro-industrial waste, plastic bottles, jute bags, cardboard, glass, metal drums, fiber drums, wood waste, etc.	The type of waste to be expected is : - domestic waste from base camp and work area (waste from canteens, packaging and plastic bottles, glass bottles, paper and cardboard) - green waste from land clearance - inert waste (soil, wood, packing boxes, scrap metal, plastics and concrete debris) - hazardous waste (batteries, oil filters, contaminated drums, etc) • Organic waste = 1500 tons / year • Non Hazardous waste = 2105 tons / Year • Hazardous waste = 280.39 tons / Year
Hazardous products	Construction work involves handling of chemicals (paints, solvents) corresponding to hazardous materials.	Hazardous materials that can be used in the operation of the facilities related to the wastewater treatment as well as the solar park and other technical equipment. The exact nature and volumes of these materials are unknown at this stage.

3.8. Impact factors

The Project, in its final selected alternative, is likely to produce impacts on the human and natural environment. Indeed, at all phases of the Project (preparation, construction, operation and decomissioning), the activities that will be carried out are likely to modify the various components of the environment. These activities are therefore presented here as " impact factors" and will serve as input data for the impact analysis.

The following table presents a summary of the most relevant impact factors identified for the Project. Per each factor, a brief description is provided to clarify the related activities.

Table 29 Impact factors

Project phase	Impact factor	Description
Preparation	**Project land acquisition**	Land use modification Temporary and permanent land access Physical and economical displacement resulting from land acquisition and attribution for the project implementation
Construction	**Civil works, including drilling**	Clearance, earthworks, soil cut and fill Natural drainage pattern / runoff modification and soil erosion Works resulting in the production of dust, exhaust (air pollutants and greenhouse gas) and noise
	Traffic	Circulation with mobilization of machinery, materials and equipment for the site and works. Risk of accidents with other vehicules or pedestrians
	Solid waste production	Production, handling, transportation, treatment and disposal of waste. Decontamination and earthworks activities: production of inert waste (with the exclusion of green waste from land clearing) Construction work: hazardous and non-hazardous waste Onsite construction base: domestic waste
	Green waste production	Clearance, transportation and disposal of green waste at the dumping site.
	Liquid discharges production	Construction work: surface runoff, wastewater from vehicle washing, wastewater from boring works and wastewater from plant maintenance facilities. (no concrete batching plant on Phase 2 site). Workers' accommodation: production of domestic effluents (black and grey water) collected at septic tanks
	Resources consumption (energy, water)	Construction activities will require significant amounts of primary construction materials such as: excavated earth, sand, cement, water, metal, plastics, wood, glass, hydrocarbons, etc. The operation of the construction base involves the consumption of: water, hydrocarbons, food products etc. Energy will be a major resource for this phase.
	Employment	Recruitment of labor for low-skilled jobs and development of local services related to the construction site Workers Influx
	Accidental spills and emergencies situations	Risks related to construction activities : fire, explosion, scaffolding collapse, major structural failure, spillage of flammable liquids, accidental release of hazardous products, deliberate release of products (e.g. dangerous toxic chemicals)
Operation	**Project Footprint**	Permanent land occupation and use Modification of the landscape Soil sealing and erosion
	Atmospheric emission	Operation of the industrial zone and its infrustructure (excluding atmospheric emissions from industries that will be based in the IZ)

Project phase	Impact factor	Description
	Solid waste production	Collection, transport, manipulation, treatment and disposal of waste. Operation of the industrial zone: household waste from administrative / common buildings, green waste from open spaces, specific industrial waste.
	Sludge production	Management of sludge originating from domestic and industrial treatment plant and from the network drainage
	Liquid discharges production	Domestic sewage effluent : from administrative / communal buildings and industrial site sanitation Industrial effluents processed in CETP and discharged into the environment Runoff water : mix of potentially contaminated rainwater (pre-treated with oil separator at least) and non contaminated rainwater
	Resources consumption (energy, water)	The operation of the administrative / common buildings of the IZ involves the consumption of raw materials: water, oil, food products, etc. Utilities involve consumption of raw materials: water, hazardous materials (chemicals, petroleum, solvent, etc.), etc.
	Traffic	On-site circulation and traffic to and from the industrial zone. Emission of exhaust (air pollutants and greenhouse gas) and noise Risk of accidents with other vehicules or pedestrians
	Employment	Recruitment of labor for common infrastructures of the industrial zone and development of local services related to the development and operation of implanted industries
	Accidental spills and emergency situations	Risks related to the industrial operations (excluding risks related to specific industries that will be implanted in the IZ) : fire, explosion, building collapse, major structural failure, spillage of flammable liquids, accidental release of hazardous products (e.g. dangerous toxic chemicals)

4. Alternatives analysis

4.1. Alternative without Project

The alternative "zero Project" refers to the reference situation without Project implementation. The environment would then progress under the influence of its usual management mode.

A significant part (~50%) of the lands that will be affected to PIA Phase 2 are today mostly in fallow and unused. Thus, the absence of human activity will allow these lands not to be exposed to any degradation or contamination. Vegetation will naturally develop.

By maintaining the "zero Project" alternative, all the economic, financial and social benefits brought by the development of the Project will not exist, thereby slowing down the expected economic growth in the area as well as the development of an electrical power infrastructure based on renewable energies and resilient to cimate change.

4.2. Location alternatives

The variants that were analyzed for PIA Phase 2 were related to the localisation of the Project site. It is important to take into account that the first analysis of alternatives was conducted at the time of the Phase 1 development. In that case, two different locations were initially considered: the area of Adetikope and the area of Agbelouve. Based on the analysis of the advantages and disadvantages of the 2 sites, the site of Adetikope was selected as optimal. Indeed, it combines proximity to the city of Lome, port infrastructures, progressive economic and demographic development and availability of labor force along with limited environmental impacts due to anthropisation of the Project area. Besides, Adetikope site does not require to perform land acquisition since the land was already acquired by the Government of Togo in 2005.

For PIA Phase 2, two different locations have been considered. The first alternative was the area of Adetikope (site 1 in the figure below), directly adjacent to the Phase 1 , and the second alternative was the area of the cantons of Dalavé and Kpomé (site 2, same figure), 8 km east of the Phase 1 site.

Figure 16 Alternative localization map

4.2.1. Site 1 – Adetikope, adjacent to PIA Phase 1

The projected site is located on the east edge of the PIA Phase 1 site.

4.2.1.1. Advantages

4.2.1.1.1. Strategic and economic level

The site of Adetikope is strategically located in relation to the facilities of the newly constructed PIA Phase 1 site. It benefits from direct access to the RN1 as well as a significant availability of manpower.

The proximity to PIA Phase 1 will potentially foster the development of synergies among different industries, that could share on-site services. PIA Phase 2 could also further develop the commercial activities in the immediate neighbourhoods of the site.

The choice of locating PIA Phase 2 adjacent to PIA Phase 1 avoids the need to build connecting infrastructure between the two phases, such as roads or power lines. This optimises the construction and the use of shared services in the operational phase. In this sense, it requires fewer financial, human, technical and material resources.

4.2.1.1.2. Environmental level

By deing developed as an extension of PIA Phase 1, common practices may be developed to assure the environmental management of the industrial platforme. Economies of scale may also be exploited to implement more efficient solutions for waste management (and particularly for industrial water treatment).

The choice of a PIA Phase I extension prevents land clearance for connecting infrastructure area such as roads.

4.2.1.2. Disadvantages

4.2.1.2.1. Social level

The construction of the PIA Phase 2 as an extension of the PIA Phase 1 site will impose a significant increase in social pressure. The area is densely inhabited and its aquisition would demand the displacement of a substantial number of people and of economic activities.

The development of PIA Phase 2 could also create a strong concurrence among developing businesses and services.

By centralizing a large number of industries and doubling the number of jobs offered by PIA, a large number of people would be attracted to work and live in the immediate surrounding of the industrial park, thus adding pressure on an already highly urbanized and populated area.

4.2.1.2.2. Increasing of pollution and nuisance sources

The construction of the PIA Phase 2 as an extension of the PIA Phase 1 site will increase the current flow of vehicules (and particularly of trucks) on the already congested Nationale 1 road. This situation will result in increased traffic disruption, air pollution by incessant exhaust emissions. In addition, noise pollution will be more noticeable in neighboring residences.

4.2.1.2.3. Damage to ecosystem services

The projected site is located in an area of fast-growing urbanization, an increase in population and scarcity of arable land and vegetation islands. 130 unused hectares offering agricultural space,

biodiversity conservation and ecosystem services to the population have already been occupied for the development of PIA Phase 1. The development of PIA Phase 2 would then add a significant pressure on the remaining ecosystem services offered by the site and its role in biodiversity conservation in the area.

4.2.2. Site 2 – Kpomé/Dalavé, 8 km east of PIA Phase 1

The projected site is located 8 km east of the PIA Phase 1 site.

4.2.2.1. Advantages

4.2.2.1.1. Development level

The identified location is in a semi-rural area offering great potential for rational and sustainable planning. The choice of this locality will make it possible to constitute a large industrial pole in direct connection with the Phase 1 site.

Moreover, the development of the industrial zone in this locality would be integrated in the development plan of the localities in the North of the Maritime region on the RN1. There are also other agricultural development projects and rock crushing units in the area.

It is important to note that there are large areas of land in this zone that are still available for future projects to expand the PIA.

The locality is well served by both the RN1 (via the new road connecting PIA hase 1 to PIA Phase 2) and the RN34. The existence of an old railway line offers the potential to its rehabilitation to international standards, which could allow the transport of containers and merchandises from the port to the PIA Phase 1 and PIA Phase 2 sites.

Finally, we will note the further development of the new economic pole created by PIA Phase 1 while offering a better access for people living in the localities along the N34 (Hagblévou, Gnatikopé, Akadjamé, Tokpanou, Agbadovinou, Vondjogbékopé, Djogblakopé, Fiogblé and Kpomé Agomé) and the possibility to develop business and services in direct connection with the new industrial zone.

4.2.2.1.2. Social level

The main advantage of this site is that large part of it is currently unused. Minimal physical and economic displacement is envisaged.

Jobs created by the new industries will contribute to the economic development of the area, thus resulting in land valorization and housing development.

4.2.2.2. Disadvantages

4.2.2.2.1. Economic level

The development of PIA Phase 2 on the Kpomé/Dalavé site will result in additional costs to build the road connecting PIA Phase 1 to PIA Phase 2 as well as the power transmission line.

4.2.2.2.2. Environmental level

As the area is semi rural, the development of PIA Phase 2 will result in a degradation of the quality of the environment in general due to the influx of individuals, atmospheric emissions, discharges, wastes, etc. The need to build the connection road between PIA Phase 1 and PIA Phase 2 will demand the degradation of an additional 209 ha of semi rural environment.

Land and woodlands transformed into a development center will lead to a loss of biodiversity and ecosystem services. Development through future extensions may accentuate the land conflicts that are characteristic of these localities.

4.3. Selected alternative

Table 30 Comparison of the advantages/disadvantages of the two sites

Item	Site 1	Site 2
Location and Connectivity	• Direct access to the RN1 and PIA Phase 1 facilities (structuring transportation infrastructures, connection to energy distribution networks	• Direct access to the RN34 • Need to build a new 8 km route connecting PIA Phase 2 to Phase 1 sites and assuring connection to the RN1 • Need to develop transportation infrastructure
Environment	• Loss of ecosystem services • Possibility to exploit economies of scale	• Semi-rural area • Environmental degradation of the area and need of additional 209 ha for the construction of the Industrial zone, connecting road and TL • Availability of large areas for the conservation of biodiversity and ecosystem services
Social	• Lack of availability of the site land that needs to be acquired by Government with substantial physical and economic displacement • Demographic pressure: highly urbanized and populated area • Availability of manpower • Job creation • Valorization of the land • Housing development	• Availability of the site land already acquired by Government with only economic displacement (little to no physical displacement) • Little demographic pressure • Availability of manpower • Job creation • Valorization of the land • Housing development
Traffic	• Pressure on the already congested Nationale 1 road	• No significant deteriorationin traffic conditions
Conclusion	Site 1 has the logistical advantage, connectivity with Phase 1 site and industrial/infrustructure synergies, however land has to be acquired, thus generating significant physical and economic displacement and increasing pressure on an already highly populated area	Site 2 has the disadvantage of lacking critical infrastructures (connecting roads, transmission power line) that will need to be developed. It will deteriorate natural habitats. However the site benefits from the land being already acquired without significant commercial or physical displacement. Economic growth of the nearby villages is also to be expected.

Based on the analysis of the advantages and disadvantages of the 2 sites, the site of Kpomé/Dalavé appears to be more optimal. Indeed, even if it requires more investments in order to develop the necessary infrastructures (road, power transmission line), its impact on physical and economic displacement will be limitedThe Project will boost the economic development of the villages and localities nearby. However, the degradation of a large semi-rural area will result in potentially significant environmental impacts.

4.4. Location selection for the vegetation dumping site

The 2 ha area needed for the vegetation dumping site has not been identified and located yet. Therefore, an approach to select its location based on minimizing the environmental and social impacts is presented here below.

4.4.1. General description

The 102,1 ha area, where the vegetation dumping site will be established, is located in the canton of Kpomé, prefecture of Zio. In terms of biogeography, it is part of the coastal plains of Togo (Ern, 1979). The original vegetation of this zone is dense dry forest (Brunel et al., 1984), which was heavily anthropised following the demographic explosion, giving rise to a mosaic of field and fallow land (Batawila, 1997). There are also grassy savannahs and swampy forests/savannahs, especially in the south-east of the region (Amegnaglo et al., 2018).

The two following figures present the location of the land.

Coordinates of the area are :

Longitude (X)	Latitude (Y)
316198,81	705721,89
315263,82	704988,60
314605,95	705549,12
315579,69	706305,24

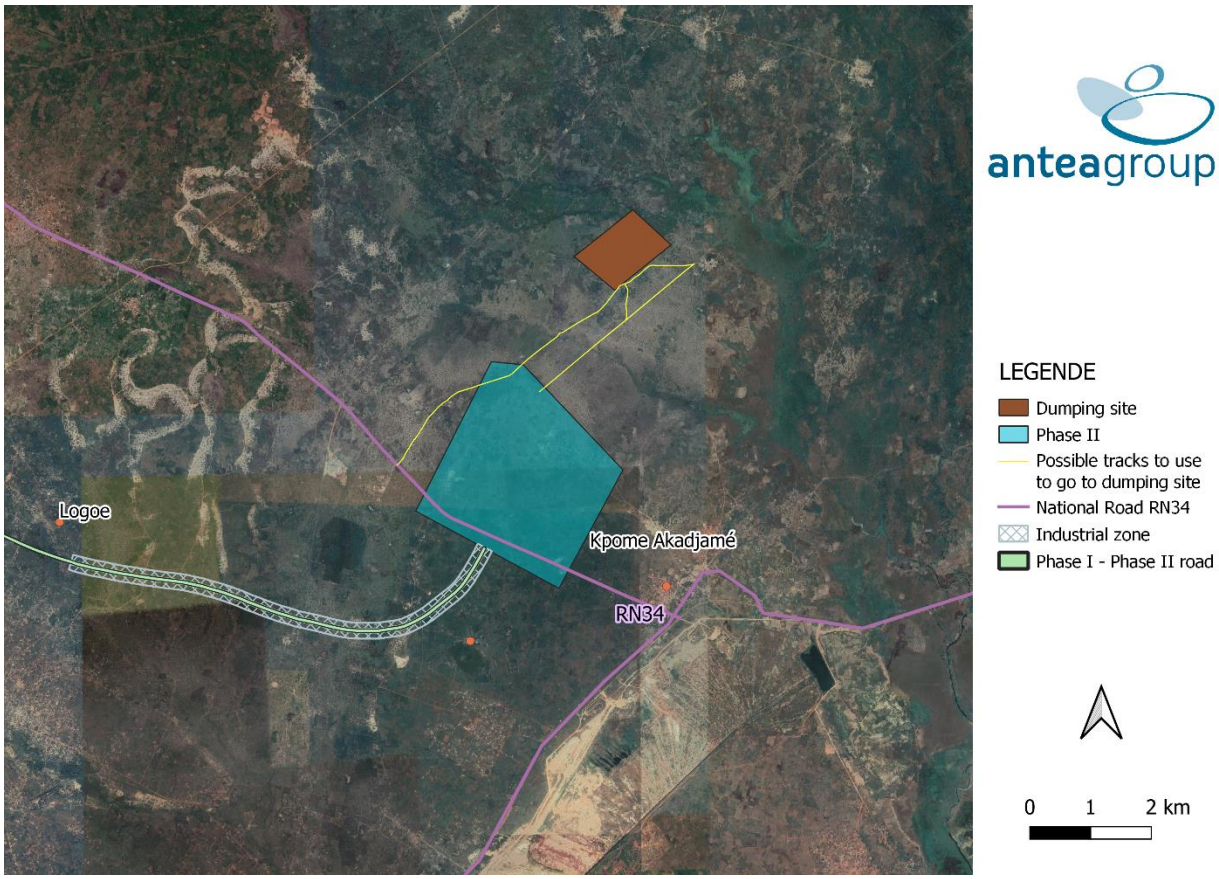


Figure 17 Location of the state-owned land to host the dumping site and accessibility from PIA Phase 2 (Antea, 2022)

4.4.2. Land use and site selection criteria

The first step in analysing environmental and social sensitivities within the 102.1 ha area was to review satellite imaging data.

The satellite image used has a resolution of 50 cm and is dated March 4, 2022 from DigitalGlobe Incorporated.

Concerning traffic, it is estimated that a dozen trucks per day will be used during the clearing phase to make the journeys from the PIA Phase 2 site to the dumping site.

On the basis of this analysis, initial site selection criteria were established to consider areas of lowest sensitivity. The criteria and distances to identified receptors were determined as follows :

- 150m from water bodies or wetlands;
- 25m from roads and tracks;
- 100m from residential structures and buildings;
- 25m from plantations;
- 50m from the land border.

A map was created using the above criteria and based on the satellite image analysis to pre-identify alternative sites of lowest sensitivity (Figure 34). Other criteria such as the presence of sacred sites, conflicts concerning land tenure or special use (hunting, harvesting) could not be identified and mapped at this stage but need to be taken into account in the final selection of the dumping site.

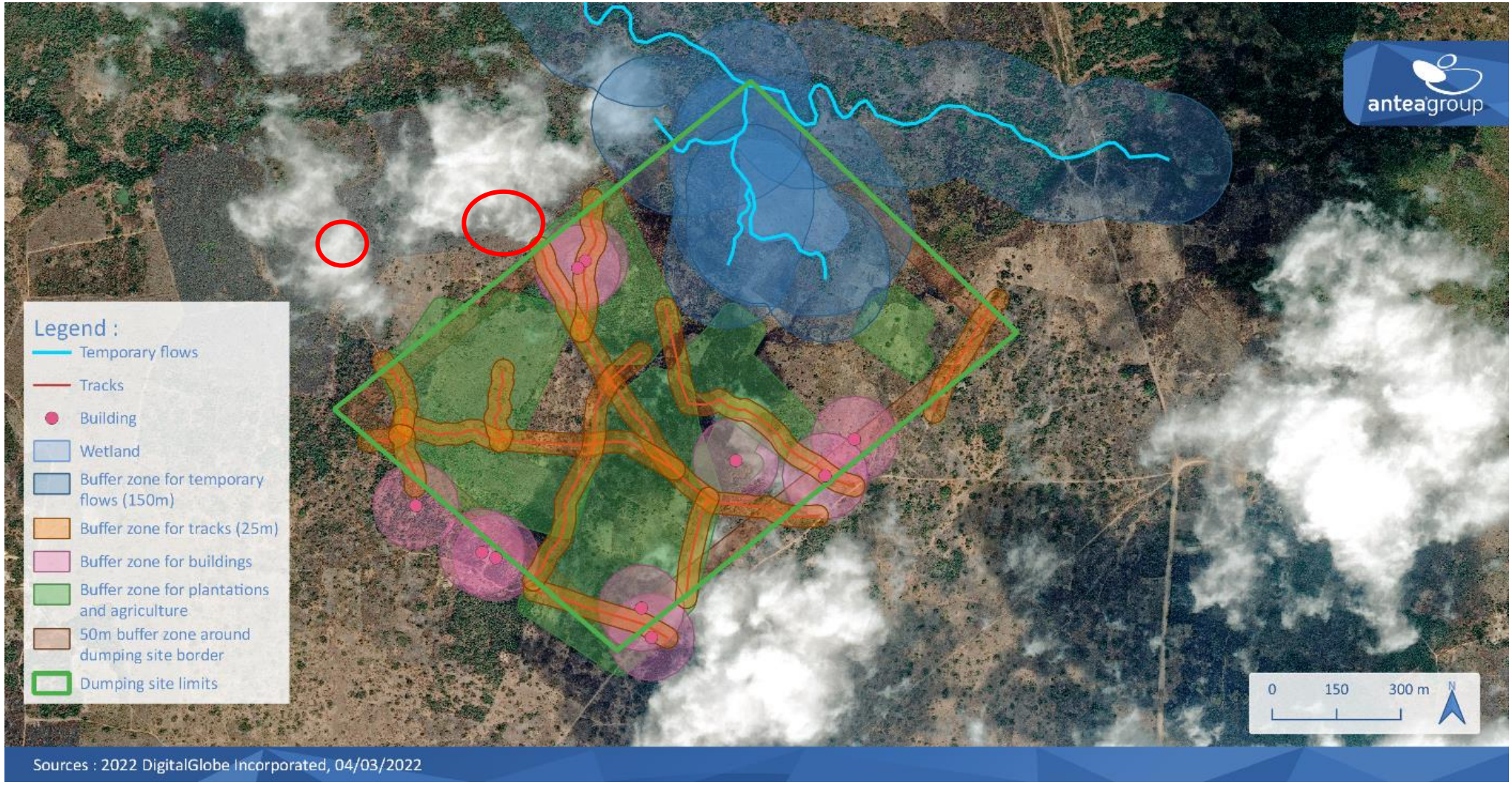


Figure 18 Preliminary mapping of land use and and pre-identification of areas of lowest sensitivity (Antea, 2022)

The findings of this step were then verified by a site visit detailed in the section below.

4.4.3. Results of the preliminary site visit

4.4.3.1. Methodology

The site visit took place on March 17 and 18, 2022.

For the selection of the stations, the land use units were previously established on the basis of a Google Earth image which allowed the identification of the areas of interest for the field investigations. A total of 25 verification points (**Erreur ! Source du renvoi introuvable.**) were visited in order to validate the f indings of the sensitivity analysis map (that includes clear information on the location of existing residential structures). At each verification point four photographs were taken following the north, east, south and west directions. In addition to these points, other control points corresponding to key features such as the crossing of a track, a watercourse, or any other environmental and social sensitivities were considered.

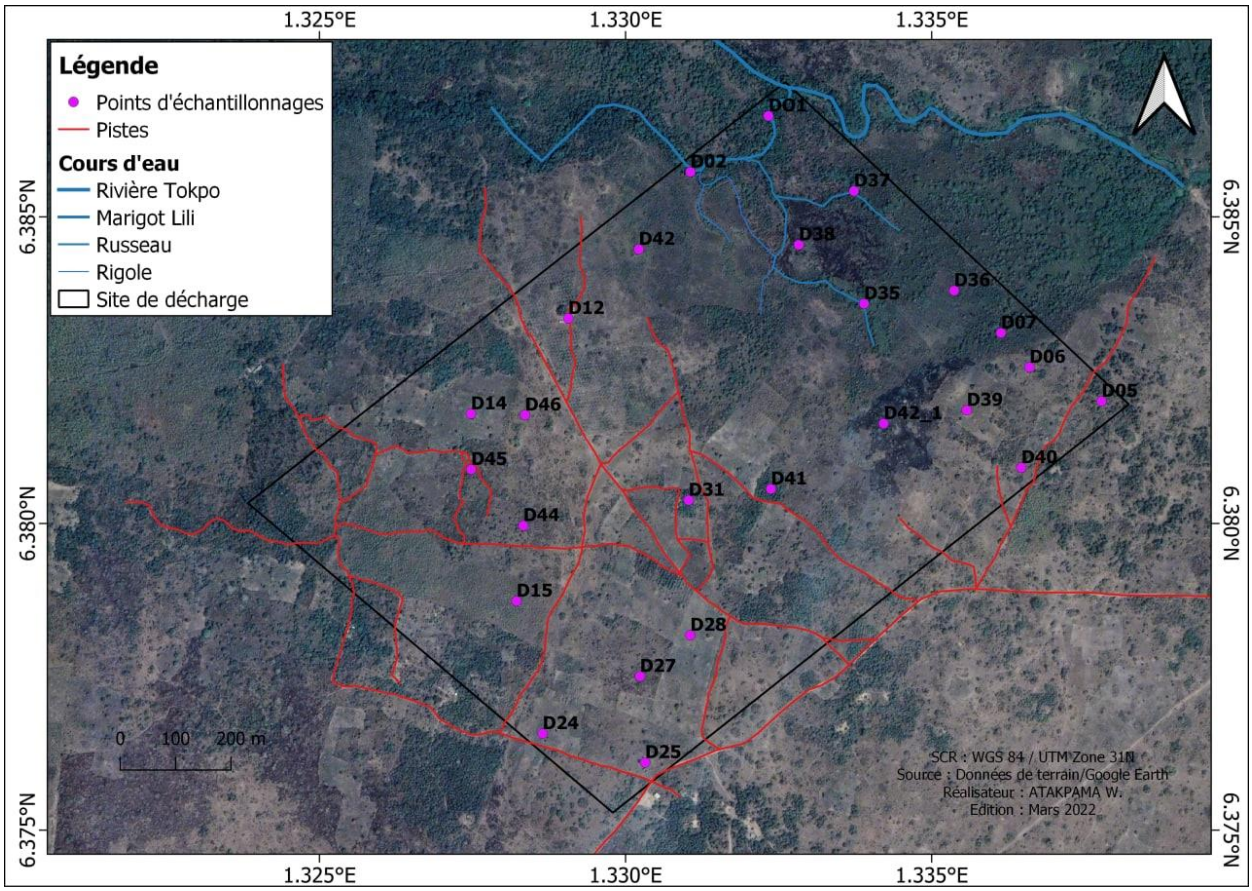


Figure 19 Location of verification points along the transects (JAT Consulting, 2022)

4.4.3.2. Habitat description

The majority of the study area is occupied by fields/fallow lands (61.29%) followed by plantations (13.69%). The most common crops are maize and cassava (**Erreur ! Source du renvoi introuvable.**). T wo major types of plantations are found: oil palm plantations and teak plantations (**Erreur ! Source du renvoi introuvable.**). In addition to these two species, eucalyptus is marginally represented. Tree/shrub savannahs and wooded savannahs/wetlands occupy 13.04% and 9.88% respectively. Riparian forests (2.01%) and settlements (0.1%) are poorly represented (**Erreur ! Source du renvoi i ntrouvable.**). The soil in the area is sandy-clay and hydromorphic. The notable species are : *Mitragyna*

inermis (Willd.) Kuntze (21.43%), *Elaeis guineensis Jacq*. (17.86%) and *Tectona grandis* L.f. (14,29 %) (JAT Consulting, 2022).

Cassava field

Maize harvest residues

Figure 20 Illustation for most common crops for the zone (JAT Consulting, 2022)

Oil palm plantations

Teak plantation

Figure 21 Illustrations for the two major types of plantations (JAT Consulting, 2022)

Figure 22 Illustration of riparian vegetation (JAT Consulting, 2022)

Figure 23 Shrub/flooded savannah with Mitragyna inermis (JAT Consulting, 2022)

The habitat map of the study area is presented in the figure below. Table 28 summarises the different habitat types and areas/proportions.

The map analysis shows a mosaic of fields and fallows. It is difficult to distinguish clearly between fields and fallows in this landscape. These habitats are dominated by *M. inermis* and *E. guineensis*. The plantations consist of teak and oil palm (*E. guineensis*) plantations. They include species such as *E. guineensis, T. grandis* and *Dichrostachys cinerea* (L.) Wight & Arn. The tree savannas/shrub savannas are dominated by *M. inermis* and *D. cinerea*. Species such as *M. inermis* and *Dichrostachys cinerea* (L.) Wight & Arn. dominate the tree/shrub savannas. The settlements are often surrounded by *E. guineensis* and *Hexalobus monopetalus* (A. Rich.) Engl. & Diels.

The Tokpo River with its permanent water availability flows in a NW-SE direction. It is enlarged by the Lili marigot which dries up in the dry season. The latter flows in a west-east direction and collects runoff from almost the entire study area.

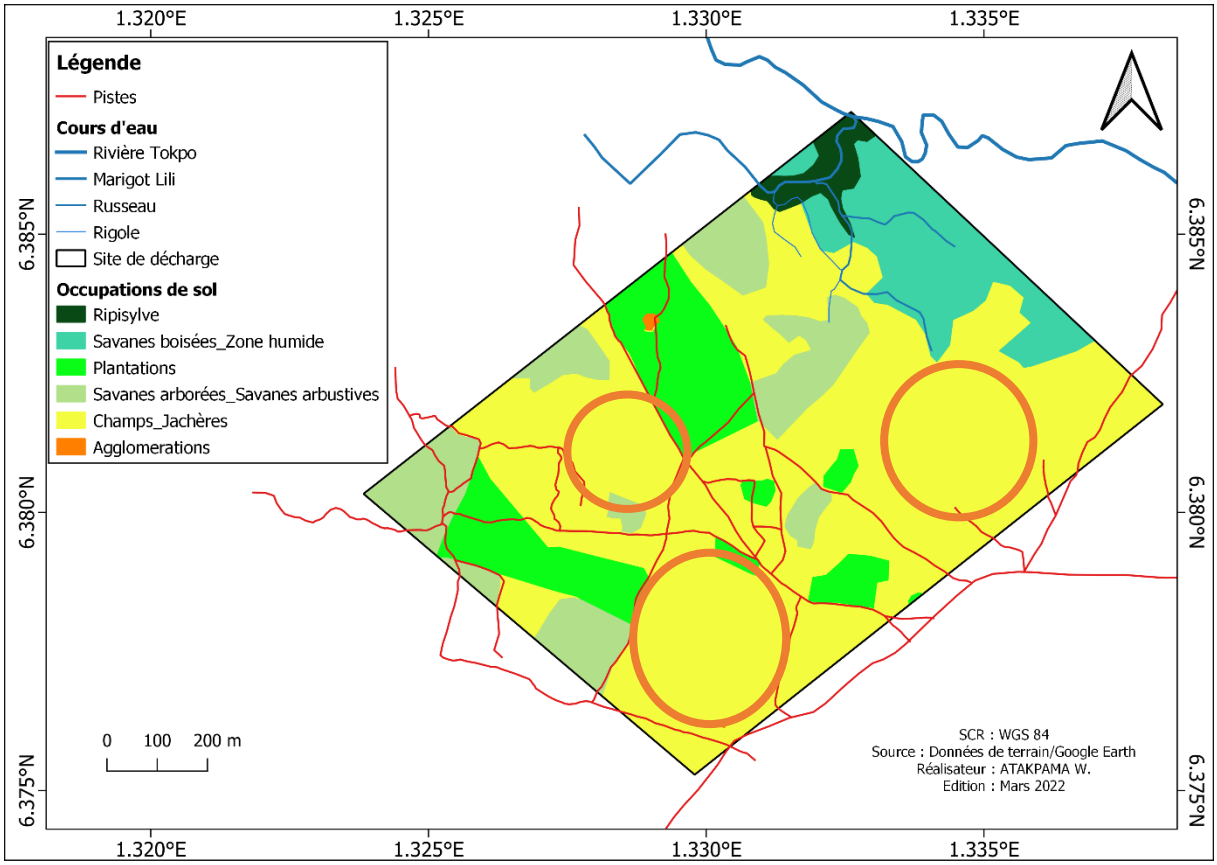


Figure 24 Land use overview

Table 31 Land use types in the study area

Site	Land use	Area
Land owned by the State	Field/Fallowland	62,58 ha, or 61,29 %
	Plantations	13,98 ha, or 13,69 %
	Wooded savannahs/shrubby savannahs	13,32 ha, or 13,04 %
	Wooded savannahs/wetlands	10,09 ha, or 9,88 %
	Riparian vegetation	2,05 ha, or 2,01 %
	Constructed area	0,1 ha, or 0,1 %

Some buildings are present in the land, as the following figure shows.

Example of building located in D25 *Example of building located in D12*

Figure 25 Illustration of building in the area (JAT Consulting, 2022)

All photographs taken during this visit are presented in Annexe XI.

In conclusion, it can be stated that the high sensitivity areas that should be avoided by the dumping site are the wetland, including riparian vegetation habitats, populated areas with buildings, crops and savannah areas.

It has to be noted that no sacred site or protected species has been observed. This would have to be confirmed during the final 2 ha site selection by a qualified biodiversity specilist.

Based on the site visit and preliminary satellite imagary analysis the most suitable alternatives for dumping site location have been defined in **Erreur ! Source du renvoi introuvable.**. They appear to r epresent areas of least sensitivity and potentially lowest impacts. On the other hand, as public consultations have not been carried out, this map does not take into account the potential sacred sites (none has been observed), land tenure conflicts or special use of the zone. Moreover, the site visit presents the situation for a specific season whereas land use can change throughout the year. Therefore, this is not a final proposal for the selection of the dumping ground. A final site visit will be required by a team with social and environmental specialists few weeks prior to disposal. The final 2ha site will have to meet the following criteria:

- 150m from temporary flows or wetland;
- 25m from tracks;
- 100m from buildings;
- 25m from plantation or crop area;
- 50m from land border;
- Absence of sacred sites;
- Absence of conflict on land tenure;
- No use of harvest or hunting of the area;

Compensation to potential land users (if any identified) in line with the IFC Performance Standard 5.

5. Environmental and social baseline

5.1. Delimitation of the Project Area of Influence

5.1.1. Introduction

The initial step in the baseline characterisation is the definition of the Project Area of Influence (AoI) and the Study Area.

The AoI (based on the definition in IFC PS1) adopted by the Project is:

- The area likely to be affected by:
  - Project activities and facilities that are directly owned, operated, or managed (including by contractors) by the Project Proponent and that are a component of the Project;
  - Impacts from unplanned but predictable developments caused by the Project that may occur later or at a different location; or
  - Indirect Project impacts on biodiversity or on ecosystem services upon which 'Affected Communities'[4] livelihoods are dependent.
- Associated facilities, which are facilities that are not funded as part of the Project and that would not have been expanded if the Project did not exist and without which the Project would not be viable. It is anticipated there will not be any associated facilities for the Project; and
- Cumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the Project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted.

Using this definition of the Project components the areas of direct and indirect influence are discussed below.

5.1.2. Direct influence zone

The direct influence zone corresponds to the actual Project footprint, and includes:

- Phase 2, covering 716 ha, and comprising of the industrial zone, general infrustructure, including 552,56ha for a solar park.
- Industrial Corridor, covering 209.18ha, and comprising of connecting road and HT transmission line within 60 meters Right of Way (RoW) , as well as the plots for light industry and commercial developments.

5.1.3. Indirect influence zone

The indirect influence zone encompasses, per the IFC definition (IFC, PS1, 2012):

- The area likely to be affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location;
- The area likely to be affected by indirect project impacts on biodiversity or on ecosystem services upon which Affected Communities' livelihoods are dependent;

[4] Local communities who are directly impacted by the Project

- Associated facilities, which are facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable; and
- Cumulative impacts that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted.

This zone includes :

- the villages and neighborhoods surrounding the site, including Hagblévou, Gnatikopé, Akadjamé, Tokpanou, Agbadovinou, Vondjogbékopé, Djogblakopé, Fiogblé and Kpomé Agomé;
- National highway 34 in its part that will be crossing the site project site.

The direct and indirect influence areas are illustrated in the following figure.

The area of influence of the Vegetation Dumping Site (Associated Facility) includes the investigated areas presented in paragraph 3.4.1

The spatial scope of cumulative impacts is deliniated in Chapter 6.9.3.

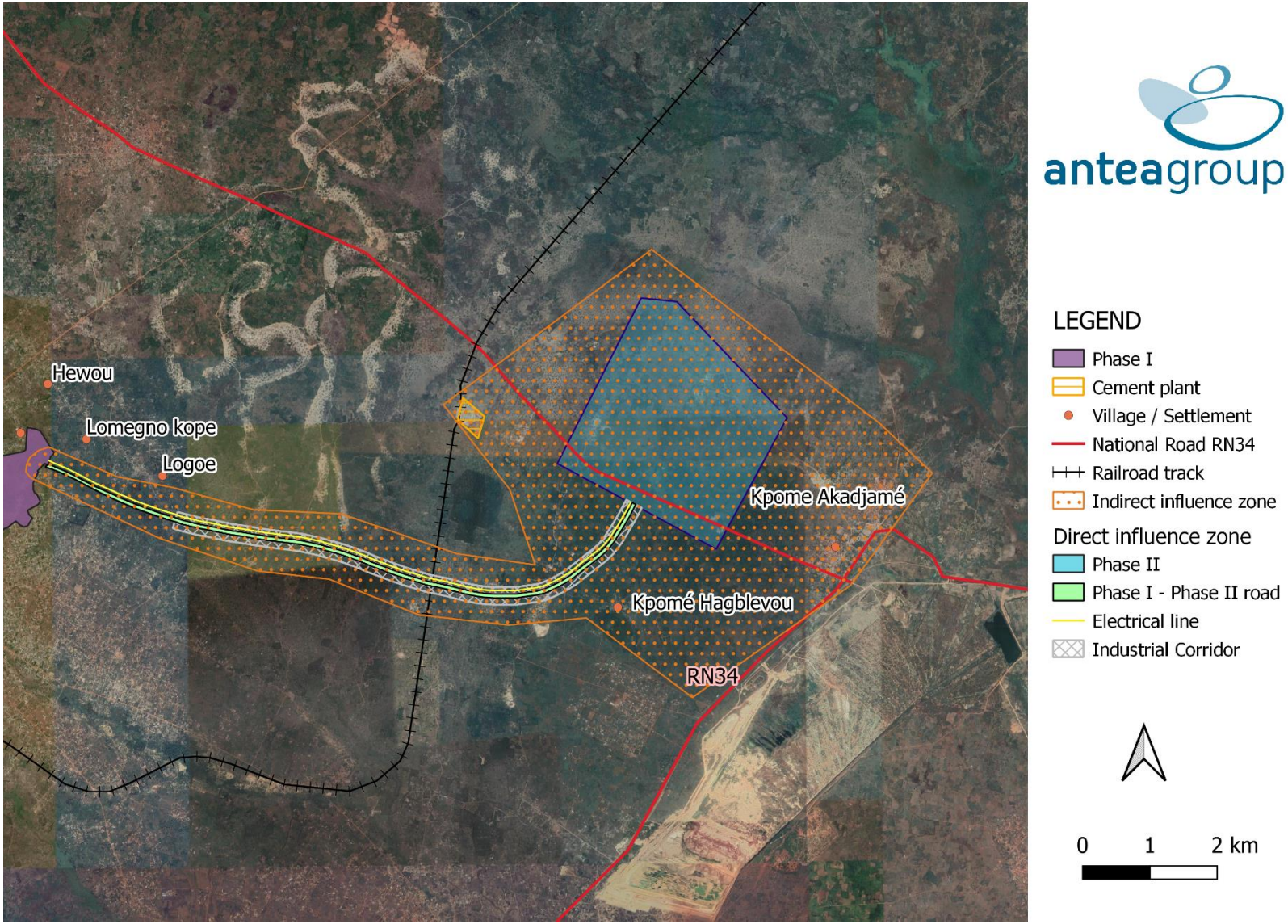


Figure 26 Direct and indirect influence zone

5.2. Environmental sensitivity rating

Sensitivities are defined as aspects of the natural (biologic and physical) or social environment that support people and nature. Once affected, the disturbances could lead to a more or less strong interruption of the uses associated with the component treated.

The rating of the sensitivity of the environment is based on 4 levels scale:

- Negligible;
- Minor;
- Moderate;
- Major.

The sensitivity analysis has been carried out by different environmental and social suject matter experts, taking into account each receptor's resilience (its ability to withstand adverse impacts) and value. The analysis may as well consider the regulatory protections of an environment (for example protected forest, catchment perimeter, presence of protected species, etc.), as well as the capacity of a component to contribute to the well-being of human beings by offering them a healthy and peaceful living environment, by allowing them to meet their basic needs in housing, food, monetary income and other essential goods or by ensuring social cohesion.

As specific criteria may vary, for each environmental component a conclusion is given to justify the sensitivity rate adopted in the study.

5.3. Field data collection

Primary data collection consisted of a series of visits to the site, the surrounding neighbourhoods and the neighbourhood of the Project in order to gather preliminary information on its initial state, to identify the various components of the biophysical and human environment, to determine the zone of direct and indirect influence of the Project and to delineate the perimeter of the study.

The influence zone of the Project was determined on the basis of the evaluation of the extent of the potential impacts of the Project on the different components of the Project's receiving environment (air, soil, water, fauna, flora, housing, commercial activities, socio-community infrastructures, etc.).

In addition, for data collection, in situ and ex situ observations were carried out. The in-situ observation consisted of a visual analysis of the elements of the study environment in the field, because to know a landscape to describe it in a detailed and coherent way, it is necessary not only to look at it from a distance, but also and above all to go through it by observing the immediate environment.

The ex-situ observation consisted of an analysis of the existing cartography and satellite images (Google) of the Project area.

This preliminary work of collecting bibliographical information allowed the definition of investigation programs for the biological, physical and human environment.

5.3.1. Field visits and investigations

The activities of the inventories of the biophysical environment and the baseline situation are summarized in the table below:

Table 32 Dates of field visits and investigations

Activities	Date
Site exploration / Field visit / Data collection	2020-2021
Flora characterization	23-28/08/2021
fauna characterization	23-28/08/2021
Location of water and soil sampling points	10/08/2021
Groundwater and surface water sampling	01/09/2021
Soil sampling	17-21/08/2021
Positioning of GPS points of water and soil sampling points	17-21/08/2021
Positioning of air analysis sampling points	24/09/2021
Collection of air analysis equipment	25/10/2021

5.3.2. Physical environment investigations

The prior visual explorations of the physical environment were made by the team of ANTEA consultants through a recognition visit of the Project site. This visit made it possible for the different teams (cartographers, sociologists and environmentalists) to make a direct observation of the elements of the environment likely to be affected within the framework of the implementation of the Project. The elements observed were essentially topography (relief, slopes), soil and hydrography (surface and underground water). The objective of this investigation is to be able to characterize the different elements observed.

The sources of the information collected on the physical environment and the tools used to record them are presented in the following table.

Table 33 Methods of data collection on the physical environment

Study area considered	Methods/Tools / Exploitable data source
Project Area of Influence	Existing documents in libraries and in particular at the University of Lome and on the Internet (dissertations, theses, study reports, etc.). Cartography/GIS resulting from data collection.
	Coverage of the Project site and the surrounding area on foot and by car by our teams (environmental expert, topographer, cartographer) to carry out field observations on all the variants considered.
	Exhaustive environmental surveys of physical constraints and issues.

Sampling was undertaken all by JAT Consulting for:

- Soils;
- Groundwater and surface water;
- Air ;
- Noise.

Analysis of soils and water were realized by Eurofins laboratories certified COFRAC.

Air analysis realized by QUADLAB laboratories certified ISO/IEC 17025.

Sampling of surface water, groundwater and soil was carried out in accordance with the IFC's general EHS guide and COFRAC requirements by personnel trained or under the supervision of JAT Consulting, accredited to carry out environmental assessments in Togo. However, for logistics constraints affecting transportations between Togo and France, it has not been possible to comply with the full requirements imposed by COFRAC accreditation.

Concerning the noise measurements, in accordance with the IFC's general ESS guide, the measuring devices were positioned on tripods at about 1.5 m from the ground and always at more than 3 m from reflective surfaces. The duration of the measurements was fixed at 1 hour (day and night), chosen according to the periods where the sound environment is likely to be representative of the activities of the zone. For reasons of safety of personnel and equipment, the night measurements were brought forward to the time slot 19:00-21:00 instead of 22:00 - 7:00. For the same reason, it was not possible to leave the devices in place for a long period of time in order to avoid any damage or theft.

The map below shows the location of the different sampling points.

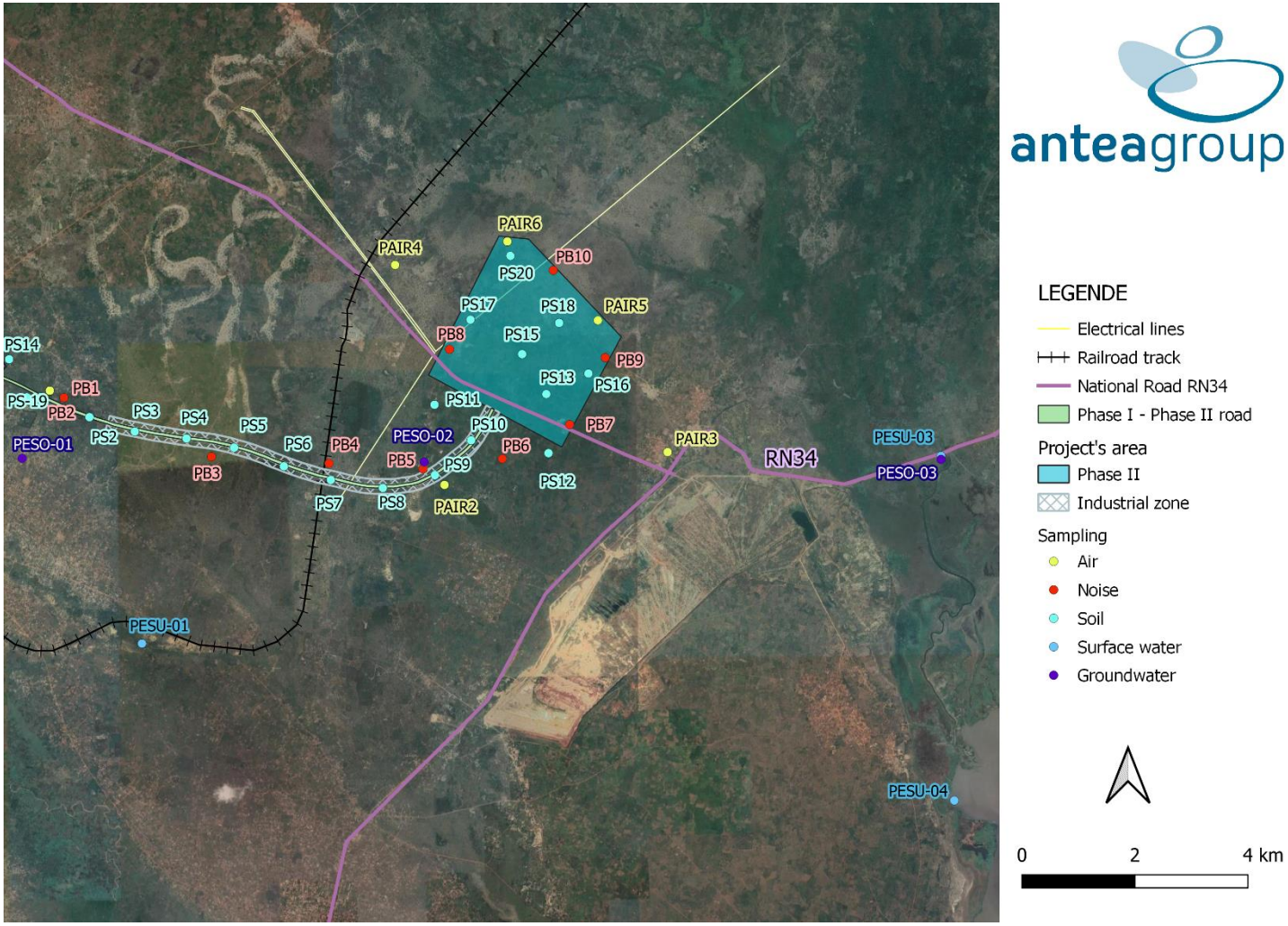


Figure 27 Location of soil (PS), groundwater (PESO), surface water (PESU), air (PAIR) and noise (PB) sampling points

5.3.2.1. Measurement of air quality

The purpose of the ambient air quality measurement is to:

- Determine the concentrations of the following pollutants:
  - ozone (O_3),
  - sulfur dioxide (SO_2)
  - nitrogen dioxide (NO_2),
  - volatile organic compounds (VOCs).
- Determine the concentrations of micro particles PM2,5 and PM10
- Compare these levels with reference concentration levels including WHO air quality guidelines.

The measurements of the parameters SO2, NO2, O3 and VOCs were carried out using equipment consisting of absorbent cartridges installed inside the diffusive bodies. Each of the four devices corresponding to a parameter were then placed in five boxes closed at the top and open on the other three sides to allow air circulation while protecting the diffusive bodies from the weather. The dates, times and temperatures at the beginning and end of the sampling were noted for each of the cartridges.

Figure 28 Passive air sampling devices

6 sampling points have been identified and were positioned according to the following approach:

- 1 point at proximity of the Phase 1 site
- 1 point south of the Phase 2 site
- 2 points on the northern boundary of the Phase 2 site
- 1 point 1.6 km east and 1 point 1.4 km west of the Phase 2 site.

The samples were taken over a period of 31 days (24/09/2021 to 25/10/2021). Their location is shown in Figure 27.

5.3.2.2. Surface water, groundwater and soil

The samples were carried out on Wednesday, Septembre 01, 2021 by a team of experts including an environmental expert, an expert in water and depollution and a technician. The following methods and materials were used.

- pH, this measurement is made by the electro-metric method using a pH meter type WTW ph 330i;

- Electrical conductivity and TDS using a conductivity meter type WTW 33 0i;
- Turbidity by the DRT 100B turbidimeter; model 20012 by the Tyndall effect principle;
- Magnesium by the volumetric method with EDTA;
- Chemical oxygen demand by the hot potassium dichromate method in the presence of silver sulfate and mercury sulfate;
- Biochemical oxygen demand by the manometric method using the BSD MeBgerät 602 equipment;
- Heavy metals were determined by the air/acetylene flame molecular absorption spectrophotometric method.

The sampling points and analytical programs were as follows:

- For groundwater :
  - 3 points in boreholes on site (see Figure 27);
  - Parameters analyzed (the list is not exhaustive):
    - pH, temperature, conductivity, dissolved solids
    - Alkalinity (TA) °F, full alkalinity (TAC),
    - Suspended Solids (SS)
    - Carbonates ($CO3^{2-}$), bicarbonates (HCO_3^-)
    - Calcium (Ca), Magnesium (Mg) Sodium (Na) Potassium (K) Nitrites (NO_3^-) Nitrates (NO_2^-) Ammonium (NH_4^+) Chlorides (Cl) Sulfates ($SO4^{2-}$) orthophosphates ($PO4^{3-}$) fluorides (F^-)
    - Dissolved organic carbon (DOC)
    - Total phosphorus (P)
    - Kjedjhal nitrogen (NTK)
    - Hydrocarbons index C10-C40 (oils and fats)
    - Heavy metals: total iron (Fe) arsenic (As) cadmium (Cd) chromium (Cr) cobalt (Co) copper (Cu) Mercury (Hg) nickel (Ni) silver (Ag) zinc (Zn)
- For surface water :
  - 4 points (see Figure 27);
  - Parameters analyzed: same as for groundwater.
- For soils: the 36 soil samples (2 per each of the 18 points) were collected at a rate of 500 grams per sample and at a depth of 15 and 30 cm using a manual corer. Samples are collected in sterile vials prepared in the laboratory and stored in coolers with cold accumulators.
  - 18 points distributed on site (seeFigure 27), two depths per each point;
  - Analytical program :
    - Pollution indexes : nitrite (NO_2^-), nitrate (NO_3^-) and orthophosphate (PO_4-P)
    - Metals, among which total iron (Fe), arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), zinc (Zn)
    - Hydrocarbons C10-C40
    - Polycyclic Aromatic Hydrocarbons PAHs

- Organophosphate pesticides
- Organichlorinated pesticides

Samples are collected and placed in sterile vials prepared by the laboratory for this purpose. Samples collected are stored in coolers with cold storage until they are received at the laboratory where they are processed within the required timeframe. The physico-chemical parameters were investigated in both the water and soil samples.

The analyses of water samples were based on the WHO drinking water quality guidelines (2017). The standards used for the soil analysis are based on the Groundwater Target Values and soil and groundwater Intervention Values, Soil remediation circular 2013 (Dutchland regulation) and US EPA standards.

Figure 29 Manual collection of soli samples

5.3.2.3. Measurements of environmental noise

The measurements of environmental noise were carried out between 02-05 october and on 15/12/2021 using an Extech EXTEN300 integrating sound level meter over a period of 1 hour per measuring point.

10 noise measurement points were identified. Their position is illustrated in Figure 50.

5.3.3. Natural environment investigations

5.3.3.1. General approach to data collection on the natural environment

The origins of the information collected on the natural (or biological) environment and the tools used to collect it are presented in the following table

Table 34 Methods of data collection in the natural/biological environment

Study area considered	Methods/Tools / Exploitable data source
Project study area	Existing documents in libraries and in particular at the University of Lome and on the Internet (dissertations, theses, study reports, etc.). Cartography/GIS resulting from data collection
	Coverage of the study area on foot and by car by our teams (environmental and wildlife expert and botanist) to carry out field observations in August 2021. The August period does not allow for an exhaustive inventory of all

Study area considered	Methods/Tools / Exploitable data source
	biodiversity. However, the majority is represented there. In particular in August, some Poaceae in particular are not yet in bloom, which makes it more difficult to determine them. However, this is the ideal period to better inventory hydrophytes and all the flora of wetlands. Regarding the fauna, the observation of the latter can be hampered by the density of the vegetation. Exchanges and meetings (focus on specific groups) with local population.
	Exhaustive environmental surveys of physical biological constraints and issues.

The investigations of the biological environment provided additional information through interviews with the services of the Forest Resources Department in charge of natural environment management. Other information was collected in an "informal" manner during exchanges with the local population.

During August, the biodiversity was characteristic of the rainy season. The limitation of the conducted surveys is that they provide a selective snapshot at a given moment in time, which does not reflect baseline conditions throught the year. However, the desktop study and interviews with stakeholders helped to mitigate this limitation.

5.3.3.2. Floristic inventory and habitat characterization

5.3.3.2.1. Floristic data collection

The inventories were carried out from 23 to 28 august 2021 by a team of 3 people including an expert in flora, an expert in fauna and an assistant cartographer. These inventories were preceded by a field visit to ensure the boundaries of the area to be studied and then the sampling design.

The inventories were carried out along seven (7) transects covering the Phase 2 industrial zone area. The route connecting Phase 1 to Phase 2 has been considered as an additional transect made of 9 additional inventory points. A total of 8 transects is then considered. The transects are equidistant and oriented east-west.

On each transect, equidistant points 500 m apart were previously defined for the systematic inventory of plant species. The size of the inventory area is 50 x 20 m, or 1000 m² of surface for the phytosociological inventory of woody plants and forest inventories and 10 x 10 m (100 m²) for the inventory of herbaceous plants (Polo-Akpisso et al., 2015). Therefore, along a transect the sampling areas are 450 m apart from each other.

The total number of plots inventoried is 25 for the future industrial zone and eight (8) for the road connecting Phase 1 to Phase 2, the buffer zones and the power transmission line siding the road. This represents a sampling area of 3,3 ha. The location of the transects and the location of the plots are shown on the map below:

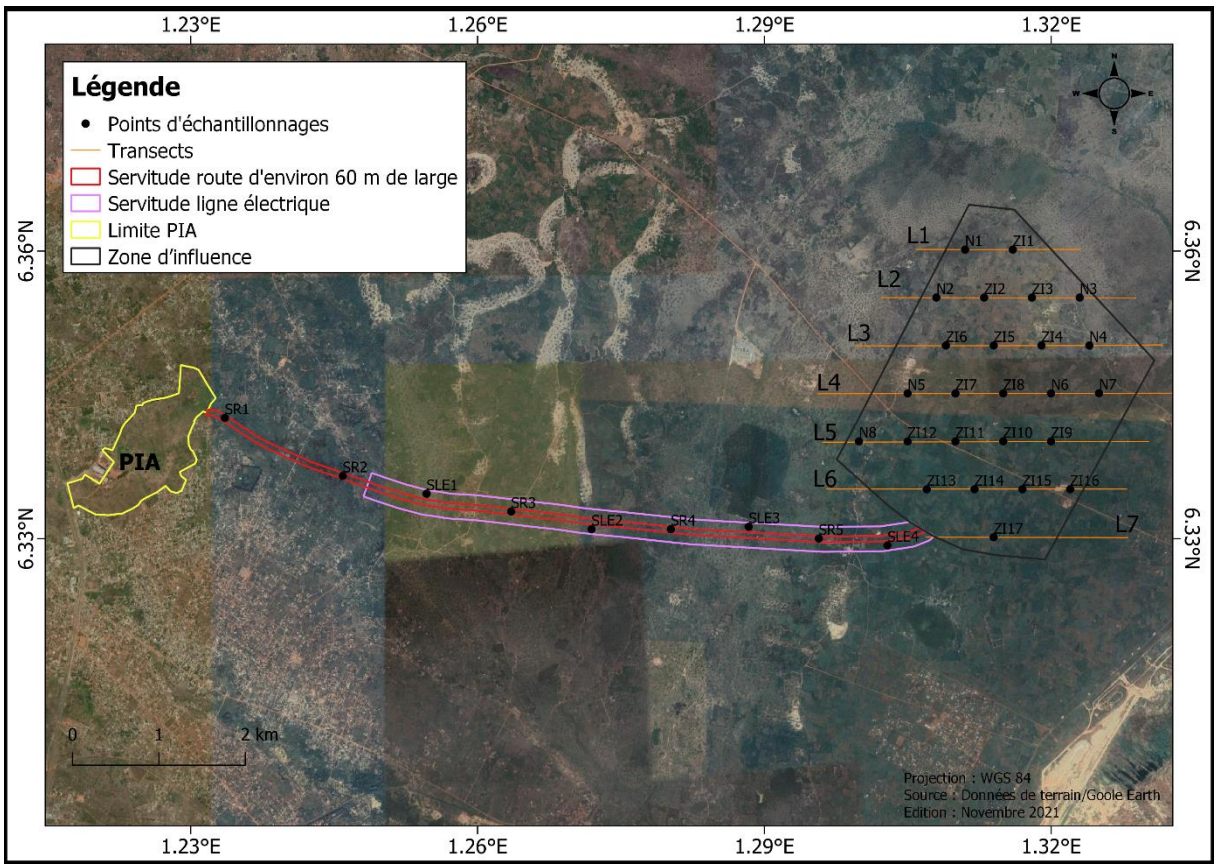


Figure 30 Location of transects and sampling points

The phytosociological surveys were carried out on the basis of a classic phytosociological data sheet with the following information

- ID, station and plot reference, survey date, location ;
- GPS coordinates, survey type (surface), area of survey;
- physical environment parameters: soil type, water characteristics, condition of the dynamics, management / human activities;
- vegetation characteristics: type of vegetation, global coverage, coverage of tree layer, shrub layer and herbaceous layer;
- for each taxon the coefficient of abundance/dominance and sociability according to the Braun-Blanquet scale (Braun-Blanquet, 1932).

The list of inventoried taxon (woody and herbaceous) indicates their families, genus, biological type and phytogeographical type. The conservation status according to the vulnerability criteria of the International Union for Conservation of Nature (IUCN, 2020) was researched for each species. The list of Togolese endangered plant species (Radji & Akpene, 2018) and the Togolese priority food plants list (Eyog-Matig et al., 2002) were also consulted.

The forest inventories involved woody trees with a diameter at breast height (DBH) ≥ 10 cm. The parameters considered are the following: diameter at 1.30 m from the ground, stem height and total height (Atakpama and al., 2014). The biovolume and biomass of each tree is calculated using an approach based on the methods of Dagnelie (1998), Dupouey et al. (2006) and IPCC (2006).

$$Biovolume = \lfloor \frac{(\pi\ HD^2) \times 1{,}28\ \times 0{,}546}{4} \rfloor$$

π= 22/7 ; 1,28 = root expansion facteur ; 0,546 = tree shape factor ; D=diameter of the tree (cm); H= tree height (cm)

$$Biomasse\ (en\ kg) = (Biovolume\ x\ 0{,}58)10^{-3}$$

(0,58 g/cm3 = default wood density for African tropical forests (GIEC, 2006 ; Mugnier et al., 2009)).

The carbon stock and CO2 equivalent are calculated by determining the total biomass first. The resulting carbon stock is expressed per hectare.

$$Stocks\ C\ (t/ha)\ =\ Biomasse\ x\ 47{,}5/100$$

47,5 % = carbon concentration of the wood, chosen as constant (GIEC, 2006 ; Mugnier et al., 2009)

$$Equivalent\ CO2\ =\ 3{,}67\ x\ Stocks\ C$$

Foliage, herbaceous layer, trees that cannot be inventoried (DBH < 10 cm) and dead wood will not be taken into account in the calculations (Dupouey et al., 2006).

The floristic inventories have been completed by the ecological inventories. The elements considered are: land use type, soil hydromorphy (marshes, flood soil, non-flood soil).

For the cultivated areas, the types of crops were noted affected by their representativeness according to the Braun-Blanquet scale (1932).

5.3.3.2.2. Floristic data processing

The results of the inventories, namely (i) the list of species identified for each station and (ii) the list of consolidated species for all the stations were entered into a Microsoft Excel 2016 spreadsheet. For each species the common names, the IUCN status, the list of stations where the species occurs and the average abundance index and uses of the species were also recorded.

The data entered were coded and processed using the same spreadsheet program. Each species entered following each survey was assigned its coefficient of abundance/dominance according to the Braun-Blanquet scale (1932).

The species recorded were determined based on analytical Flora from Togo and Benin (Brunel et al., 1984; Akoegninou et al., 2006). Nomenclature is carried out with reference to those of the flora of Benin (Akoegninou et al., 2006). These species have been classified into genus and family. For the species surveyed, biological and phytogeographic types were searched for. The biological types considered for the analysis of biological spectra are those defined by Raunkiær (1934) and taken up and developed by the various studies of tropical regions (Lebrun, 1981; Ake Assi, 1984). The chronological subdivisions used in the analysis of phytogeographic spectra are those defined by Ake Assi (1984).

Floristic species of ecological interest (nationally protected and with VU, EN, CR status on the IUCN Red List, etc.) were determined (IUCN, 2020). Species frequencies and abundances have been calculated. These data were then generated according to each habitat.

Each habitat was described. Its conservation status (excellent, good, poor) and the various pressures on it (agriculture, market gardening) were assessed.

5.3.3.2.3. Mapping of habitats and vulnerable species

In addition to the types of vegetation formations noted at the sampling points, any changes in vegetation physiognomy were noted. These various field truth points were projected into a Google Earth satellite image using Google Earth Pro software (Atakpama et al., 2017). The land cover units were first digitized on Google Earth Pro and then brought back into the QGIS mapping software for editing. It is the same for the other attributes of the map, notably watercourses and communication roads. With regard to the houses, the GPS points of the houses were directly taken during the inventories and field checks as well as the use of Google Earth images. The image used is dated in March 30, 2020.

5.3.3.3. Wildlife inventory

5.3.3.3.1. Wildlife data collection

For the collection of reliable wildlife data, the inventory focused mainly on vertebrates, particularly mammals, reptiles and birds. The method used is that of the pedestrian inventory of line transects that are known to estimate the density of biodiversity in tropical regions (Peres, 1999; Plumptre, 2000).

Data were collected by following the eight (8) transects of floristic inventories (see Figure 30). Along these transects, effective presence (visual contact) and signs of presence (droppings, shouts, prints, fur, feathers, etc.) were noted. Each index or presence is coupled to geographical coordinates recorded with a GPS receiver for spatial analysis.

The inventory mobilized a collection team composed of 2 persons including a team leader and an observer. The role of the observer is to locate the animals, while the team leader is in charge of orienting the team along the transect using a GPS receiver, making and recording the measurements (coordinates, distances and angles of observation, species, number of individuals in the group, sex and age class). Any observed threat indicators are also recorded.

5.3.3.3.2. Wildlife data processing

The data collection forms were manually stripped. These raw data were then compiled using Excel software. The identification of the scientific names of the animal species was done on the basis of works on tropical fauna (Delvare & Aberlenc, 1989; Rigout & Allard, 1992; Dorst, 1997; Robiche et al., 2002). The IUCN, africanbirdclub, birdlife and avibase status of each species was determined on the basis of the proposed threat categories and assessment criteria.

Calculations of frequency and number of species per IUCN category, family, groups were made on the basis of the data compiled through the analysis of pivot tables in Excel. This categorization is a good indicator to situate the wildlife species richness on the site and the extent of threats to its fauna in a global context.

5.3.4. Human environment investigations

5.3.4.1. General approach to data collection

The collection of data about the social environment and for the identification and assessment of socio-economic impacts was based on :

- Socio-economic surveys of local households, which took place from 10 to 22 August 2021;
- Individual interviews with resource persons;
- Public consultation meetings in the 10 neighbouring village.

5.3.4.2. Sample-based socio-economic survey

5.3.4.2.1. Conduct of the socio-economic survey

A socio-economic survey to provide a monograph of the project area was conducted as part of the ESIA with a sample of 330 households residing in the social influence zone. The survey was sampled in accordance with the IFC's requirements.

The sample size was calculated using data from the 2010 RGPH4 and additional data obtained from local authorities, which allowed us to estimate the number of households in the 10 villages and hamlets bordering the site at 1678 households.

The sample size was calculated using the following formula :

$$n = \frac{z^2 p(1-p)/e^2}{1 + (z^2 p(1-p)/e^2 N}$$

N= reference population (enumeration)= for example 1000 households
n = required sample size
z = the z value represents the confidence level. It is the number of standard deviations of the proportion of the confidence level to the average. The norm is 95% with a standard value of 1.96.
p = estimated prevalence of the variable of interest in the project area expressed as a standard deviation. 50% is the prevalence when we have no statistical data on the level of variability of the variable of interest, i.e. 0.5.
e = margin of error expressed as a decimal. The standard is 5% which is 0.05.

The calculated sample size was thus 313 households. This allowed a larger number of households to be interviewed, giving us a fairly accurate sample.

The map below illustrates the distribution of the socio-economic surveys conducted in the study area.

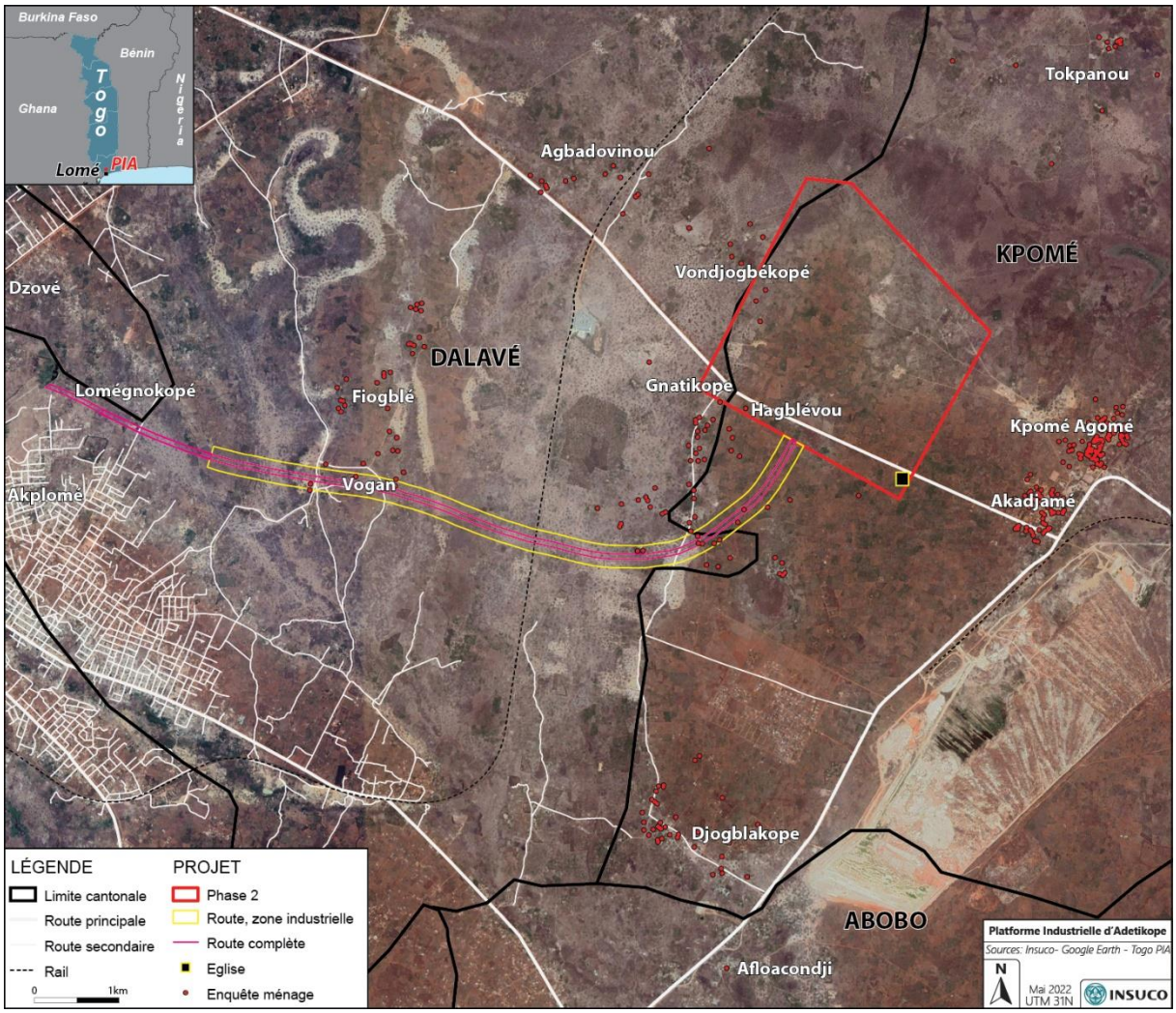


Figure 31 Location of surveyed households

Thus, the socio-economic survey was conducted on a sample of potentially affected and unaffected households. A questionnaire developed for this purpose was distributed to all household heads in the sample. The data collected was uploaded to the ONA.io platform and checked daily before being exported for further cleansing and analysis.

5.3.4.2.2. Treatment of basic socio-economic data

The survey data that was collected, loaded and verified on the ONA.io platform was then extracted into an Excel database. The Excel database was then revised during a quality control phase. This step made it possible to eliminate outliers (errors of understanding or data entry), resulting in a consolidated data file ready for processing. As more surveys than necessary were carried out (in relation to the statistical calculation of the representativeness of the sample), the outlier data for which no verification could be carried out were removed from the database without affecting the statistical representativeness.

Thanks to the geolocation of the investigations, an inventory map positioning each household surveyed in the study area was produced. The analysis of this map enabled us to verify the homogeneity of the points and the fair and random distribution over the entire zone of predetermined social influence.

5.3.4.3. Individual interviews

Individual interviews were conducted with local and customary authorities as well as with authorities involved in the monitoring and validation of impact studies (see paragraph 8.2.1). The method adopted was that of a non-directive interview. This is a qualitative method in which the interviewer leaves the interviewee free to structure their answers as they wish. The interviewer guides the interview on the basis of broad topics and only intervenes to stimulate and relaunch the interviewee in a non-directive manner.

5.3.4.4. Public consultation

Public consultation sessions were held with the populations of the 10 villages bordering the project from 21 to 24 September 2021 (see paragraph 8.2.2). The purpose of these consultations was to present the environmental and social assessment procedure, to inform about the project and its main potential positive or negative impacts, to discuss the corrective measures to be proposed and to exchange with the stakeholders on their concerns, complaints and expectations. They were organised in the form of an open discussion, where the different stakeholders were given the opportunity to express themselves.

5.4. Physical environment

5.4.1. Climate

5.4.1.1. General description

The project area is located in the south of Togo and is characterized by a sub-equatorial climate. This climate is dependent on two air masses, the harmattan or continental trade winds of the north-east, hot and dry, and the monsoon of the south-west, hot and humid. The movement of the intertropical front (ITF) within the intertropical convergence zone determines the contrasting water seasons during the year in southern Togo.

There are two dry seasons and two rainy seasons. The dry seasons are spread over five months and the rainy seasons over seven months. The temperature is a determining element of the radiation and energy balance.

It is also a crucial parameter in the climate characterization. With an annual average of 28 to 29°C (Badameli, and Dubreuil 2010), maximum temperatures are generally higher in the dry season than in the wet season. The months with the highest maximum temperatures are November, December, January, February and March, while the lowest values are observed in June, July and August (DGMN 2018).

In terms of winds, we observe winds coming mostly from the south-west, i.e. from the ocean. Wind speeds are mainly moderate. There are very few extreme wind speeds.

The figure below shows the monthly average temperature rainfall.

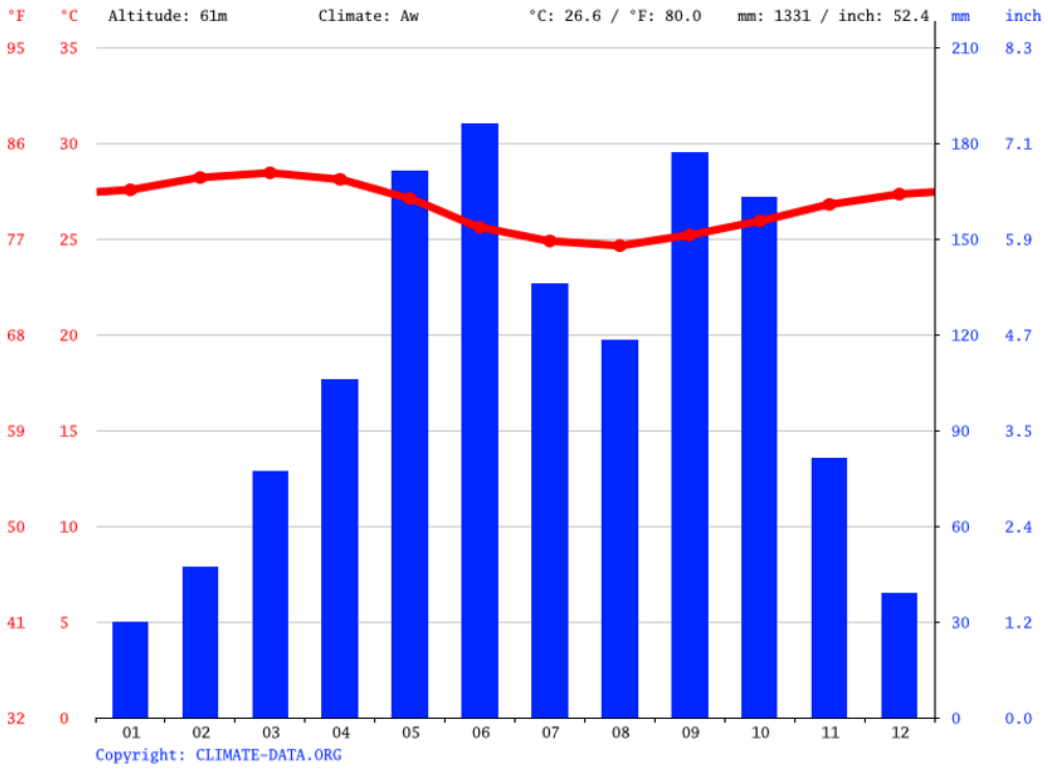


Figure 32 Monthly average temperature and rainfall

5.4.1.2. Climate change projection for Togo

Among other elements, the National Plan for Climate Change Adaptation (2017) indicates that climate observations in Togo over the period 1961-2012 show a warming of 1°C compared to the period 1961-1985; and decrease in total annual rainfall of between 3 and 81 mm, however with a recovery in rainfall observed in some stations since 2005. Climate change also causes inconsistencies in precipitation, some regions will suffer from a trend of increasing precipitation and others from a trend of decreasing precipitation. The southern regions are more concerned with decreasing of rainfall.

According to IPCC climate scenarios, global warming in Togo is expected to continue with an increase in average temperature between +0.9 and +5°C by 2100. As for rainfall, it can potentially increase or decrease, depending on the location between +5 and +29 mm for the same period.

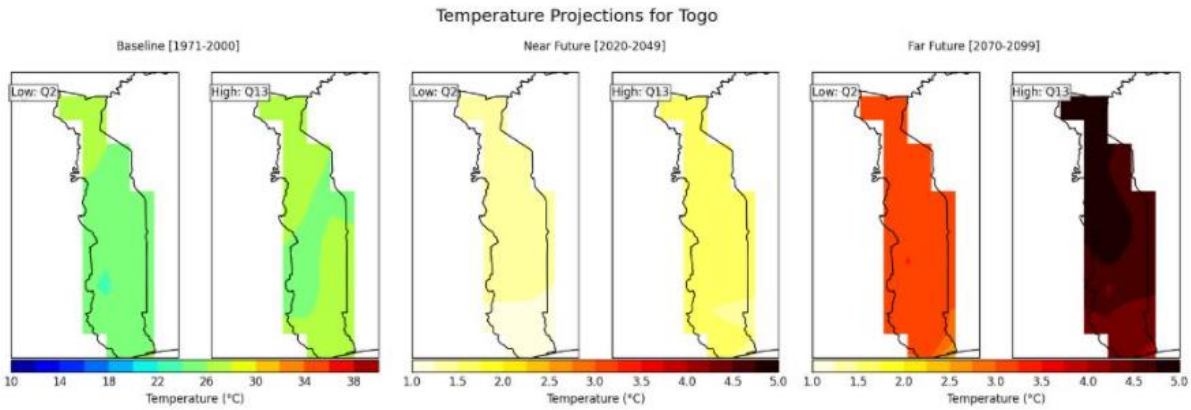


Figure 33 : Temperature Projections for Togo (Source : PARCC, 2015)

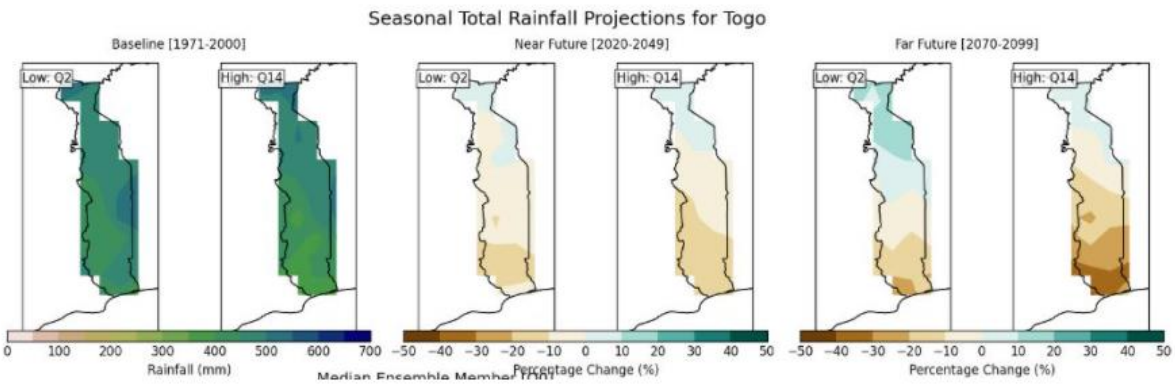


Figure 34 : Seasonal total rainfall projections for Togo (Source : PARCC, 2015)

The warming is predicted across the country, and would be more pronounced towards the north and west, while annual rainfall totals would be higher within the northern regions and would gradually decrease towards the southern part of Togo.

Togo's overall climate is expected to become drier, as the increase in rainfall is too small to compensate for the increase in evapotranspiration resulting from the large temperature increases.

Taking into account climate change, the main climate risks identified in Togo are

- floods ;
- drought ;
- hot weather;
- seasonal shifts of up to 30 days;
- poor distribution of rainfall ;
- strong winds;
- land erosion, especially along the coast in the littoral zone;
- landslides/floods; and
- sea level rise.

Table 32 includes the climate hazards that are considered material in the Project region currently.

Table 35 Relevant Climate Hazards in the Project area

Hazard	Hazard Level Valuation
River flood	High
Wildfire	High
Urban flood	Medium
Extreme heat	Medium
Landslide	Very low
Water scarcity	Very low

Source: Think Hazard, 2021[5]

Togo does not have adequate monitoring systems for predicting the likelihood of extreme events occurring, or for assessing possible changes in weather patterns. This deficiency makes the task of developing short term-response or disaster mitigation strategies extremely difficult. Adaptation strategies are likewise difficult to formulate unless detailed vulnerability and impact assessment studies are undertaken. However, the National Multirisk Contingency Plan, published every year, presents existing coordination mechanisms as well as mechanisms for managing information and mobilizing financial and external resources in case of disaster. The risk analyzed are only in short term (one year).

At the institutional level, Togo has been engaged in a national climate change adaptation planning process since 2014. One of the objectives of this process is to promote the integration of the climate issue into the country's development strategies, in order to reduce the vulnerability of development sectors and strengthen their resilience.

Togo has integrated into its National Development Plan (NDP 2018-2022) the various Sustainable Development Goals, and in particular SDG 13 concerning climate change.

5.4.1.3. Climate change projection for the project's area

As we can see in Figure 33 and Figure 34, the project's area should observe a rise in temperature of +0.5° to +2° by 2050 and +3° to 4.5° by 2100 according to IPCC climate scenarios. Moreover, rainfalls will disminish by -10 to -20 % by 2050 and -30 to -40% by 2100. Considering an annual average rainfall of 850 mm (based on DPR PIA Storm water management September 2020) it means a decrease between :

- 85 and 170 mm per year by 2050;
- 255 and 340 mm per year by 2100.

The project seems to be located in the region that will suffer the most from reduced precipitation, and therefore periods of drought. The rainfall intensity however is expected to change, where more intense rains can occur resulting in exacerbated flooding phenomena (PNACC, 2017).

In terms of water resources, vulnerability to the effects of climate change occurs through overexploitation of aquifers in the Lomé region. Currently the risk of water scarcity is categorized as very low for the Project area (see Table 32), however this may change as climate gets hotter and precipitation decreases limiting groundwater recharge. According to a study carried out in 2020 (PASIET, 2020), based on population growth and an estimated annual consumption of 22,5m^3 per person, the maritime region will exhaust its groundwater supply by 2036 and 2039 respectively for the

[5] The Global Facility for Disaster Reduction and Recovery (GFDRR) Think Hazard. Available at: https://thinkhazard.org/en/report/65288-togo-maritime-zio [03.86.2021]

extreme and medium scenarios. As long as this information may not be specific to the project area of influence and does not clearly refer to any specific groundwater horizon, it points out the relevance of the water resource sensitivity and pressure in near future.

Hence, the demand for surface water may increase significantly to delay the depletion of groundwater resources. Under these conditions, the country may have difficulty in meeting national drinking water needs.

As a result, agricultural activities will be strongly impacted. Water stress will reduce the productivity of crops such as cereals. In addition, climatic conditions, particularly periods of drought and flooding, will no longer be favourable to the growing of certain plants, especially as these phenomena will eventually lead to the proliferation of harmful insects and pests. Thus, at the national level, climate change is likely to affect first and foremost the most vulnerable populations, especially households that depend on natural resources and rain-fed agriculture. As a reminder, with its relatively favorable natural and climatic conditions, Adetikope had, until the 2000s, an economy based almost exclusively on agriculture. It was thus an important center of food production. With the urban thrust and the extension of Lome's urbanization fronts, agricultural activity gave way over time to commercial and industrial activities.ESIA survey results previously showed that 74% of the heads of households surveyed continue to practice agriculture for family self-consumption, 24% of the heads of households practice for own consumption and sale and only 2% of these practices it exclusively for marketing.

5.4.1.1. Climate sensitivity

In the global context of climate change, Togo’s climate is expected to be impacted mainly by drought and flooding due to changing rainfall intensity and increasing temperature. As this change on climate could probably impact people around PIA site, therefore, sensitivity of climate is rated as **Moderate**.

5.4.2. Soil and topography

The Project site is located in the vast peneplain in the south of Togo. The relief is monotonous and very little contrasted with decreasing altitudes from north to south. It is constituted in the south by a continental shelf formed by a series of other shelves compartmentalized by the valleys of the Haho, Zio and Lili rivers, and in the north by the Precambrian peneplain.

5.4.2.1. Geology

The geology of the project zone corresponds to the Precambrian to Eburnean coastal sedimentary basin.

It is bounded to the north by outcrops of its bedrock (crystalline basement of Pan-African age) and is extended to the south by the offshore portion under the Atlantic Ocean. It extends from west to east, from the border with Ghana to the Mono River which forms the border with the Republic of Benin (Gnazou, et al. 2015). The main formations encountered are Mastrichtian (superior Cretaceous), Paleocene, Ypresian (inferior Eocene), Lutetian (middle Eocene), Continental terminal and quaternary formations (Gù-konu, et al. 1981).

In the emerged part, several works carried out by Slansky, 1962; Monciardini et al. 1986; Sylvain et al. 1986; Johnson, 1987; Yotouroufey, 1990 ; Da Costa, 1992 ; Da Costa et al. 1996 Johnson et al. 2000 ; Da Costa, 2005, reveal a mesocenozoic sedimentary series with a thickness of about 600 m in boreholes.

It lies in fundamental discordance on a metamorphosed Pan-African substratum, represented by the internal units of the Dahomeyides chain (Affaton, 1987). This basement outcrops to the north as a peneplain oriented NW - SE. The series includes two discordant assemblages: a lower marine

assemblage of upper Cretaceous-Lower Miocene age and an upper assemblage consisting of continental deposits of Miocene-Pliocene to Quaternary age (Da Costa et al., 2013).

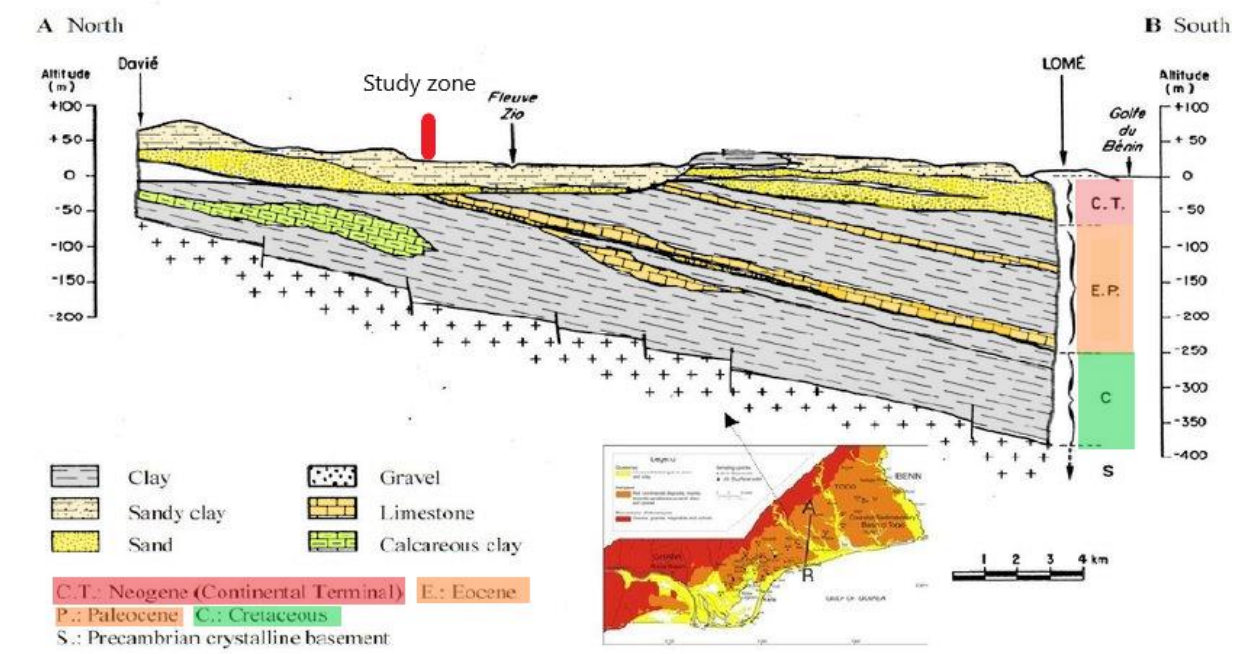


Figure 35 Geological cross section around the studied area (modified after BRGM 1982)

Locally, main geological formations are shown on figure above. On the study zone, cretaceous calcareous clay and sands are present on top of the Precambrian basement. They form the Maastrichtian targeted aquifer. Palaeocene and Eocene formations are tilted and undeformed, like the Upper Cretaceous formations. They represent an alternance of thick clay units with limestones layers in-between. Lying uncomfortably upon theses formations are the Continental Terminal series. This term regroups the fluvio-lacustrine formations from Eocene to present, composed of sands at the base and sandy-clay on top. All this facies and geometries have a major impact on the hydrogeological functioning of the studied zone.

5.4.2.2. Pedology

The soils in the Project area are geologically part of the coastal sedimentary basin plateaus. The coastal sedimentary basin includes the barrier beach, the lagoon system and the barrens plateau. The dominant soils are :

- Poorly evolved soils ;
- Ferruginous soils ;
- Ferralitic soils ;
- Hydromorphic soils.

The soil of the site has a ferralitic sandy-clay texture.

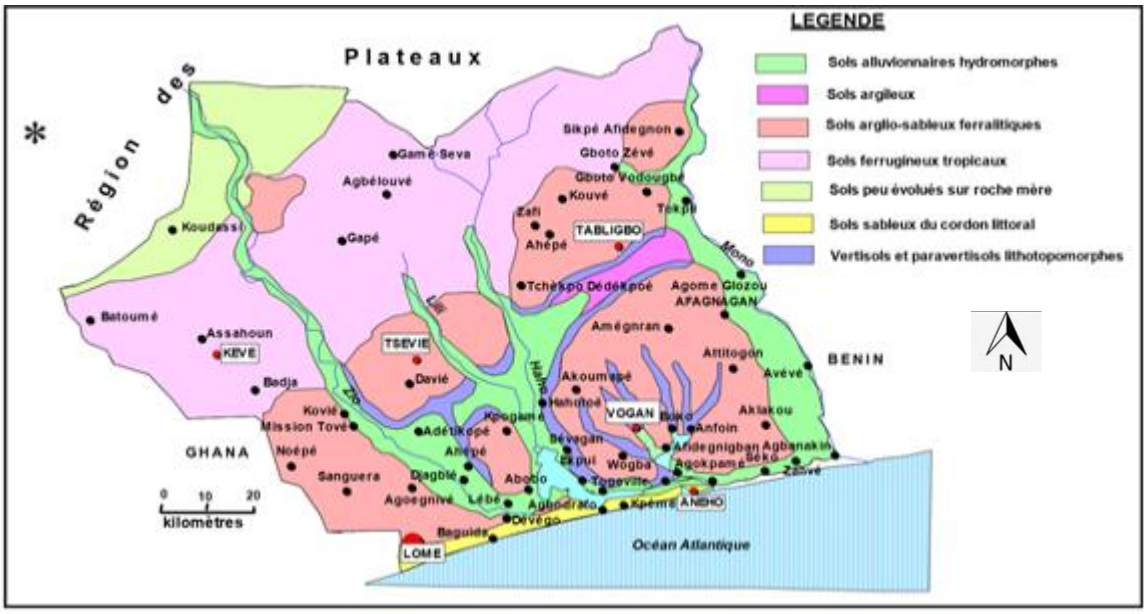


Figure 36 Soil map of the maritime region of Togo (Source: IGN)

5.4.2.3. Topography

The project area has a relatively flat topography. The sandy areas at the west of the site have been the object of sand quarrying, leaving, in places, holes and shallow areas.

No topographic survey covering the whole Phase 2 area has been provided.

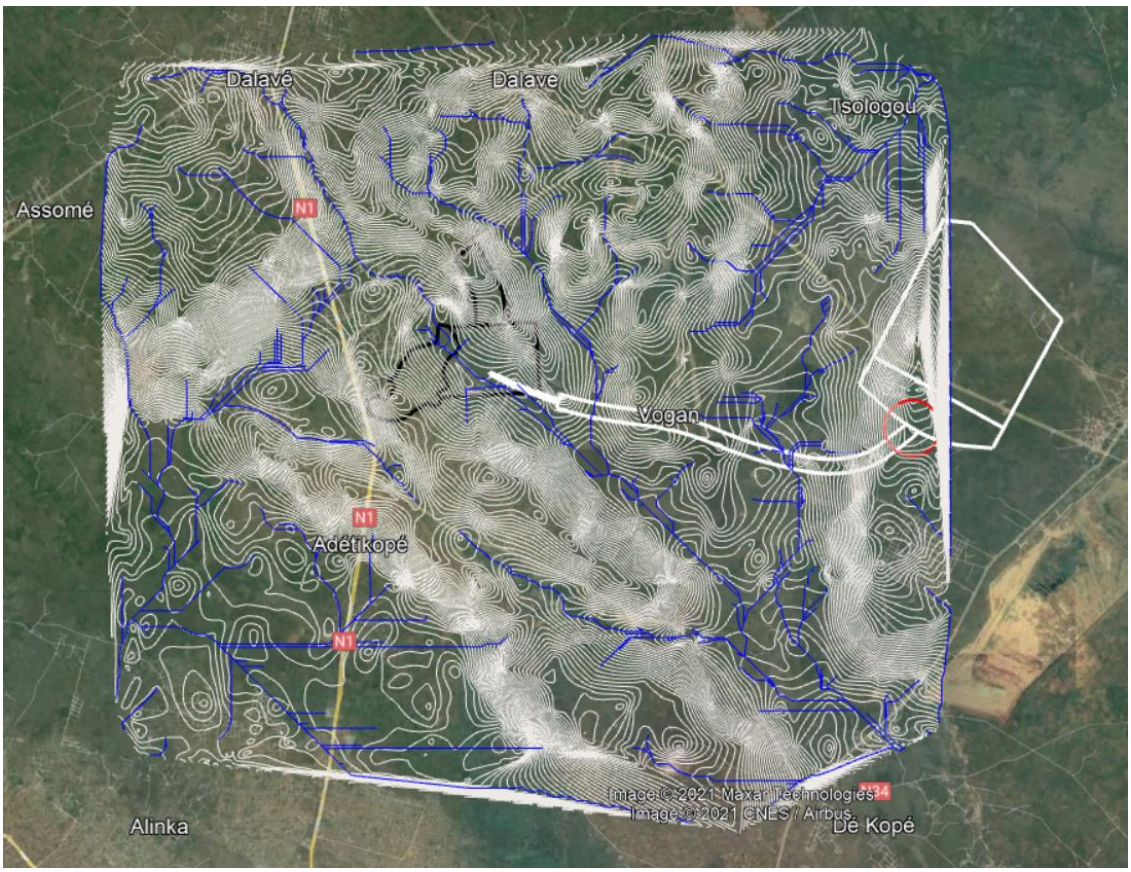


Figure 37 Topography of the Project area

5.4.2.4. Soils quality

Sampling carried out on the site made it possible to analyze the soils in place on site. The various results obtained were compared, in the absence of national standards, to the thresholds of the Dutch and US EPA standards as an international reference (see section 0) . The vast majority of measured values are within the thresholds.

The sampling stations are shown in the figure below.

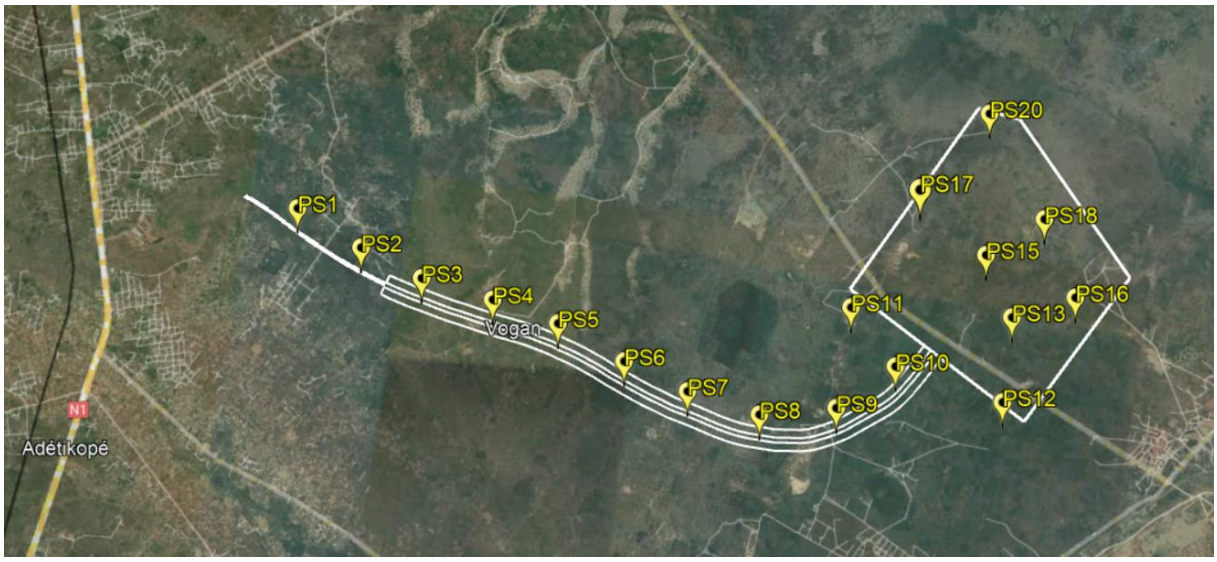


Figure 38 Soil sampling points

The main results of soil analysis at 15 and 30 cm depth are presented in the table below. The results for all the analysed parameters are presented in Annexe V.

The in-situ findings do not reveal any signs of spills or persistent traces on site that would suggest any targeted soil contamination within the Project area.

In terms of heavy metals, we note an exceedance of the target values for zinc (PS13, PS15, PS16 and PS20). PS1 shows an exceedance for antimony, barium and selenium, which may be the result of industrial liquid discharges accumulated in the natural pond existing north of PS1. The higher iron levels, in line with the higher values found in the groundwater and surface water samples, indicate natural iron levels related to the geochemical background of the area.

For most samples, the concentration of C10-C40 is below the analysis sampling threshold (15 mg/kg). The highest concentration measured is 91,3 mg/kg (PS12 at 30 cm depth). This concentration is not considered as to be critical.

As for PAHs, the maximum amount sampled is 1,1 mg/kg (PS07 at 30 cm depth). This concentration is far below the intervention value indicated by the Groundwater Target Values and soil and groundwater Intervention Values, Soil remediation circular 2010 (Dutchland regulation) (40 mg/kg).

No presence of organochlorine- or organophosphate-pesticides is noted in the samples analysed.

The presence of fertilizers in the soils is noted, which is linked to the results of the surface water analyses (see section 5.4.4.2).

Table 36 Results of soil analysis

Parameters	Units	Results										Selected comparison criteria (1)
		PS-01		PS-02		PS-03		PS-04		PS-05		
		0,15 m	0,30 m	0,15 m	0,15 m	0,30 m	0,15 m	0,15 m	0,30 m	0,15 m	0,30 m	
Pollution indexes												
Nitrates (NO_3^-)	mg/kg	<20.0	<20.0	20,5	<20.0	<20.0	<20.0	55,8	24,9	<20.0	<20.0	-
Nitrites (NO_2^-)	mg/kg	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	-
Orthophosphate (PO4-P)	mg/kg	28,4	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	-
Total hydrocarbons C10-C40	mg/kg	49,4	40,2	29,8	30,9	27,6	18,6	<15.0	<15.0	<15.0	<15.0	-
Polycyclic Aromatic Hydrocarbons PAHs	mg/kg	<0.05	0,076	0,052	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
Organophosphate pesticides	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
Organichlorinated pesticides	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Heavy Metals												
Antimony (Sb)	mg/kg	3,84	4,39	<1.00	<1.00	<1.00	<1.00	<1.00	1,31	<1.00	<1.00	3 (Dutch regulation)-
Arsenic (As)	mg/kg	6,28	5,1	1,58	<1.00	1,66	<1.00	<1.00	1,17	<1.00	<1.00	30 (US EPA)
Barium (Ba)	mg/kg	473	802	45,1	26,3	66,8	22,8	19,8	30	34,8	44,6	160 (Dutch regulation)
Cadmium (Cd)	mg/kg	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	98 (US EPA)
Calcium (Ca)	mg/kg	3930	3280	1670	3040	1860	911	595	631	912	1230	-
Chromium (Cr)	mg/kg	34,7	40,7	11,9	10,9	18,2	8,68	12,3	16,9	12,1	11,6	
Copper (Cu)	mg/kg	5,93	6,65	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	4700 (US EPA)
Iron (Fe)	mg/kg	43500	46100	12100	6230	8850	2880	6310	10700	6660	7200	-
Lead (Pb)	mg/kg	24	30	8,94	6,35	5,8	<5.00	<5.00	6,52	<5.00	<5.00	800 (US EPA)
Magnesium (Mg)	mg/kg	1380	1380	718	327	970	313	200	296	539	641	-
Manganese (Mn)	mg/kg	6630	15000	125	20,7	259	36,6	172	200	133	230	-
Mercury (Hg)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	4.6
Molybdenum (Mo)	mg/kg	1,28	1,29	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	
Nickel (Ni)	mg/kg	11,9	12,2	2,89	1,94	4,68	<1.00	2,4	4,21	2,59	2,87	1 200 (US EPA)
Phosphorus (P)	mg/kg	302	209	156	72,7	192	67,7	113	114	79,9	109	-
Potassium (K)	mg/kg	754	692	185	92,9	189	54,3	163	167	70,2	104	-
Selenium (Se)	mg/kg	2,56	5,23	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	0.7 (Dutch regulation)-
Zinc (Zn)	mg/kg	88,5	101	58,9	43,6	55	10,6	9,36	16,8	17,2	17,5	35000 (US EPA)

Parameters	Units	Results										Target values [1]
		PS-06		PS-07		PS-08		PS-09		PS-10		
		0,15 m	0,30 m	0,15 m	0,30 m	0,15 m	0,30 m	0,15 m	0,30 m	0,15 m	0,30 m	
Pollution indexes												
Nitrates (NO_3^-)	mg/kg	31,5	<20.0	<20.0	<20.0	<20.0	<20.0	26,7	<20.0	40,9	32,7	-
Nitrites (NO_2^-)	mg/kg	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	-
Orthophosphate (PO4-P)	mg/kg	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	26,1	<20.0	<20.0	-
Total hydrocarbons C10-C40	mg/kg	<15.0	<15.0	<15.0	<15.0	36,3	20	<15.0	<15.0	<15.0	<15.0	-
Polycyclic Aromatic Hydrocarbons PAHs	mg/kg	<0.05	<0.05	<0.05	1,1	0,059	<0.05	<0.05	<0.05	<0.05	<0.05	-
Organophosphate pesticides	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
Organichlorinated pesticides	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Heavy Metals												
Antimony (Sb)	mg/kg	<1.00	1,16	<1.00	<1.00	<1.00	<1.00	2,29	1,44	<1.00	2,01	3 (Dutch regulation)-
Arsenic (As)	mg/kg	1,11	1,16	<1.00	<1.00	<1.00	<1.00	2,37	1,45	1,35	2,18	30 (US EPA)
Barium (Ba)	mg/kg	89,1	68,6	10,4	4,56	16,9	6,29	33,2	44,5	45,2	40	160 (Dutch regulation)
Cadmium (Cd)	mg/kg	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	98 (US EPA)
Calcium (Ca)	mg/kg	1980	1380	639	233	754	416	1020	988	872	566	-
Chromium (Cr)	mg/kg	20,4	20,6	<5.00	<5.00	5,09	<5.00	28,5	22,6	17	22,8	
Copper (Cu)	mg/kg	<5.00	<5.00	<5.00	<5.00	<5.00	<5.00	6,88	6,82	7,43	8,13	4700 (US EPA)
Iron (Fe)	mg/kg	10300	10900	2960	1460	2660	1420	18900	16900	13600	21000	-
Lead (Pb)	mg/kg	7,89	7,24	<5.00	<5.00	<5.00	<5.00	8,53	9,21	9,51	11,6	800 (US EPA)
Magnesium (Mg)	mg/kg	951	805	166	62	301	150	316	318	277	270	-
Manganese (Mn)	mg/kg	529	261	35	10,6	97,9	18,7	532	587	690	700	-
Mercury (Hg)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	4.6 (US EPA)
Molybdenum (Mo)	mg/kg	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	
Nickel (Ni)	mg/kg	7,4	6,49	1,02	<1.00	1,25	<1.00	5,3	6,34	6,65	7,86	1 200 (US EPA)
Phosphorus (P)	mg/kg	124	79,7	40,4	14,2	66,4	26,3	234	150	161	154	-
Potassium (K)	mg/kg	226	149	42,4	<20.0	66,1	34,8	168	140	266	153	-
Selenium (Se)	mg/kg	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	0.7 (Dutch regulation)-
Zinc (Zn)	mg/kg	12,3	16,7	37,1	17,2	25,4	16,1	32,7	27	19,6	29,2	35000 (US EPA)

Parameters	Units	Results										Target values [1]
		PS-11		PS-12		PS-13		PS-15		PS-16		
		0,15 m	0,30 m	0,15 m	0,30 m	0,15 m	0,30 m	0,15 m	0,30 m	0,15 m	0,30 m	
Pollution indexes												
Nitrates (NO_3^-)	mg/kg	<20.0	24,7	<20.0	26,7	<20.0	24,8	33,1	<20.0	28,3	<20.0	-
Nitrites (NO_2^-)	mg/kg	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	-
Orthophosphate (PO4-P)	mg/kg	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0	-
Total hydrocarbons C10-C40	mg/kg	<15.0	26,1	<15.0	91,3	<15.0	<15.0	<15.0	36,2	20,9	17,1	-
Polycyclic Aromatic Hydrocarbons PAHs	mg/kg	<0.05	<0.05	<0.05	0,34	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
Organophosphate pesticides	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-
Organichlorinated pesticides	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Heavy Metals												
Antimony (Sb)	mg/kg	<1.00	1,16	<1.00	<1.00	1,58	2,21	1,86	1,68	<1.00	1,47	3 (Dutch regulation)-
Arsenic (As)	mg/kg	<1.00	1,84	1,4	2,14	1,39	2,48	2,33	2,93	1,7	1,46	30 (US EPA)
Barium (Ba)	mg/kg	22	34,1	35,5	42,8	27,5	34,4	44,8	52,8	32,1	35,4	160 (Dutch regulation)
Cadmium (Cd)	mg/kg	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	98 (US EPA)
Calcium (Ca)	mg/kg	669	773	616	1880	1060	784	1050	907	1690	864	-
Chromium (Cr)	mg/kg	14,9	22,5	17,8	26,4	20,5	31,4	23,9	32,3	16,6	18,3	
Copper (Cu)	mg/kg	<5.00	5,62	5,65	9,47	5,85	7,22	7,92	9,94	<5.00	5,39	4700 (US EPA)
Iron (Fe)	mg/kg	8810	15200	12000	46400	13600	23600	18400	26300	9380	11300	-
Lead (Pb)	mg/kg	6,8	10,1	7,86	10,5	7,87	11,7	12,7	15,1	9,04	9,5	800 (US EPA)
Magnesium (Mg)	mg/kg	272	387	257	412	260	340	364	402	269	246	-
Manganese (Mn)	mg/kg	274	330	501	644	371	413	615	625	443	476	-
Mercury (Hg)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	4.6 (US EPA)
Molybdenum (Mo)	mg/kg	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	1,12	<1.00	<1.00	
Nickel (Ni)	mg/kg	4,26	7,18	5,02	7,51	4,82	6,91	4,99	9,29	4,55	5,5	1 200 (US EPA)
Phosphorus (P)	mg/kg	108	118	151	180	161	169	177	186	161	151	-
Potassium (K)	mg/kg	100	125	152	180	152	149	209	196	249	220	-
Selenium (Se)	mg/kg	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	0.7 (Dutch regulation)-
Zinc (Zn)	mg/kg	11,8	18,4	35,6	29,4	111	171	143	215	476	365	35000 (US EPA)

Parameters	Units	Results										Target values (1)
		PS-17		PS-18		PS-20						
		0,15 m	0,30 m	0,15 m	0,30 m	0,15 m	0,30 m					
Pollution indexes												
Nitrates (NO_3^-)	mg/kg	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0					-
Nitrites (NO_2^-)	mg/kg	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0					-
Orthophosphate (PO4-P)	mg/kg	<20.0	<20.0	<20.0	<20.0	<20.0	<20.0					-
Total hydrocarbons C10-C40	mg/kg	20,7	<15.0	<15.0	<15.0	15,7	19,9					-
Polycyclic Aromatic Hydrocarbons PAHs	mg/kg	<0.05	0,062	<0.05	<0.05	<0.05	<0.05					-
Organophosphate pesticides	mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05					-
Organichlorinated pesticides	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					-
Heavy Metals												
Antimony (Sb)	mg/kg	<1.00	<1.00	<1.00	<1.00	<1.00	1,08					3 (Dutch regulation)-
Arsenic (As)	mg/kg	<1.00	<1.00	<1.00	<1.00	1,18	1,54					30 (US EPA)
Barium (Ba)	mg/kg	14	5,63	16,1	28,8	63,2	59,2					160 (Dutch regulation)
Cadmium (Cd)	mg/kg	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40					98 (US EPA)
Calcium (Ca)	mg/kg	3340	1820	576	1040	2240	1890					-
Chromium (Cr)	mg/kg	5,03	<5.00	12,4	13,2	19,1	19,4					
Copper (Cu)	mg/kg	<5.00	<5.00	<5.00	<5.02	<5.00	<5.00					4700 (US EPA)
Iron (Fe)	mg/kg	1960	1330	4580	5400	9870	10800					-
Lead (Pb)	mg/kg	<5.00	<5.00	<5.00	5,96	8,71	11,3					800 (US EPA)
Magnesium (Mg)	mg/kg	204	87,3	201	389	974	918					-
Manganese (Mn)	mg/kg	124	61,8	131	322	928	488					-
Mercury (Hg)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10					4.6 (US EPA)
Molybdenum (Mo)	mg/kg	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00					
Nickel (Ni)	mg/kg	1,13	<1.00	2,87	4,23	6,92	6,73					1 200 (US EPA)
Phosphorus (P)	mg/kg	151	64,9	59,2	117	128	103					-
Potassium (K)	mg/kg	137	56,9	74,4	143	152	175					-
Selenium (Se)	mg/kg	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00					0.7 (Dutch regulation)-
Zinc (Zn)	mg/kg	29,2	19,1	28,1	120	347	521					35000 (US EPA)

(1) Groundwater Target Values and soil and groundwater Intervention Values, Soil remediation circular 2013 (Dutchland regulation) and RSLs (Regional Screening Levels) of the US EPA Region 9 (Western US Environmental Protection Agency) ,as international reference, See Section 2.5 .

5.4.2.1. Soil and topography sensitivity

The soil at PIA site is of reasonably good quality. Low levels of contamination, mainly with some fertilizers, but also isolated exceedances of heavy metals have been identified. As soil around PIA site is used mainly for agricultural activities, representing value to local communities and regional economy, its sensitivity is rated as **Minor**.

5.4.3. Hydrology

5.4.3.1. General hydrology

The south of Togo is drained by three main rivers (Mono, Zio and Haho), (see figure below) and smaller streams (Bokole chenal de, Gbaga and Elia, Lake Boko). Three main lagoon waterbodies are present:

- lake Togo,
- lake Boko and Aneho lagoon;
- permanent and/or temporary ponds also exist (DFC, 2007).

The lagoons of the maritime region are arranged in a continuous system from the outlet of the Zio at Devego to the Mono river serving as border between Togo and Benin. In this system, are the lake Togo, a large watercourse supplied by the Zio and Haho, and the Zowla and Aneho lagoons which communicate with the Atlantic Ocean at Aneho through an outlet permanently open since 1989.The available water reserves are constituted by the Zio river and the lagoon system. The managed lagoon of Lome is supplied by rainwater and runoff water and is connected to the sea by a diversion channel.

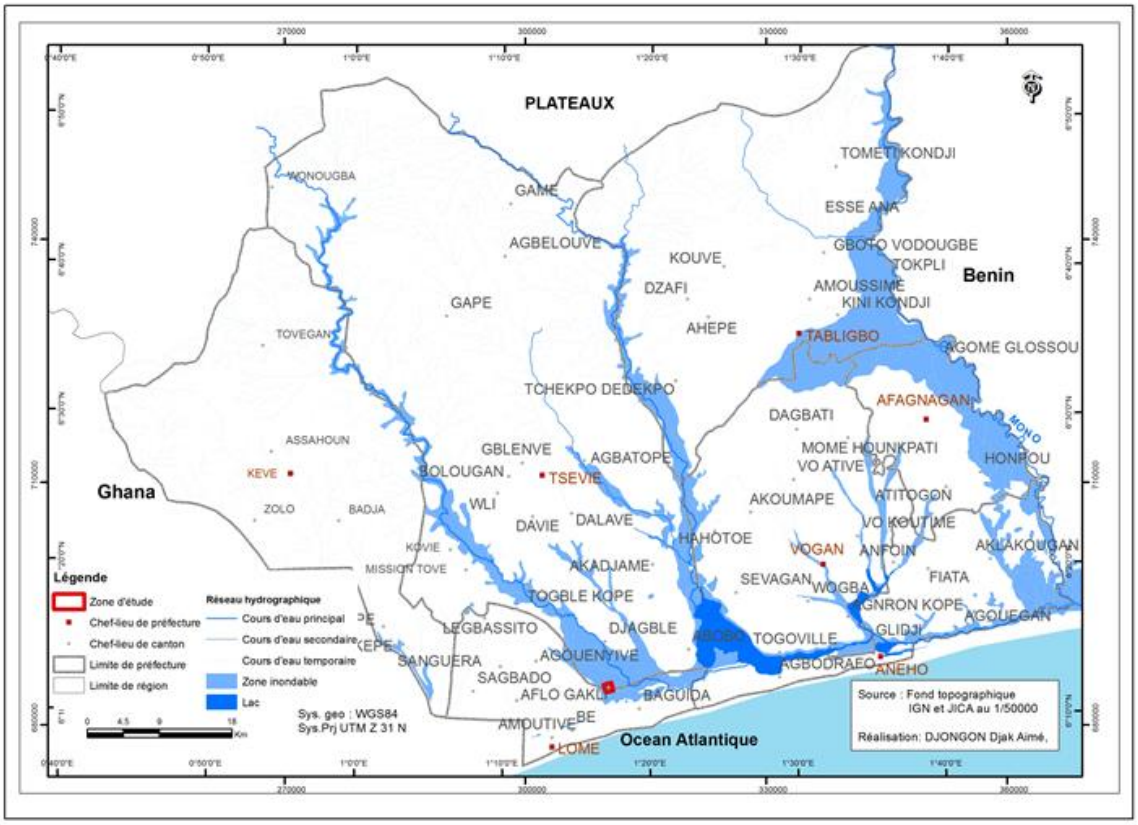


Figure 39 Hydrological map of South Togo

5.4.3.2. Hydrology of the Project area

The Project is located between the main courses of the Zio river, 8,5 km to the south- west, and the Haho river, 5 km to the east, as illustred on the following figures.

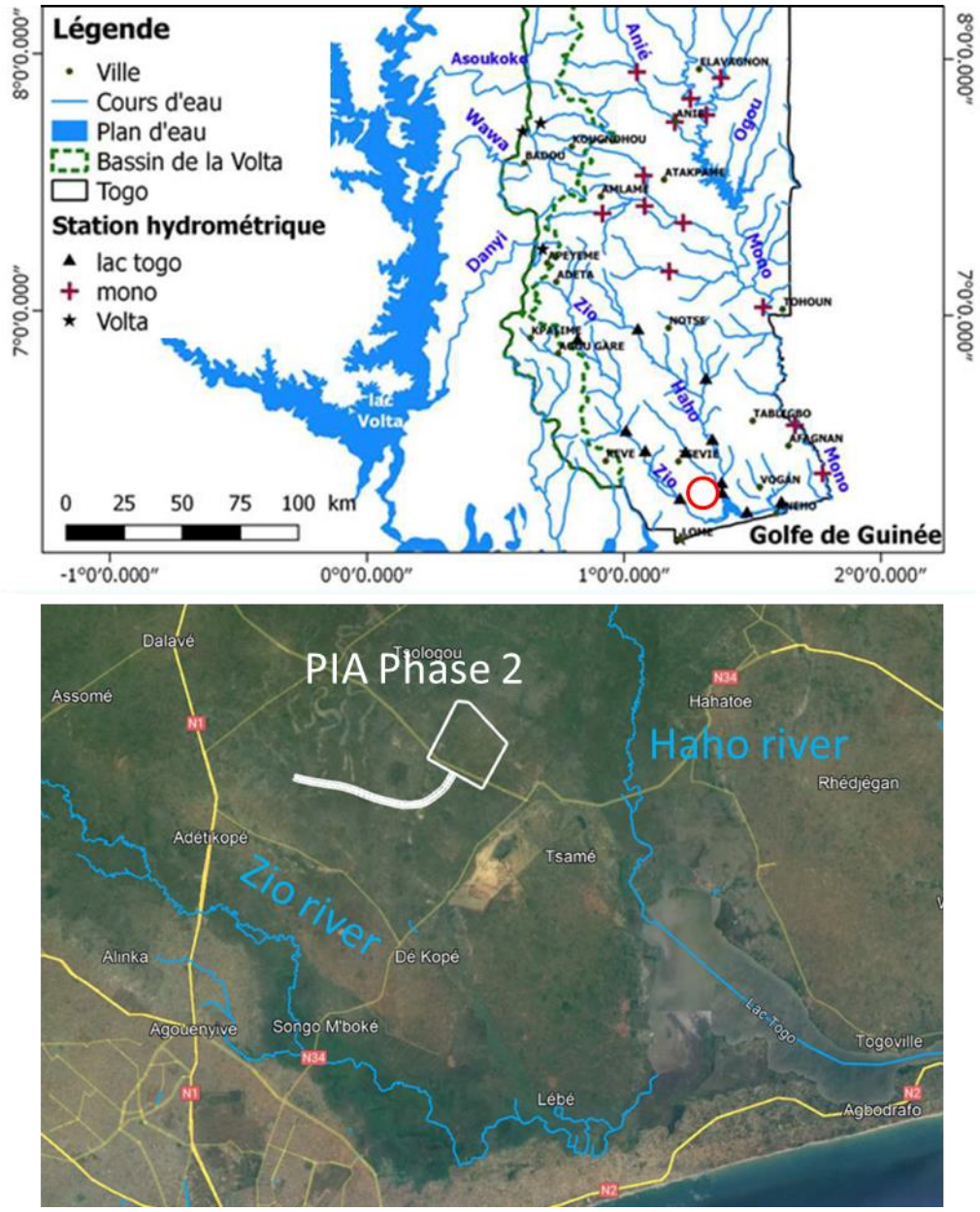


Figure 40 Hydrographic network of south of Togo and location of PIA Phase 2 are with reference to Zio and Haho rivers

The Zio River basin located to the north of the Project area is watered by the Zio River, whose main course length is approximately 195 km. Its depth varies from 4 to 5m and its width from 10 to 15m depending on the season. Its waters feed, at the end of the network, the coastal lagoon system located in coastal depressions and whose surrounding mudflats are colonized by mangrove vegetation (Guyot & al 1990). It is characterised by its flow rate and the permanence of its flow. The average interannual flow at the mouth is 9.9 m3/s.

Like the bimodal rainfall regime, the hydrological cycle of Zio has also shown a bimodal regime. The period of high water likely to generate floods is modelled on the months of June to October. A comparison between the rainfall regime and the monthly flow regime reveals that the high-water period is the one that integrates the two rainfall maxima. Inversely, the lowest water period corresponds to the part of the calendar year during which rainfall is less important.

Over a course of 139 km, the Haho River drains a watershed of 3549 km² oriented approximately north-west - south-east. The source is located at an altitude of 661 m on Mount Melindo. It has a fairly steep gradient, around 7%, for the first 5 km. Its slope then gradually decreases to become low on its lower reaches, Gati to the lake. Most of the basin is made up of ancient rocks. In the southern part, a little upstream of Gati, it crosses coastal sedimentary lands.

With a normal decreasing rainfall of about 1350 mm towards the source to about 900 mm towards the coastal zone, the basin receives an average annual water slide of about 1090 mm (Source: Hydrological yearbook of Togo: year 1961).

The Haho is subject to a two-season rainy regime very similar to an equatorial regime, and it generally has two annual crests, the first in May, June or July and the second in September, October.

The flow control is ensured by the station located in Gati. This station is located under the bridge between the N4 and Tsévié Tabligbo. It has been operating since 1961. The only data sampled are the average daily flow values. Missing data (from 08/02/1961 to 31/12/2017) represent ~20% of the whole series.

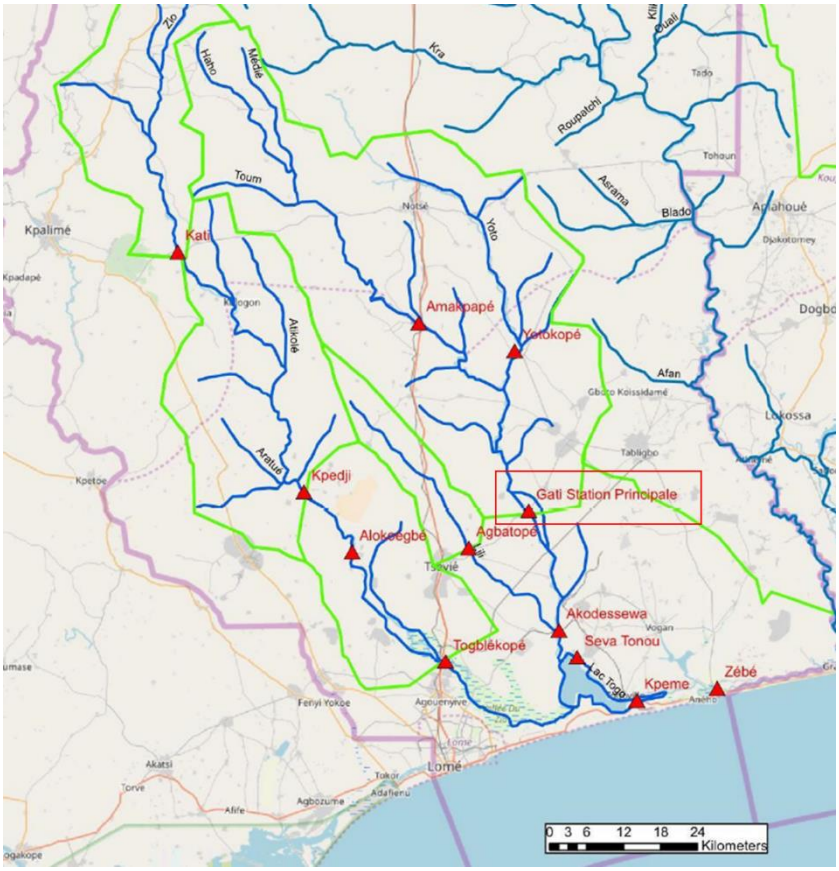


Figure 41 Location of the Gati measurement station (Source : SAFEGE, 1991)

The watershed drained at the Gati station measures 2560 km². According to the "Etude d'actualisation du plan directeur d'alimentation en eau potable de la ville de Lomé, SAFEGE 1991", the average daily flow measured at Gati is 5,3 m³/s. Low flow is 0,00 m3/s meaning that the Haho river is dry for at least 10 days in a row every year.

5.4.3.3. Quality of surface water

Four (4) samples of the surface water were collected and analysed.

The sampling stations are located on the figure below.

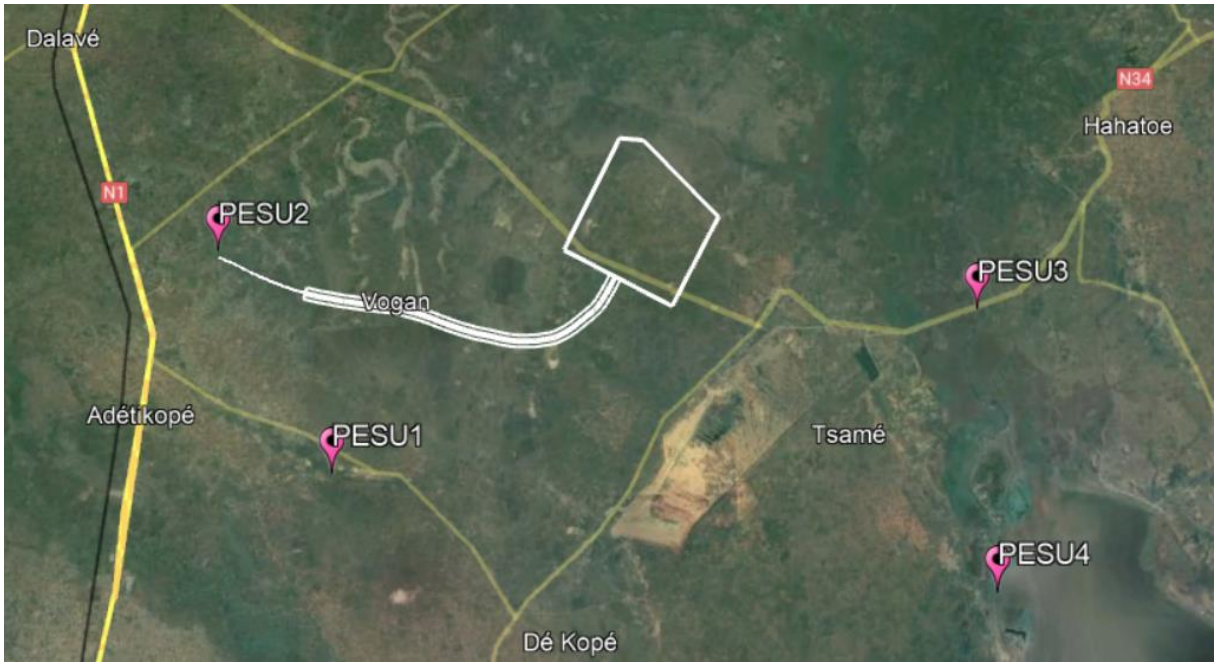


Figure 42 Surface Water (PESU) sampling points

The results are shown in the table below. Details of the analysis results are presented in Annexe V.

Table 37 Results of surface water analysis

Parameters	Units	Results			
		PESU-01	PESU-02	PESU-03	PESU-04
pH	µpH	7,3	7,8	7,2	7,3
Electrical conductivity at 25°C	µS/cm	378	1580	139	209
Dissolved solids	mg/l	22	29	190	100
Alkalinity (TA)	°f	<2.00	2,1	<2.00	<2.00
Complete Alkalinity (TAC)	°f	6,6	87	4,5	5,4
Carbonates (CO_3^{2-})	mg/l	<24.0	25,1	<24.0	<24.0
Bicarbonates (HCO_3^-)	mg/l	32,2	1010	5,61	17,2
Calcium (Ca)	mg/l	13,5	59,5	9,29	10,3
Magnesium (Mg)	mg/l	6,04	9,47	4,37	6,12
Sodium (NA)	mg/l	46,8	323	11,8	22,8
Potassium (K)	mg/l	8,05	18,3	3,86	4,99
Ammonium (NH_4^+)	mg/l	0,14	1,84	0,09	0,16
Nitrites (NO_2^-)	mg/l	<0.04	<0.04	<0.04	<0.04
Nitrates (NO_3^-)	mg/l	<1.00	<1.00	1,47	1,31
Chlorides (Cl^-)	mg/l	71,2	35,2	9,86	31,3
Sulphates (SO_4^{2-})	mg/l	12,3	9,44	11,3	8,63
Fluorides (F^-)	mg/l	0,25	0,59	0,12	0,12
Cyanides	µg/l	<10	39	<10	<10
Bromides (Br)	mg/l	0,2	3,3	<0.1	<0.1
Orthophosphates (PO_4^{3-})	mg/l	<0.10	6,73	0,2	0,22
Total Nitrogen (NT)	mg/l	1,22	4,02	2,34	2,4

Parameters	Units	Results			
		PESU-01	PESU-02	PESU-03	PESU-04
Kjeldahl Nitrogen	mg N/l	1,1	3,9	2	2,1
Total Phosphorus (PT)	mg/l	0,03	8,35	0,29	0,4
Chemical O_2 Demand (COD)	mgO_2/l	11	28	7,7	12
Total hydrocarbons C10-C40	mg/l	<0.03	<0.03	<0.03	<0.03
Arsenic (As)	µg/l	0,83	4,32	0,49	0,59
Total iron (Fe)	mg/l	0,88	2,94	1,61	1,9
Manganese (Mn)	µg/l	43,9	750	139	107
Cadmium (Cd)	µg/l	<0.20	<0.20	<0.20	<0.20
Lead (Pb)	µg/l	0,75	<0.50	2,25	2,33
Chromium (Cr)	µg/l	<0.50	0,73	2,09	2,5
Cobalt (Co)	µg/l	0,22	1,35	2,08	1,78
Copper (Cu)	µg/l	0,66	<0.50	5,89	6,08
Nickel (Ni)	µg/l	<2.00	<2.00	7,2	7,4
Silver (Ag)	mg/l	<0.01	<0.01	<0.01	<0.01
Zinc (Zn)	µg/l	<5.00	<5.00	7,2	6,3

For all the sample, the iron concentration is quite high. These results are coherent to those of the samples collected for Phase 1 investigations. The high content ferritic rocks and soils in the country could explain these levels. Presence of manganese in PESU-02 could indicate industrial pollution that is corroborated by the high electrical conductivity of the same sample.

5.4.3.4. Hydrology sensitivity

Surface waters are not commonly used for drinking and domestic purposes in the study area, and are polluted by uncontrolled local sanitary effluents and waste disposal. However, the possibility of a connection between the surface waters and the shallow aquifers used by populations cannot be excluded (Cf. 5.4.4). Surface waters sensitivity is rated as **Minor**.

5.4.4. Hydrogeology

5.4.4.1. Aquifers in the Project area

In the sedimentary formations of the coastal basin, there are three aquifer horizons. They differ by the nature of the reservoir rock and by hydraulic loads. These are from bottom to top:

- the captive aquifer of the Upper Cretaceous sands and limestones, commonly known as the Maastrichtian aquifer. It appears as a geological unit made up of marly black clays which are generally considered to be not very permeable. In the project area it seems to be the most productive: approximately 70 m3/h. The estimated depth of the groundwater table is around 150 m deep, and the estimated thickness of aquifer is 30 to 40 m. This aquifer is the main targeted water source for the Project.
- the captive aquifer of Palaeocene limestones and sands: the reservoir is composed by fractured white limestones from 5 to 10 m thick, constituting a captive aquifer layer of good hydraulic permeability. These limestones sometimes also rest directly on fine sands, increasing the reservoir capacity.

- the unconfined aquifer of the sands and gravels of the Continental Terminal (Eocene to present): although the permeable parts of this formation are discontinuous, and its permeability is quite variable. It is the most exploited and the most productive aquifer (flows can reach 200 m³/h with reasonable drawdowns). It is also the best-known aquifer in the coastal sedimentary basin because it is shallower and therefore more accessible. However, the water table is quantitatively depleted and qualitatively degraded continuously. Due to its unconfined nature, it is quite vulnerable to surface pollution

Geological data indicates connectivity between the Paleocene and Continental terminal aquifers. While the Maastrichtian aquifer appears to be isolated from these, it is possible that locally it might be connected to the Paleocene aquifer. Thus, the hypothesis of an interconnection between the unconfined, overexploited aquifer of the Continental Terminal and the Maastrichtian cannot be excluded. Only a pumping test and a long term piezometric study could confirm (or infirm) the existence of such connection.

A hydrogeological study carried out on the aquifers around Lomé in 2018 (Agbewornu, 2018) indicates that "a drop in the piezometric level and a deterioration in the quality of the Continental Terminal" is leading to the situation in which this aquifer is coming close to its exploitation limit. The same decline was observed in the Paleocene horizon. This overexploitation has consequences for operating wells in the region, where the higher levels of groundwater drawdowns change the dynamics of the aquifer, by favoring marine saline intrusions. Only the Maastrichtian aquifer seems to be relatively stable in 2018, however the productive areas seem to be already well exploited, especially at Lomé. Around Lomé, geology and aquifer parameters are relatively similar to the geological setting observed in Adétikopé.

All three aquifers are used for water supply in the Project area of influence by the Togolese Water Company (TdE), industries and by private boreholes for all major type of uses: drinking, irrigation and industrial which can create competition between users. Main water consumption in 2018 (last actualized available data) are summarized in 20. Tsevie is the closest city, so withdrawal in this city could have a direct impact on the project, but water withdrawn by the TdE near Adétikopé is also used to provide water for Lomé and the main consuming cities in the region. This is particularly true for the Maastrichtian aquifer, exploited by the TdE in Adétikopé.

Main water consumptions in 2018 (last actualized available data) are summarized in Table 38.

Table 38 Main city groundwater consumption in the area

Main groundwater dependent city in the region	Volume of groundwater abstracted (m3/yr)	Distance from the city to PIA Phase 2 (km) Approx
Lomé	13 873 129	27
Tabligo	893 454	34
Tsevie	656 564	14
Aneho	160 541	32
Vogan	100 310	23

The following table shows the actual amount of water abstracted by different user. In the targeted Maastrichtian aquifer, Togolaise des Eaux (TdE), municipal water provider, is the main user. They have wells reaching the Maastrichtian in Lomé, but also near Adétikopé. Maastrichtian water is used by the TdE as a water supply for both Adétikopé and Lomé.

Main cities water consumption comes from all three aquifers. But detailed repartition is not available.

Table 39 Amount of groundwater abstracted by aquifer and by user

Aquifer	TdE (Mm3/yr)	Industry and private boreholes (Mm3/yr)	Rurally (Mm3/yr)	Total (Mm3/yr)
Continental Terminal	10.6	4.3	1.7	16.6
Paleocene	3.3	4.7	1.0	9
Maastrichtian	4.2	2.0	0.4	6.6

Estimated aquifer capacities are summarized here below. Groundwater withdrawal in the Continental Terminal is higher than the actual capacity. This aquifer is highly over-used. For the Maastrichtian, the aquifer is used at 50% of capacity. PIA Phase I and Phase II will increase the stress on the aquifer.

Table 40 Aquifer capacity in regard to total groundwater removal in the region

Aquifer	Capacity (Mm3/yr)	Total abstracted groundwater (Mm3/yr)
Continental Terminal	12	16.6
Paleocene	ND	9
Maastrichtian	13	6.6

All quantified data presented above are from 2018 (Agbewornu 2018).

The figure below shows the location of the wells visited during the survey conducted in August 2021 nearby the Project site. Final results of the study are shown in Annexe XII. During field survey, 3 types of aquifers were noted. We decided to implement raw data in our location map to avoid any uncertainty due to misinterpretation. “Eocene-Paleocene” was used when no strict analysis could confirm if the reservoir is of Paleocene age (Paleocene aquifer) or of Eocene age (Continental Terminal aquifer).

Based on the information gathered, all three aquifers are exploited, with the Continental Terminal aquifer being the one most commonly used by local communities without access to public water supplies. Understanding if and how the two upper aquifers are connected to the Maastrichtian aquifer will be key in evaluating the project’s impact. Connections need to be characterized in order to assess impacts on other aquifers, users and the potential influence on PIA Phase I.

Indeed, to supply water to the project, 6 borewells are planned drawing water from the Maastrichtian aquifer at a 65 m^3/h pumping rate.

Figure 43 Investigated wells in the area of PIA Phase 2 site (Source : Antea, 2022)

5.4.4.2. Quality of groundwater

Three (3) samplings and groundwater analysis were carried out.

The sampling stations are located on the figure below.

Figure 44 Groundwater (PESO) sampling points

The results of the analyses are presented in the table below. Details of the analysis results are presented in Annexe V.

Table 41 Results of groundwater analysis

Parameters	Units	Results			Decree n°2012 - 258/PR of Octobre 17, 2012	WHO (2017)
		PESO-01	PESO-02	PESO-03		
Physico-chimicals						
pH	µpH	5,3	6,6	7,6	6,5-9,5	-
Electrical conductivity at 25°C	µS/cm	1080	395	668	>180 et < 1100	-
Dissolved solids	mg/l	<2.0	<2.0	<2.0	-	-
Alkalinity (TA)	°f	<2.00	<2.00	<2.00	-	-
Complete Alkalinity (TAC)	°f	<2.00	2,7	25,7	-	-

Parameters	Units	Results			Decree n°2012 - 258/PR of Octobre 17, 2012	WHO (2017)
		PESO-01	PESO-02	PESO-03		
Carbonates (CO_3^{2-})	mg/l	0	<7.92	<24.0	-	-
Bicarbonates (HCO_3^-)	mg/l	0	0	265	-	-
Calcium (Ca)	mg/l	33,8	16	79,5	-	-
Magnesium (Mg)	mg/l	20,9	5,7	19,9	-	-
Sodium (NA)	mg/l	128	45,3	29,2	200	-
Potassium (K)	mg/l	1,36	0,64	6,59	-	-
Ammonium (NH_4^+)	mg/l	<0.05	<0.05	0,1	0,5	-
Nitrites (NO_2^-)	mg/l	<0.04	<0.04	<0.04	3	3
Nitrates (NO_3^-)	mg/l	3,8	<1.00	<1.00	50	50
Chlorides (Cl^-)	mg/l	323	99,6	54,8	250	-
Sulphates (SO_4^{2-})	mg/l	27,7	<5.00	23,3	500	-
Fluorides (F^-)	mg/l	<0.1	<0.1	0,29	1,5	1,5
Cyanides	µg/l	<10	<10	<10	-	-
Bromides (Br)	mg/l	0,8	0,2	0,2	-	-
Orthophosphates (PO_4^{3-})	mg/l	<0.10	<0.10	<0.10	-	-
Total Nitrogen (NT)	mg/l	1,46	0,12	0,72	-	-
Kjeldahl Nitrogen	mg N/l	0,6	<0.5	0,6	-	-
Total Phosphorus (PT)	mg/l	<0.01	<0.01	<0.01	-	-
Chemical O_2 Demand (COD)	mgO_2/l	1,6	1	0,9	-	-
Total hydrocarbons C10-C40	mg/l	<0.03	<0.03	<0.03	-	-
Heavy metals						
Arsenic (As)	µg/l	<0.20	<0.20	<0.20	10	10
Total iron (Fe)	mg/l	0,01	0,02	0,03	0,3	-
Manganese (Mn)	µg/l	17	12,2	4,26	500	-
Cadmium (Cd)	µg/l	<0.20	<0.20	<0.20	3	3
Lead (Pb)	µg/l	4	<0.50	<0.50	10	10
Chromium (Cr)	µg/l	<0.50	<0.50	<0.50	50	50
Cobalt (Co)	µg/l	2,13	2,07	<0.20	-	-
Copper (Cu)	µg/l	58,7	3,61	<0.50	2000	2000
Nickel (Ni)	µg/l	5,9	2,8	<2.00	20	70
Silver (Ag)	mg/l	<0.01	<0.01	<0.01	-	-
Zinc (Zn)	µg/l	111	13,4	<5.00	3000	-

The main concern of this analysis is the highly acid pH of sample PESO-01 and its high salinity. The sampled well is labelled as industrial purpose, though it is in the Continental Terminal aquifer and surrounding wells in the area are used for personal purposes. It raises concern regarding the quality of water population have access too.

If we have a closer look at the chemistry of all sampled water (figure below), we can see that all surface water (PES4) is quite well balanced and in the same range. Samples from Continental Terminal and Palaeocene aquifers have the same signature and are very similar, meaning the same water source for these aquifers. A connection between the aquifers exists, despite the long distance between the two well sampled: PESO-02 is on site, while PESO-01 is in town. A proper pumping test and examination of the connectivity between the Maastrichtian and the Palaeocene aquifers must be conducted to be understand the level of impact from the Project on Palaeocene and potentially Continental Terminal

aquifers. PESO-03, in the east of the area have a completely different chemistry, meaning that the water in this aquifer is not connected to the other ones. It was noted as “Eocene-Paleocene”, it would be interesting to know which aquifer it belongs to: Continental Terminal or Paleocene. In any case it might indicate the existence of an impermeable barrier between the eastern part of the PIA Phase II project and the western side (including PIA Phase I).

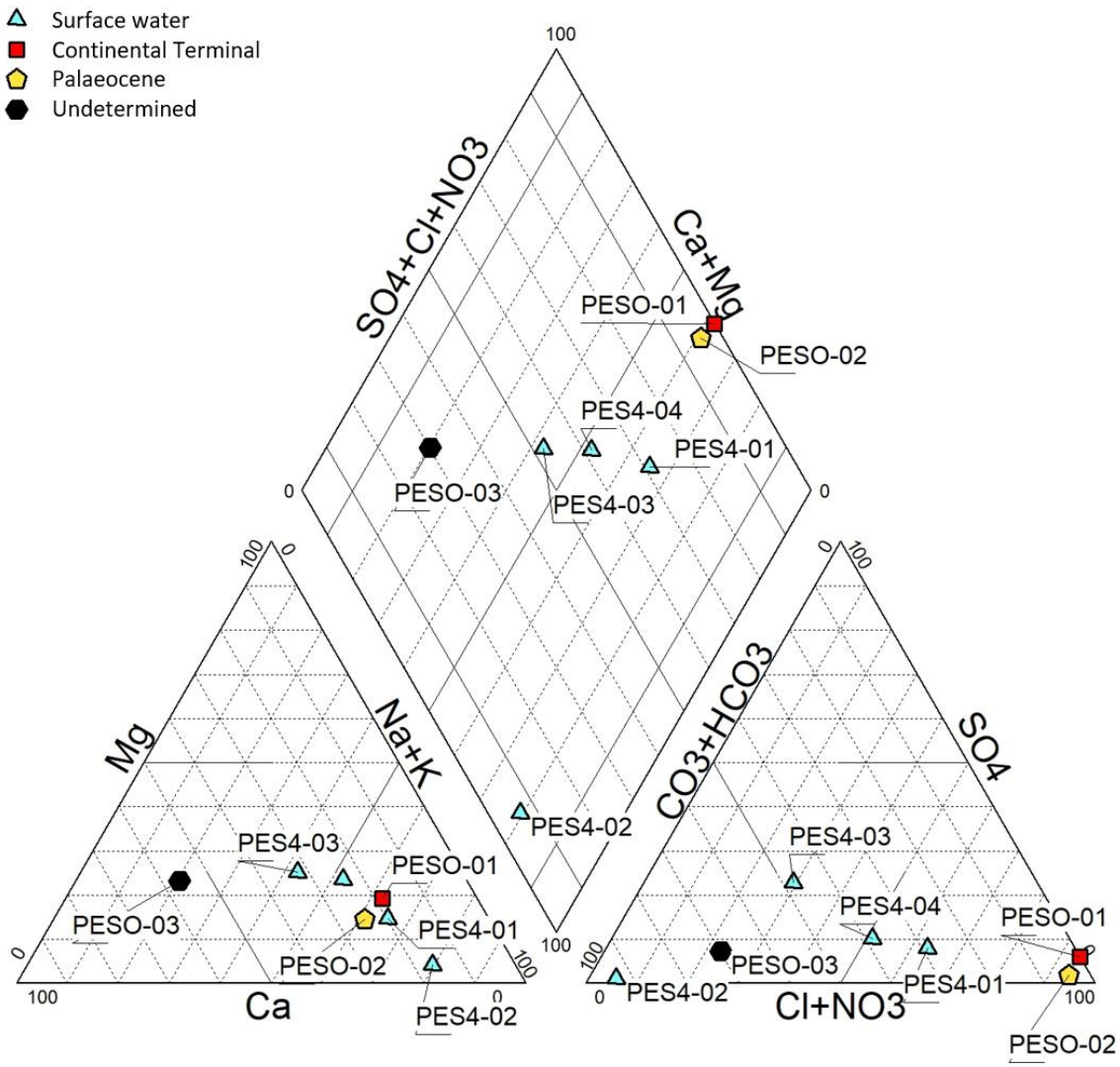


Figure 45 Piper diagramm of both surface and groundwater samples

5.4.4.3. Hydrogeology sensitivity

All aquifers within the Project AoI have high value as they are heavily relied upon for water supply by all users (national water company, industries, and communities). These aquifers are under pressure and to some extent already overexploited. The Maastrichtian aquifer targeted by the Project is a deep horizon not easily accessible by rural community and small/medium businesses. At least 50% of its capacity is utilized, although some users might be unaccounted.

Maastrichtian aquifer water quality has low vulnerability due to it’s depth and protection by multiple geological formations.Uncertainties remain concerning the connectivity of these aquifers.

Due to lack of knowledge concerning the potential interconnections among horizons and adopting a precautionary approach, the groundwater sensitivity is considered to be **moderate**. The sensitivity of this aquifer may change (minor or major) with time and based on the findings of additional hydrogeological studies that will allow a better knowledge of the groundwater resource.

5.4.5. Air quality

In the site's environment, sources of emissions that could affect air quality are identified at the municipal level. These are among others :

- practices of burning vegetation or waste,
- Industries, such as Diamond Cement Togo (DCT), DO-PHARMA serum production plant (Dzogblakopé), or SNB, VOLTIC, etc.
- traffic on the RN34.

Air quality measurements were carried out on the site and in its immediate vicinity to determine the reference situation. The parameters of volatile organic compounds, ozone, nitrous and sulphurous oxides were measured over a period of four weeks (24/09/2021 to 25/10/2021).

The sampling was carried out using Radiello absorbent tubes. The elements are absorbed in the field, following exposure of the absorber tubes to the air. A weather shelter was designed to protect tubes from unfavorable weather conditions. These absorbed elements were then dissolved in a solution for laboratory analysis.

Figure 46 Air quality measurement points

Figure 47 Measurement equipment and installation

5.4.5.1. Dust measurement results

Dust measurements have been carried out using DUSMATE and TEMPOTOP Air quality monitor M2000 equipment. These devices are designed for the automatic sampling and analysis of particulate matter concentrations in the air. They allow direct reading of the concentration of the targeted particles (µg / m3 or ppm) with a measurement range of 0 to 10000ppm. The devices have been placed at 1,5 to 3 m from the ground and away from any obstacle that could affect the air circulation.

Measurements have been carried out over a period of 3 hours under weak wind conditions with a temperature between 34 and 41 °C, during the day and during the night.

The results of the dust measurements are presented in the table below:

Table 42 Results of dust measurements

Point	PM	Average concentration (µg/m3)		IFC Threshold (µg/m3)
		Day	Night	
P1 AL	PM 2,5	11,0	10,2	25
	PM 10	15,7	14,2	50
P2 HPR	PM 2,5	13,4	24,8	25
	PM 10	18,1	35,9	50
P3 HMC	PM 2,5	14,0	35,2	25
	PM 10	18,4	50,2	50
P4 TA	PM 2,5	16,9	13,1	25
	PM 10	26,8	18,0	50
P5 KAA	PM 2,5	19,1	13,4	25
	PM 10	26,9	18,7	50
P6 KAV	PM 2,5	18,9	35,2	25
	PM 10	27,7	50,2	50

Environmental, health and safety guidelines, general EHS guidelines. IFC, 2007 (based on WHO 2005)

The particles considered in this measurement are PM2.5 and PM10. The results of the measurements carried out show that the IFC threshold concentration values were exceeded at P3 and P6 for both PM2.5 and PM10 but only during the night.

The variation of all the measurements, per each measurement point, is illustrated in the following figures.

We note that all the night measurements at PM3 (HMC) exceed the threshold value whereas PM6 (KAV) sees important fluctuations, with high peak values, resulting in a mean night value exceeding the IFC threshold. PM3 is located in the village of Hagblevou (house of the chief of the village), PM6 is located at the northern tip of the PIA Phase 2 area (Kpome Akadjame ville) in an area relatively free of agglomerations. Based on the variations observed, we can assume that the values at PM6 vere influenced by a source with a very irregular activity (not identified). The limited variations at PM3 suggest, on the opposite, the contribution of multiple sources affecting the quality of the air and resulting in the threshold exceedance.

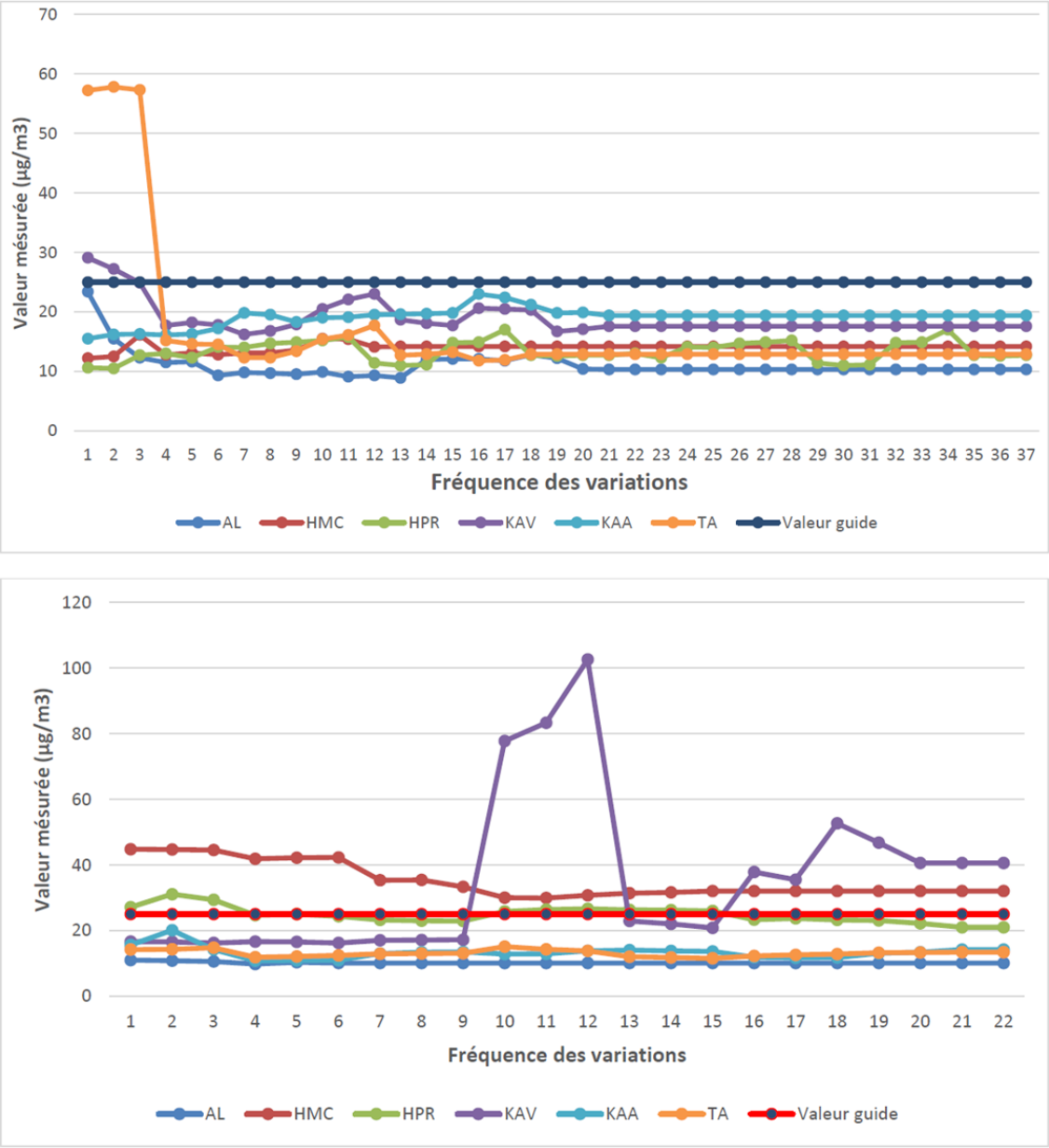
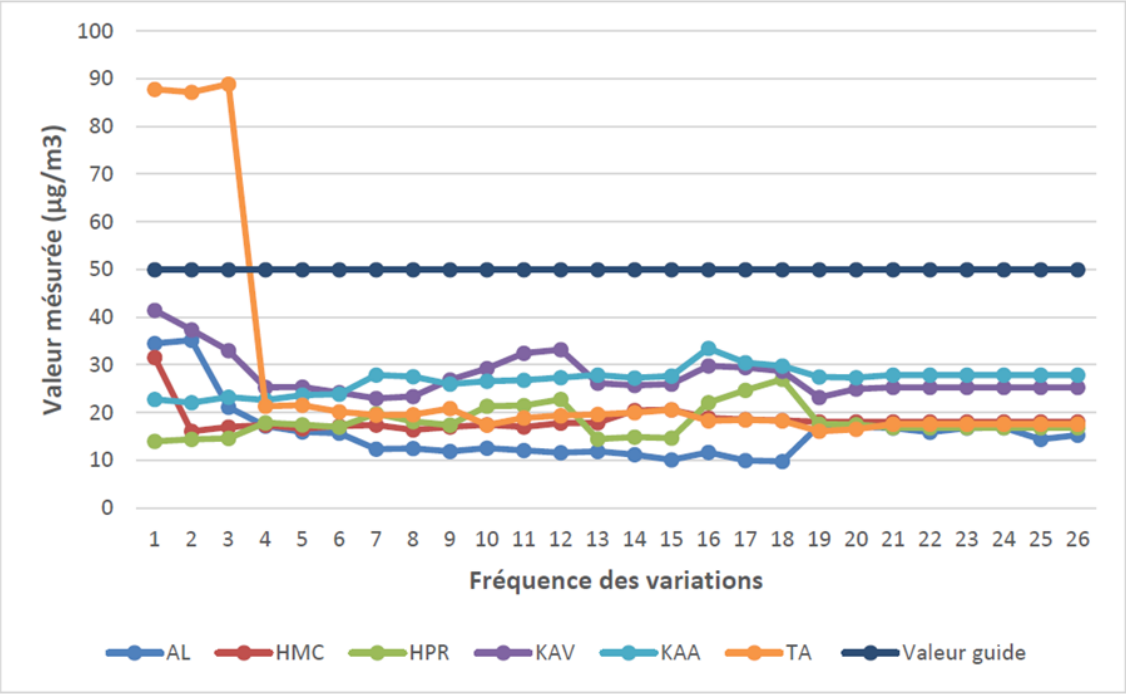


Figure 48 Variation of PM2.5 measurements – day (above) and night (below)

The following figures illustrate the variation of PM10 measurements.



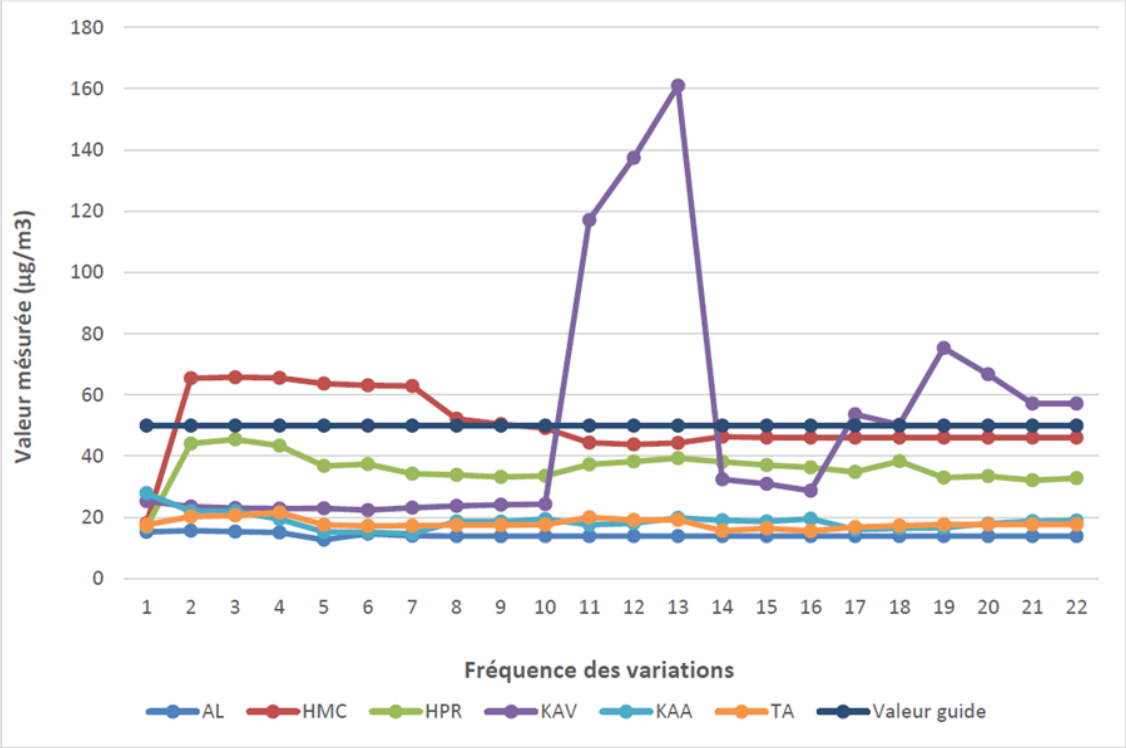


Figure 49 Variation of PM10 measurements – day (above) and night (below)

5.4.5.2. Results of air pollutant measurements

The following table presents the results of the measurements of air pollutants.

The analytical results for the parameters O_3, NO_2 and SO_2 are all below the IFC guidelines thresholds. No national regulations set a limit value for total VOCs in ambient air. However, the World Health Organization estimates that the concentrations of VOCs indoord should not exceed 1000 µg / m³. The

values of all the VOCs measured in the context of this study are considerably lower than the WHO threshold.

Table 43 Results of air quality measurements

Parameters / sampling	VOC (µg/m³)		O_3 (µg/m³)		NO_2 (µg/m³)		SO_2 (µg/m³)	
	Analysis	IFC threshold	Analysis	IFC threshold	Analysis	IFC threshold	Analysis	IFC threshold
P AIR 01	17,615	-	24,74	100	1,89	40	1,54	20
P AIR 02	18,342		24,58		Not detected		1,26	
P AIR 03	18,849		22,84		6,09		1,57	
P AIR 04	20,617		25,04		2,15		1,94	
P AIR 05	12,518		23,38		3,11		1,89	
P AIR 06	13,648		6,42		1,17		1,87	

Environmental, health and safety guidelines, general EHS guidelines. IFC, 2007 (based on WHO 2005)

5.4.5.1. Air sensitivity

The study area is only partly anthropized, characterized by low-intensity agricultural activities and low road traffic. There is no major source of degradation of air quality in the area (as confirmed by the results of air quality measures).

Sensitivity of air is rated as **Minor**.

5.4.6. Noise

The main sources of noise impacting the Project are:

- the traffic on the RN34,
- The activity of the existing industrial plants, such as Diamond Cement Togo (DCT), DO-PHARMA serum production plant (Dzogblakopé), or SNB, VOLTIC, etc
- Some construction activities

Noise level measurements were carried out on the site boundaries to characterize the baseline noise conditions of the study area. The 10 stations for noise measurements are illustrated below.

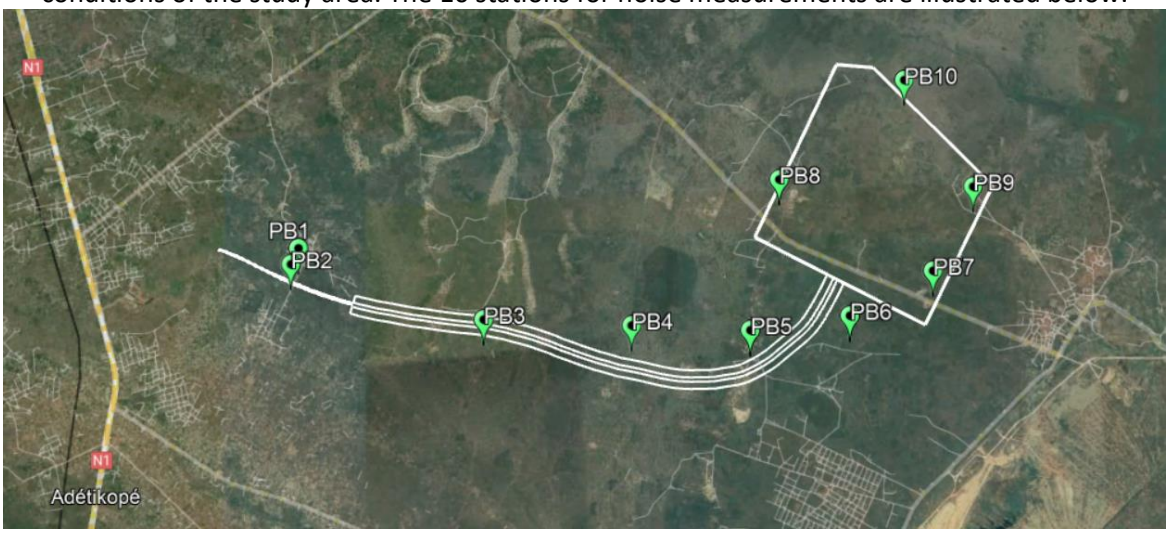


Figure 50 Environmental noise measurement points

According to IFC guidelines, noise levels should not exceed the levels presented in Table 8 (see section 2.5.2), or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

It's important to note that the threshold level depends on the type of the receptor (residential or industrial).

The results, exressed using the parameter LAeq, are presented in the table and figures below:

Table 44 Background noise measurements compared to IFC values

Station	Measured noise level (dBA)		IFC Guidelines dB(A)	
	Daytime 07:00 – 22:00	Nightime 22:00 – 07:00	Residential / institutional / educational Day/night	Industrial, commercial Day/night
PB1 (ARL1)	87,5	55,7	55 / 45	70 / 70
PB2 (ARL2)	83,2	60,9	55 / 45	70 / 70
PB3 (ALS)	96,6	44,6	55 / 45	70 / 70
PB4 (ZH)	70,1	40,3	55 / 45	70 / 70
PB5 (HEPP)	96,9	50,8	55 / 45	70 / 70
PB6 (ZHK)	96,8	58,4	55 / 45	70 / 70
PB7 (RDK)	89,5	56,3	55 / 45	70 / 70
PB8 (KAEPP)	74,3	60,3	55 / 45	70 / 70
PB9 (KAD)	73,3	47,7	55 / 45	70 / 70
PB10 (KA11)	73,5	56,4	55 / 45	70 / 70

All areas surrounding the site are residential areas, the IFC target value to be used as target are then 55 dBA during daytime and 45 dBA during nightime.

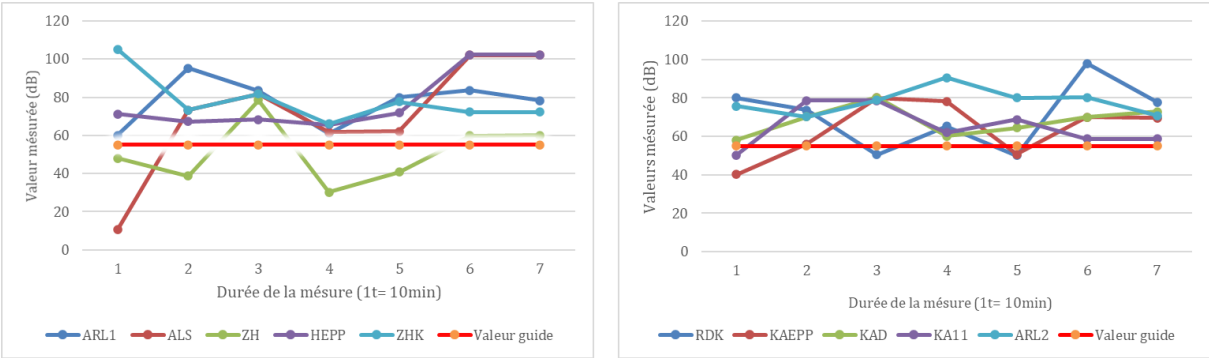


Figure 51 Daytime noise measurements results

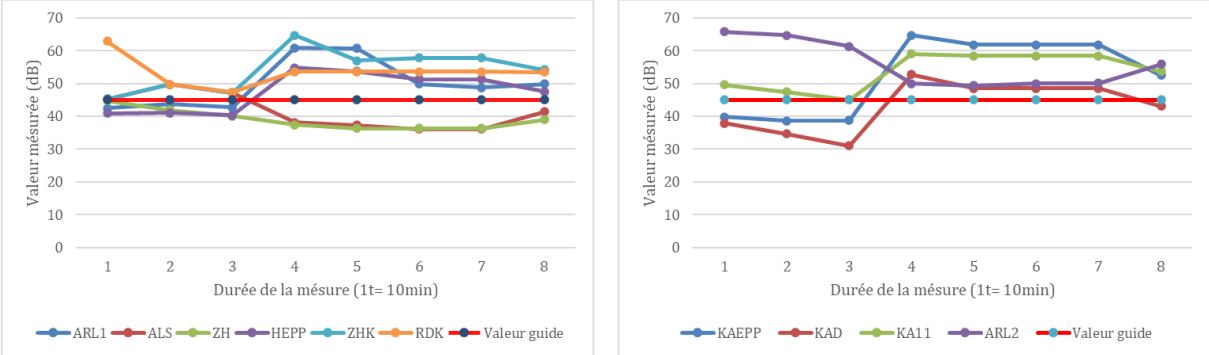


Figure 52 Night-time noise measurements results

The results of the measurements show an average noise level exceeding the IFC recommendation threshold values in residential areas. Measurement are below the threshold values only for 2 points during nighttime. These values describe a noise environment impacted by existing noise sources, among which are activities of the cement production plant, the traffic and other anthropogenic activities.

5.4.6.1. Noise sensitivity

The study area is only partly anthropized, characterized by low-intensity agricultural activities and road traffic. There are industrial and agricultural activities and road traffic that are already affecting the local amenity with noise levels significanly exceeding IFC thresholds.

Sensitivity of noise is rated as **Minor**.

5.4.7. Landscape

The landscape of the study area is characterized by a mosaic of fields and fallow land. The landscape interest of the site is low due to the absence of panoramic viewpoints or natural sites of tourist interest (lakes, waterfalls, etc.). The Project site does not have a unique or remarkable landscape character.

Examples of typical landscape that can be encountered in the project area, are provided in the following figures.

Figure 53 Typical Fallow land views with oil palms in the study area (Antea, 2021)

Figure 54 Typical Savannas views in the study area (Antea, 2021)

Figure 55 Manioc and corn fields in the study area (Antea, 2021)

Figure 56 Orange tree plantations in the study area (Antea, 2021)

Figure 57 Hamlets in the IZ area (Antea, 2021)

5.4.7.1. Landscape sensitivity

The landscape of the study area is characterized by mosaics of fields and fallow land. The landscape interest of the site and area of influence is poor due to the absence of panoramic viewpoints or natural

sites of tourist interest (lakes, waterfalls, etc.). The Project site does not have a unique or remarkable landscape character. Nevertheless, neighbourhood of PIA is mainly composed of residential areas and housing for which the current rural landscape represents an amenity value.

Sensitivity of landscape is rated as **Minor.**

5.4.8. Natural risks

5.4.8.1. Flood risk

According to the report of the United Nations Economic Commission for Africa 2015, "The assessment on the integration and implementation of disaster risk reduction measures in Togo", the following five hazards are considered major: floods, coastal erosion, landslides, wildfires and high winds. Given the projections of disproportionate consequences announced in the context of climate change, including the irregularity of the rainy seasons (heavy rain during the rainy seasons) that can cause flooding, adaptation measures and interventions must be taken into account for large projects.

It is within this framework that an evaluation has been carried out to produce assessment maps of the Project vulnerability to flooding.

The approach adopted for this scope is based on the following:

- A bibliographical search mainly consisting in consulting reference documents, maps, GIS database, satellite images, etc. on natural disasters in Togo ;
- A collection of information from different stakeholders, in particular key resourse persons (village chief, notables, residents) and site visits for the collection of geographic data with the GPS ;
- Data processing of satellite images;
- Mapping and interpretation of flood vulnerability maps.

The bibliographic search allowed to collect information on historical natural disasters in Togo. According to the previously mentioned UNECA report, Togo experienced 60 urban and rural floods, during the 1925 -2013 period.

According to the map of flood risk areas in the Maritime Region made by the Ministry of Environment and Forest Resources in 2013 (figure below), PIA Phase 2 is located at the edge of the low to moderate flood risk area of Haho river (flowing on the west of the project site). During a long rainy period, the area is likely to be partially affected by the flooding of the Haho river, situated 5 km to the east of PIA Phase 2. A tributary of the Haho river expands to the eastern part of PIA Phase 2, but it represents a temporary stream.

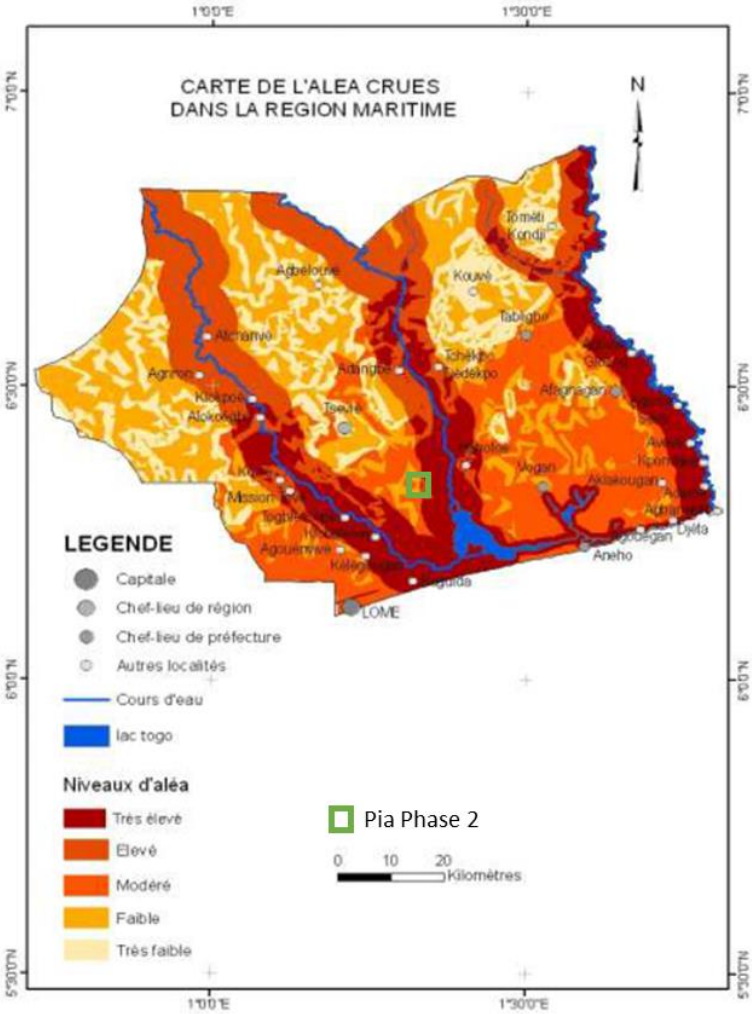


Figure 58 Map of flood risk areas in the Maritime Region (Ministry of Environment and Forest Resources, 2013)

According to the 2010 UNDP report, the above-normal high rainfall in 2010 caused exceptional flooding of the main rivers, notably the Mono, Zio and Haho rivers. Thus, due to certain factors of vulnerability to flooding and the rising water table, flooding occurred between June and October 2010 in certain localities, including PIA site.

A meeting has been organized with some key resource persons (village chief, notables, local residents) for the identification of flood zones on the ground. With their help, the team has been able to collect in the field the geographical coordinates of the boundaries of areas flooded during rainy periods using GPS. The meeting with the chief of the village of Lomégnomkopé made it possible to carry out the historical background of the flood periods known in the zone.

A cartographic study was realized in order to assess flood risk for the project. The study is based on the data processing of the geographical coordinates collected in the field, the Landsat 8 satellite images and the Digital Terrain Model MNT-30, which allowed the development of maps of flood-prone areas for three distinct seasonal scenarios:

- During the dry period (December to April and early August) only the 20 to 25 meters band on either side of the riverbeds remain flooded. This area is therefore mapped as a very vulnerable area to flooding
- During the rainy season (May, June, July and sometimes end of August and September), the flooded area can spread over 80 to 100 meters from the riverbed. The water height can reach 1 meter in some areas (Figure 59). During this period, only a small part ofPIA Phase 2 may be

affected by floodings as show in Figure 60This scenario represents the case of a major disaster that may affect the entire south of Togo.

- During intense rainfall periods large floods of the Zio or Haho rivers occur, and as shown on the flood risk map (Ministry of Environment and Forest Resources, 2013) the flooded areas may extent to over 200 m from the riverbed.

Figure 59 Height reached by the water during the flood of the rainy period (Source : Antea, 2021)

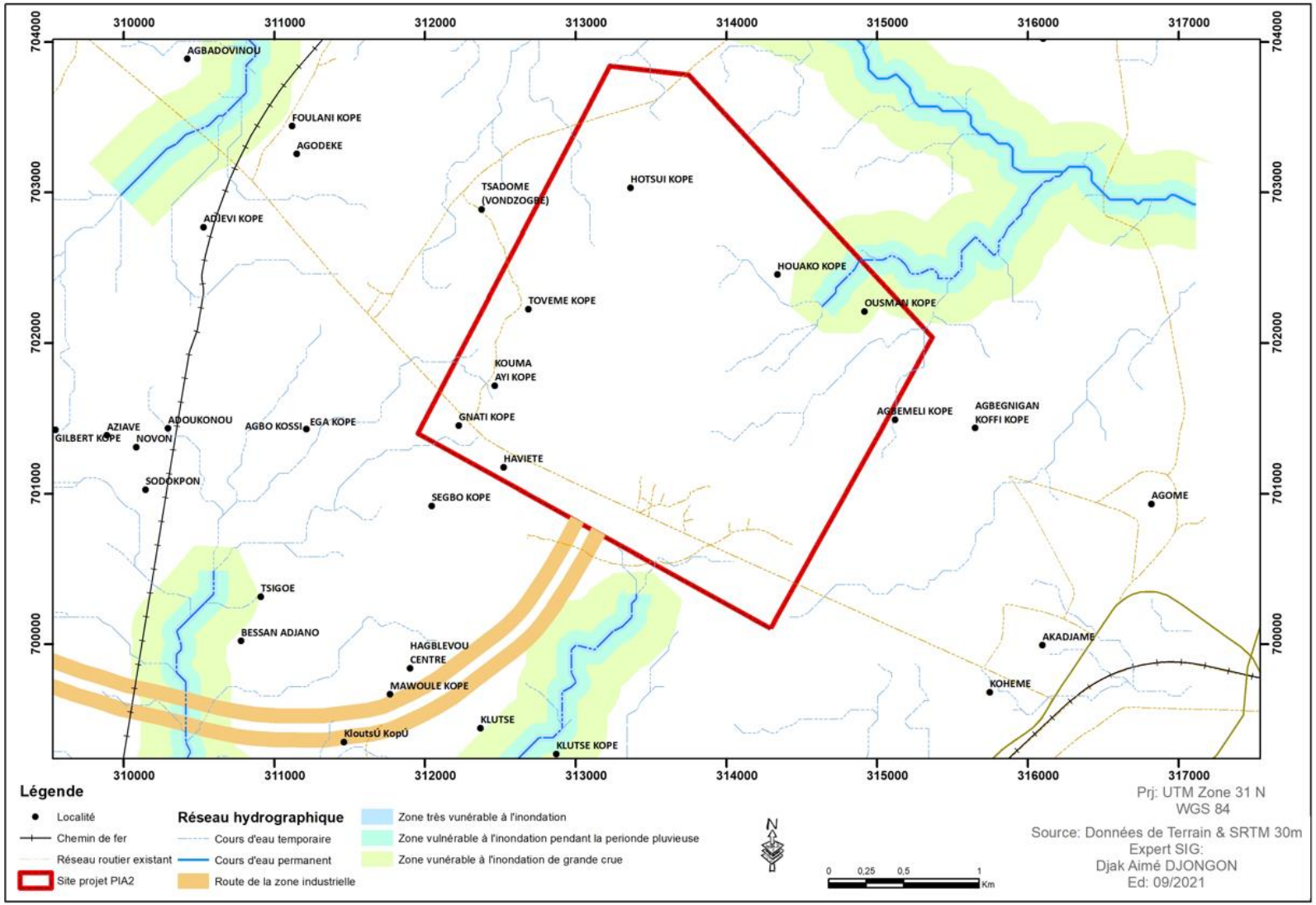


Figure 60 Flood-risk zones in the Project area

The area, being located upstream of the tributaries (secondary streams) of the Haho and Zio rivers, it therefore is not significantly exposed to the flood risk, but for exceptional events during intense rainfall periods large floods of the Zio or Haho rivers.

The map shows that the eastern tip of the Phase 2 (in the area where the solar farm will be located) will be crossed by the upper segment of a tributary of the Haho river. The upper segment of a tributary of the Zio river will cross the Industrial Corridor and the road connecting Phase 1 to Phase 2. According to the evaluations that have been carried out, ~31 ha may be flooded in case of a large flooding of the Haho river, while ~8 ha may be flooded during a typical rainy season. Hence, the drainage system for the solar park shall be adeuquately designed.

Currently, most of the Project area wet zones are covered with vegetation, allowing for infiltration and natural drainage. Hence, the construction of the site may affect the natural flows. A proper system for the management of stormwater (for instance consider infiltration of stormwater rather than the retention and discharge of runoff , and also consider adequate sizing of the rainwater bassin based on estimates of major flood flows and wastewater treatment capacities) will be necessary to prevent any possible damage to villages and or agglomerations located downstream to PIA Phase 2.

As for the Industrial Corridor, the natural flow conditions of the identified tributary will need to be preserved to allow the crossing without impacts on the project.

A stormwater drainage system is planned for the connecting road and industrial corridor. It will be similar to PIA Phase 2 drainage system.

5.5. Natural environment

5.5.1. Overview of the natural environment

5.5.1.1. Biogeographic context

The study area is located in the maritime region of Togo, more precisely in the prefecture of Agoe. Biogeographically, it is part of ecological zone 5 or zone of the coastal plains of Togo (Ern, 1979). The original vegetation is greatly affected by human activities. The vegetation is a mosaic of fallow fields (Batawila, 1997) dotted with a few islands of sacred forests (Kokou & Caballé, 2000; Kokou et al., 2005). There are also grassy savannas, forests / swamp savannas, especially in the south-east of the area (Amegnaglo et al., 2018b).

5.5.1.2. Protected areas

The forest of Bayémé, whose location is shown on the figure below, is a classified forest and is part of the national forest heritage, (decree N ° 19 / EF of April 18, 1948). It covers an area of 159,53 ha. Today, the authorities in charge of the forest management are witnessing the degradation of this forest , which has almost been replaced by dwellings. In the name of an ongoing rehousing policy 90 ha of this forest have been destroyed.

Due to its location, roughly 12 km west of the Pproject area, the Bayémé forest is not expected to be directly or indirectly affected by the Project. No cumulative impacts are expected either. As such, the classified forest of Bayémé is considered to be out of the scope of this ESIA and is not retained as a receptor in the present study.

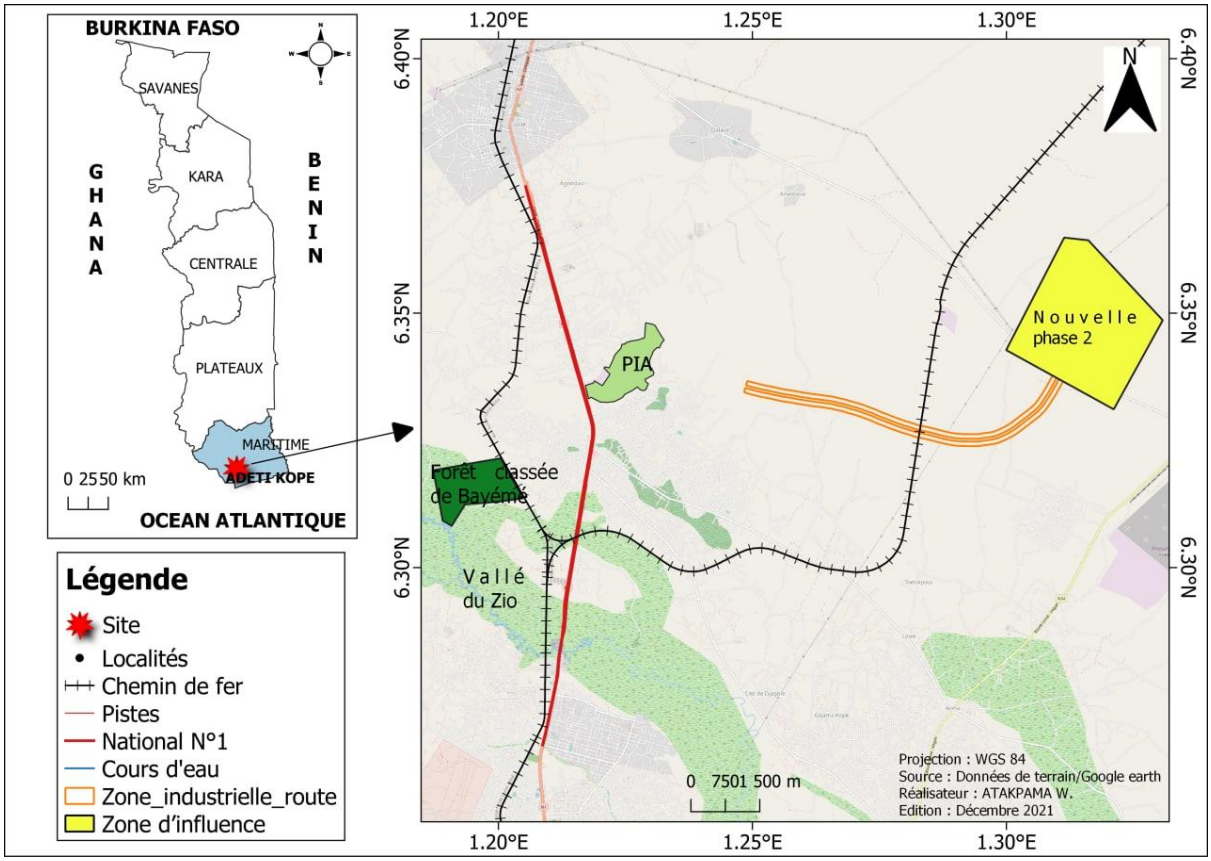


Figure 61 Location of the classified forest of Bayémé

5.5.1.3. Global threats to biodiversity

From a general point of view, the great threat to the biodiversity of ecological zone 5 corresponding almost to the entire Maritime region of Togo is that induced by human activities, in particular the advance of the urban front (Bawa, 2017) and the establishment of fields and plantations. Collecting plant parts for food and medicine also remains a threat to biodiversity. The highly developed grazing in the southwestern part around and within swampy areas (Amegnaglo et al., 2018a; Amegnaglo et al., 2018b) also contributes to the degradation of vegetation, especially those of wetlands.

5.5.2. Habitat and vegetation

5.5.2.1. Land use

On the Phase 2 site area, the land use is almost equally divided between savannas/plantations (51,58%) and fields/fallows (47,8%). A residual 0,62% of the land is occupied by agglomerations / bare land (JAT Consulting, 2021).

As for the the Industrial Corridor, the land use is predominantely represented by savannas/plantations (85,48%) followed by fields/fallows (13,85%). The residual, and almost negligible, surface is occupied by agglomerations/bare land (0,67%) (JAT Consulting, 2021).

Land use is illustrated in the figure below and detailed in the following table.

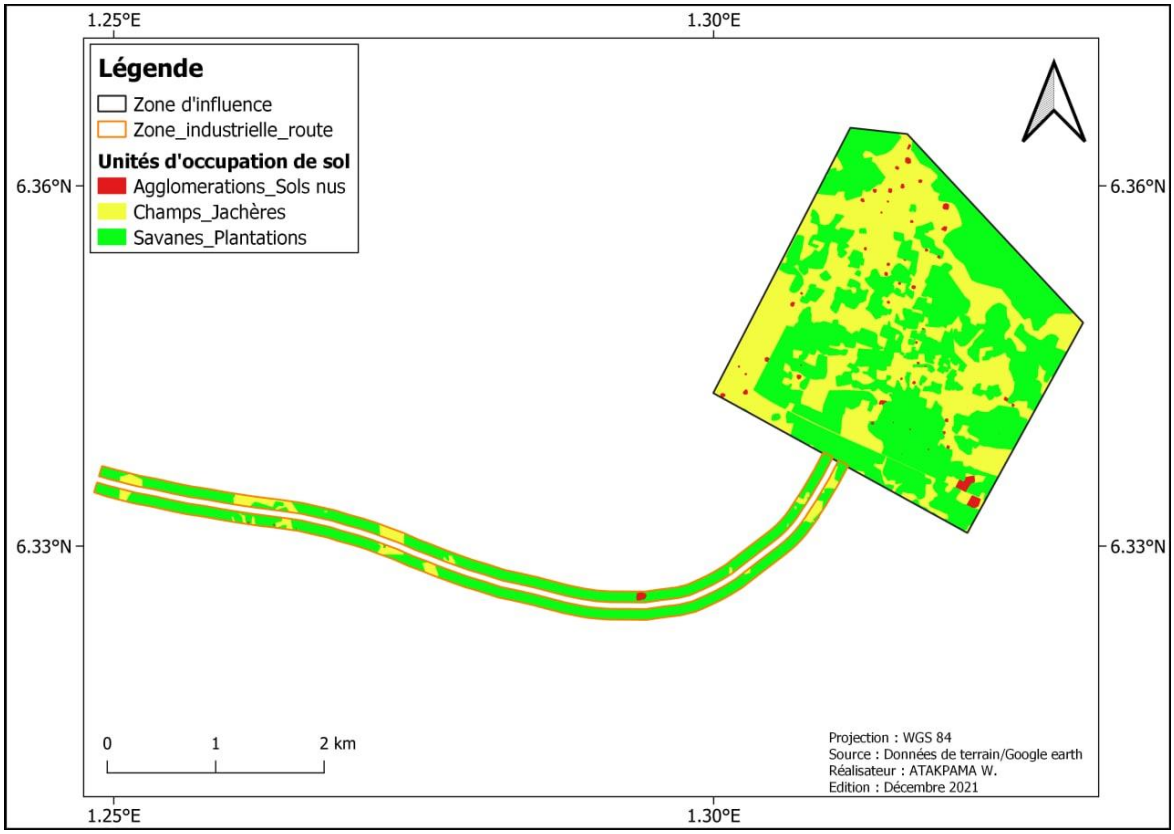


Figure 62 Land use in the study area (JAT Consulting, 2021)

Table 45 Land use in the study area (JAT Consulting, 2021)

Reference area	Land use	Affected surface
Phase 2 site	*Savannas / plantations*	369,31 ha, or 51,58 %
	Fields (manioc, cowpeas, pineapple, cassava…) / fallows	342,25 ha, or 47,8 %
	Agglomerations/ bare land	4,44 ha, or 0,62 %
Industrial Corridor	*Savannas / plantations*	199,1 ha, or 85,48 %
	Fields / fallows	32,26 ha, or 13,85 %
	Agglomerations/ bare land	1,56 ha, or 0,67 %

Some exemples of identified land use are shown here below.

Figure 63 Exemples of land use – Phase 2 site

Thickets (A), fallows (B), fields (C) and agglomerations (D)

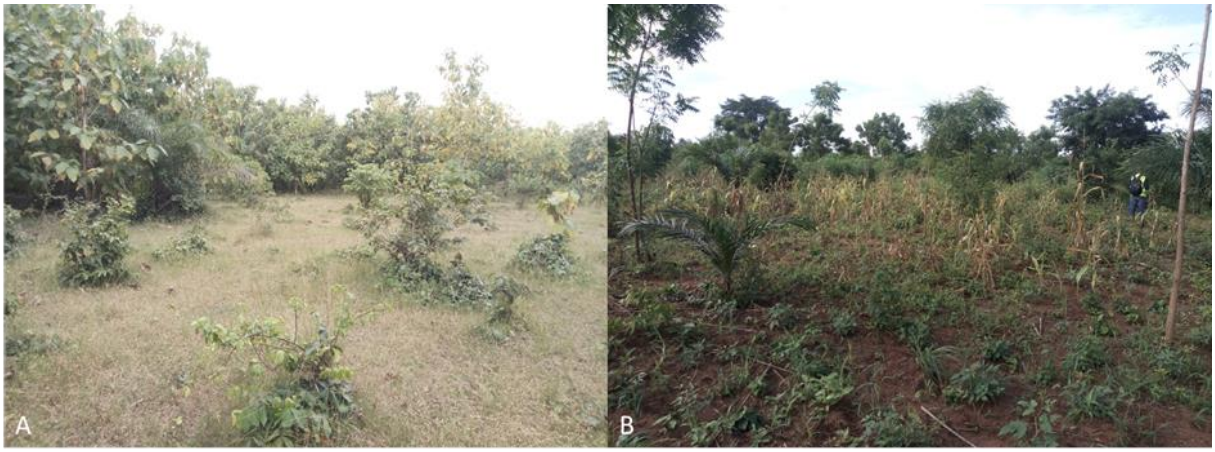


Figure 64 Exemples of land use – Industrial Corridor

Savannas (A), corn fields (B)

Figure 65 Exemples of land use – Industrial Corridor

Flood-risk savannas (A), agglomeration (B), fields (C)

5.5.2.2. Habitats

Habitat is defined as a terrestrial, freshwater, or marine geographical unit or airway that supports assemblages of living organisms and their interactions with the non-living environment. For the purposes of implementation of IFC PS6, habitats are divided into modified, natural, and critical. Critical habitats are a subset of modified or natural habitats.

5.5.2.2.1. Modified habitats

Modified habitats are areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition. Modified habitats may include areas managed for agriculture or forest plantation.

There is a mosaic of fields and fallows. The fields are made up of various crops including cereals (corn), legumes (cowpeas), fruit trees (pineapple) and tubers (cassava). These fields can be abandoned for a short period ranging from 6 months to two years in fallow to restore soil fertility. It is difficult to clearly distinguish the fallows from the fields in this landscape. The existing pressure on these fields and fallows is the high frequency of cultivation leading to soil impoverishment and reduced yields. These habitats do not present a significant stake for fauna or flora.

The savannas are dotted with plantations of teak and oil palms and sometimes citrus fruits. The stake in the conservation of flora and fauna in these habitats is low. The agglomerations include a few scattered dwellings within the area. Agglomerations and bare soils present no stake for the conservation of biodiversity.

5.5.2.2.2. Natural habitats

Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.

All savannas were identified as modified by the biodiversity experts.

Based on the investigations, no significant natural areas have been identified in the project area of influence.

5.5.2.2.3. Critical habitats

Critical habitats are areas with high biodiversity value, including:

- habitats of significant importance to Critically Endangered and/or Endangered species;

- habitats of significant importance to endemic and/or restricted-range species;
- habitats supporting globally significant concentrations of migratory species and/or congregatory species;
- highly threatened and/or unique ecosystems;
- areas associated with key evolutionary processes.

No critical habitats, within the meaning of IFC PS 6, have been identified in the Project area of influence.

5.5.2.3. Floristic richness

The floristic richness has been investigated per each of the sampling sites: the future Phase 2 site, and Industrial Corridor. The diversity of species per each site is presented below. The complete list of the identified plant specied is presented in Annexe VIII.

The survey was carried out for five days in August 2021. During August, the biodiversity was characteristic ofthe rainy season. The limitation of these surveys is that they give a picture at a given moment in time, which does not provide a representative baseline of flora during other seasons. However, the conducted desktop study and interviews with the competent stakeholders compensated for this deficiency.

5.5.2.3.1. Species diversity – Phase 2 site

The flora recorded in the Phase 2 site area is 136 plant species divided into 126 genera and 47 families. The most abundant / dominant species are: Mallotus oppositifolius (Geisel.) Müll.Arg.var. oppositifolius (14,54 %), Elaeis guineensis Jacq.(9,05 %), Zea mays L. (7,29 %), Panicum maximum Jacq. (6,20 %), Azadirachta indica A. Juss. (6,01 %) et Rottboellia cochinchinensis (Lour.) W.D. Clayton (4,66 %).

The most represented families are Euphorbiaceae (22,41%), followed by Poaceae (20,73%), Araceae (9,09%), Meliaceae (6.11%) and Asteraceae (6,05%). The high proportion of Poaceae is justified by the existence of fields and fallow land in the area.

Figure 66 Species abundance distribution – Phase 2 site

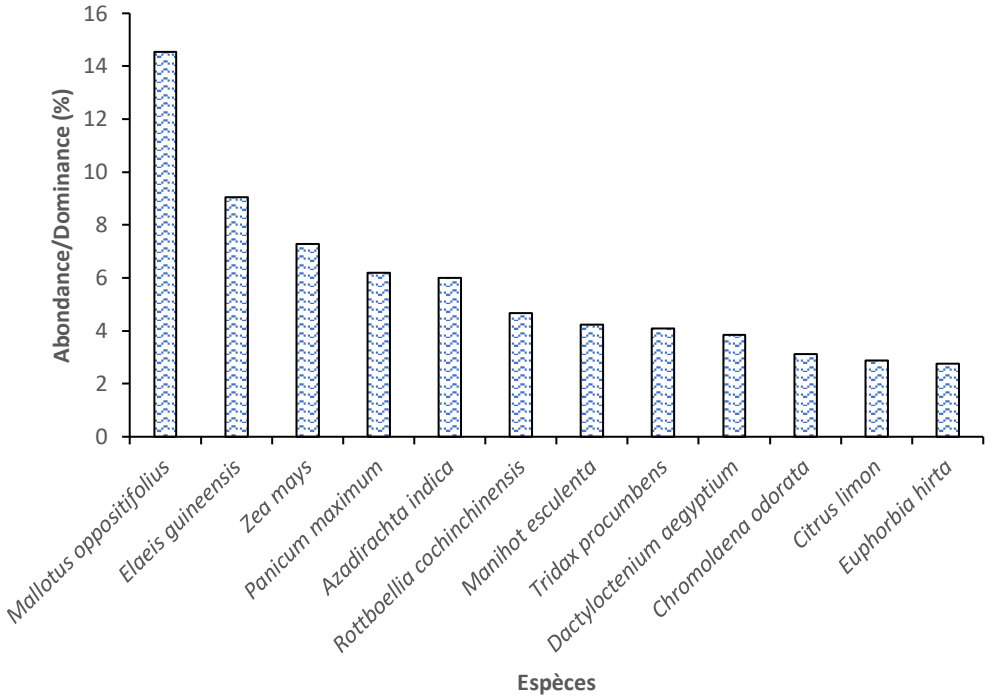
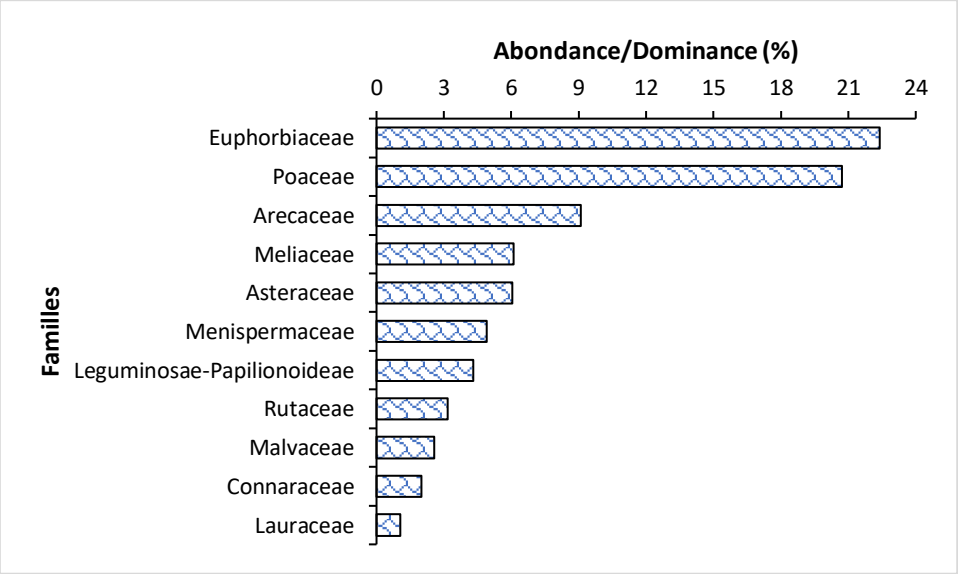


Figure 67 Family abundance distribution – Phase 2 site



5.5.2.3.2. Species diversity – Industrial Corridor

The flora recorded include 36 plant species divided into 36 genera and 21 families. The most dominant species is Sporobolus pyramidalis P. Beauv. (37.39%). She is assisted by: Cynodon dactylon (L.) Pers. (12.37%), Tectona grandis L. F. (12.27%), Elaeis guineensis Jacq. (7.95%), Azadirachta indica A. Juss. (7.65%) and Mitragyna inermis (Willd.) Kuntze.

The most represented families are the Poaceae (53.39%). We also distinguish Verbenaceae (12.37%), Rubiaceae (8.34%), Meliaceae (7.65%), Leguminosae-Papilionoideae (2.94%) and Sapotaceae 2.94%). The other families are very poorly represented.

Figure 68 Species abundance distribution – Industrial Corridor

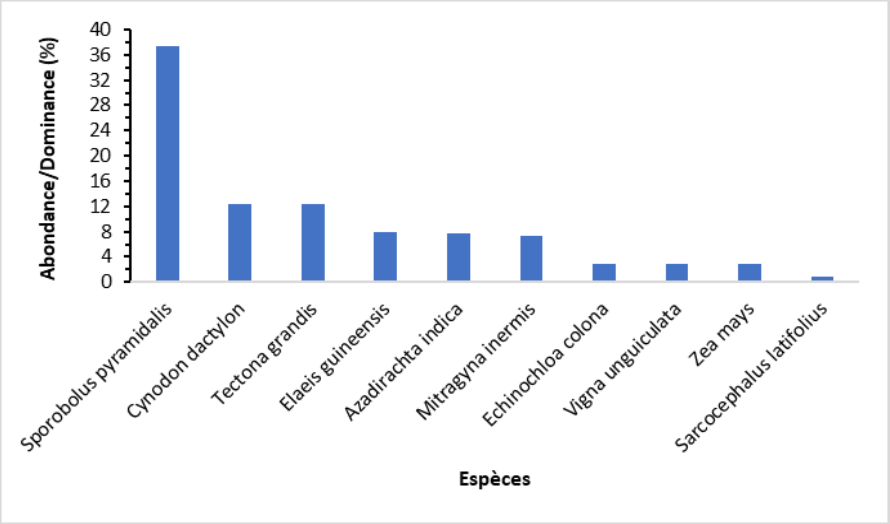
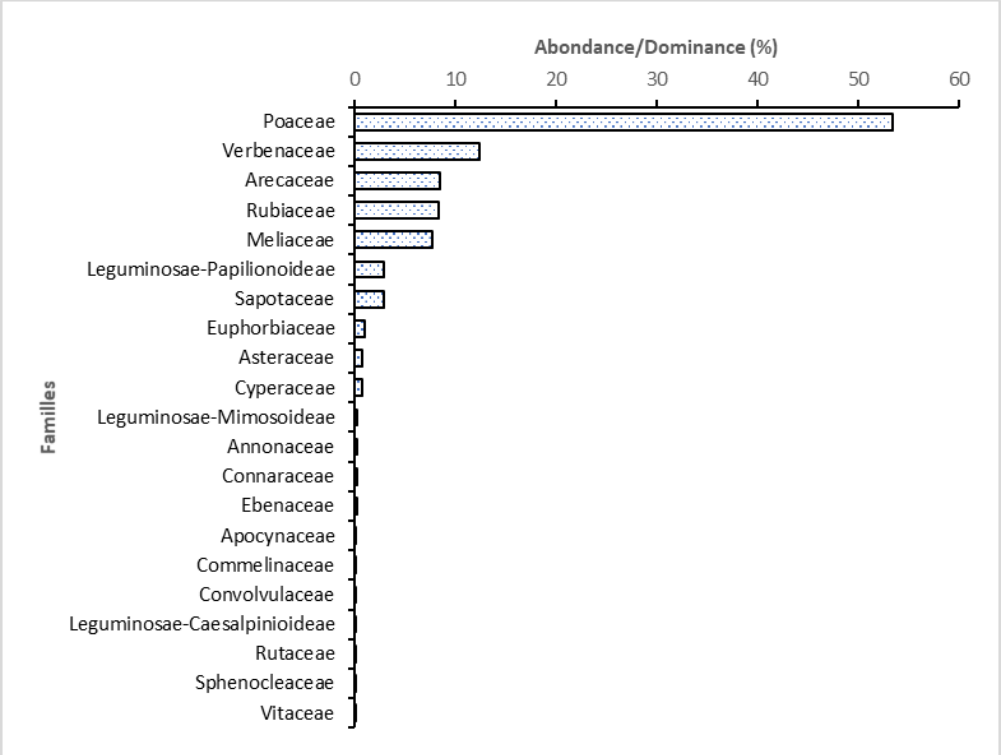


Figure 69 Family abundance distribution – Industrial Corridor



5.5.2.3.3. Invasive species

Of all the species inventoried in the Phase 2 area the followings invasive species have been identified:

- 27,34% are invasive: Chromolaena odorata (L.) R.M.King, Commelina benghalensis L., Commelina erecta L. ssp. Erecta, Euphorbia hirta L., Melinis repens (Willd .) Zizka ssp. Repens, Panicum maximum Jacq., Pennisetum polystachion (L.) Schult. Ssp. Subsp. Polystachion L., Rottboellia cochinchinensis (Lour.) WD Clayton, Senna occidentalis (L.) Link, Sida acuta Burm.f. ssp. carpinifolia (L. f.) Borss. Waalk. and Tridax procumbens L.
- 6.72% of species are exotic invasive: Acacia auriculiformis A.Cunn. Ex Benth., Azadirachta indica A. Juss. and Tectona grandis L.f.).

For the Industrial Corridor these include:

- 13.25% are invasive: C. odorata, C. erecta, Cynodon dactylon (L.) Pers. and Senna occidentalis (L.) Link ;
- 20,02% of species are exotic invasive: A. auriculiformis, A. indica and T. grandis.

5.5.2.4. Biological and phytogeographic types

5.5.2.4.1. Biological and phytogeographic types– Phase 2 site

The dominant biological types in the area of influence are microphanerophytes (32,22%), followed by nanophanerophytes (19,91%). The hemicriptophytes (14,25%), therophytes (12,44%), mesophanerophytes (10,51%) and microphanerophytes (5,39%) come in second position. There is a lower proportion of parasitic plants, chaméphytes, geophytes and hydrophytes.

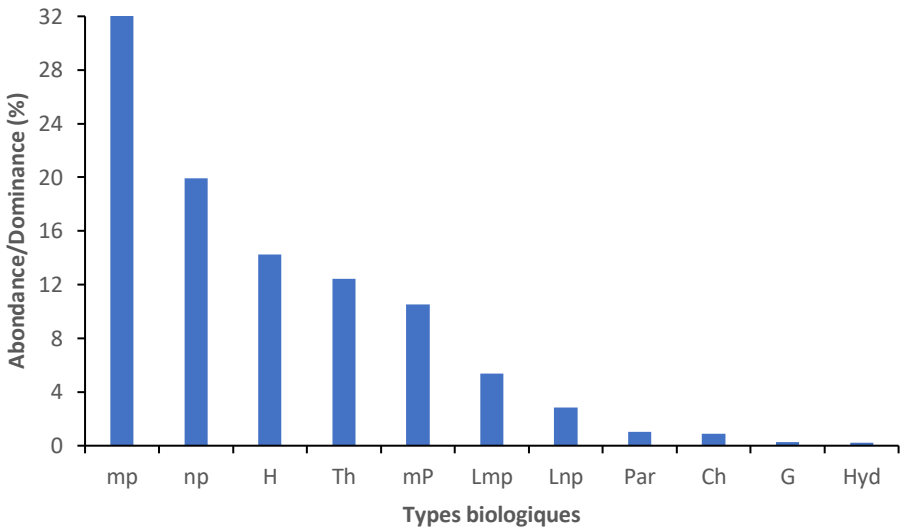


Figure 70: Biological types of vegetation in the Phase 2 site area

Th: therophytes, np: nanophanerophytes, H: hemicriptophytes, mp: microphanerophytes, Lmp: microphanerophyte lianas, Ch: chamephytes, Hyd: hydrophytes, Lnp: nanophanerophytic lianas, mP: mesophanerophytes, G: geophyte, Par: parasite.

The dominant phytogeographic types are the Guinean-Congolese / Sudano-Zambezian transitional species (56,2%). In second position, we distinguish the Guinean-Congolese species (29,27%) and the introduced species (14,10%). Sudano-Zambezian species are poorly represented. This typical florule not only highlights the climatic characteristics of the vegetation in the area, but also the significant place of human contribution.

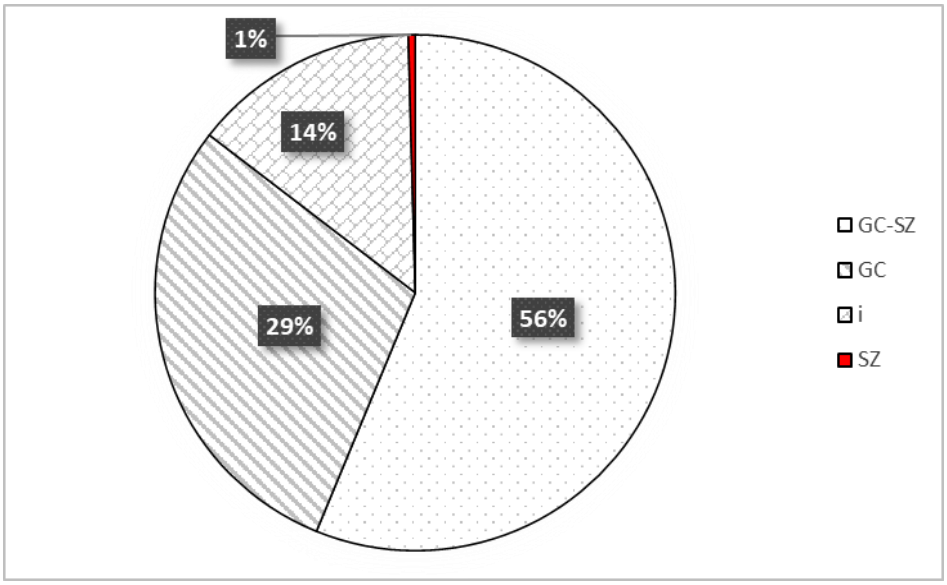


Figure 71: Phytogeographic spectrum of species in the Phase 2 site area

GC: Guinean-Congolese, SZ: Sudano-Zambezian, GC-SZ: Guinean-Congolese / Sudano-Zambezian, I: Introduced

5.5.2.4.2. Biological and phytogeographic types– Industrial Corridor

The dominant biological types are hemicriptophytes (38.21%), mesophanerophytes (20.63%), microphanerophytes (19.65%) and chaméphyes (12.48%). The dominance of hemicryptophytes and microphanerophytes highlights the savannah character of the site.

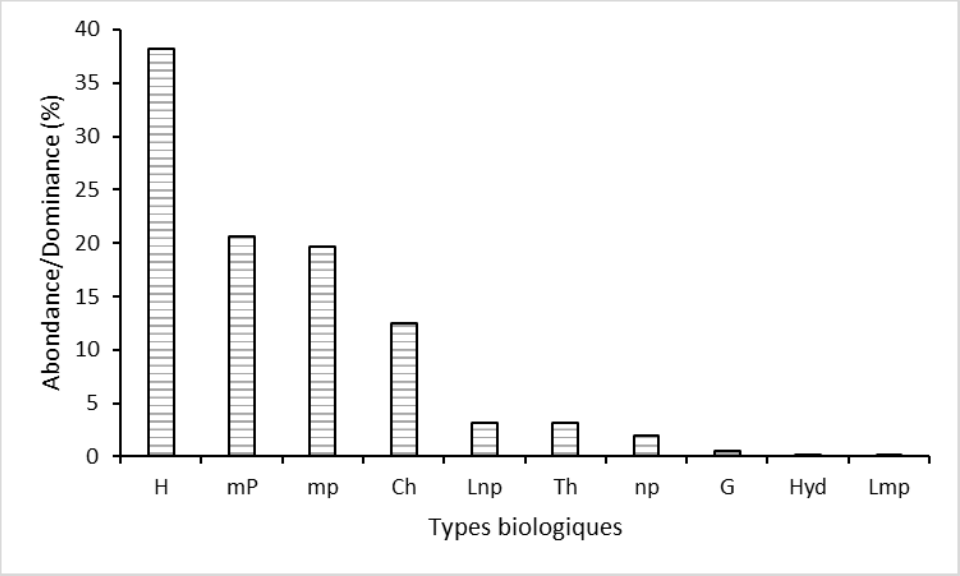


Figure 72: Biological types of vegetation in the power line easement area

Th: therophytes, np: nanophanerophytes, H: hemicryptophytes, mp: microphanerophytes, Lmp: microphanerophytes, Ch: Chaméphytes, Hyd: hydrophytes, Lnp: nanophanerophytes, mP: mesophanerophytes.

The dominant phytogeographic types are the Guinean-Congolese / Sudano-Zambezian transitional species (59.33%), followed by introduced species (23.87%) and Guinean-Congolese species (8.84%). Sudano-Zambezian species are poorly represented (Figure 19). This typical flora not only highlights the climatic characteristics of the vegetation in the area, but also the significant human input on the site. The importance of introduced species shows the greater human impact in this area compared to the Phase 2 site area.

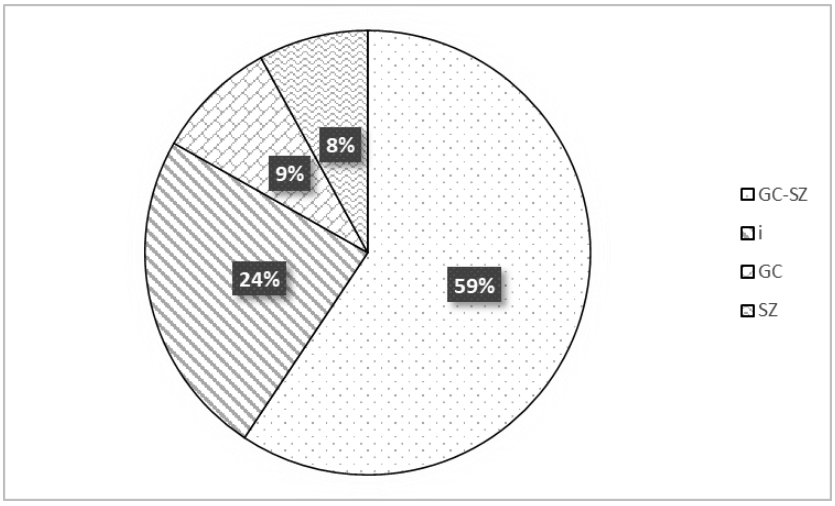


Figure 73: Phytogeographic spectrum of species in the power line easement area

GC: Guinean-Congolese, SZ: Sudano-Zambezian, GC-SZ: Guinean-Congolese / Sudano-Zambezian, I: Introduced

5.5.2.1. Habitat and vegetation sensitivity

The Project area of influence is half covered by savannas and plantations and half made of anthropized habitat with crops and fallow land. No critical habitats, within the meaning of IFC PS 6, have been observed. Based on IUCN Red list, only one species with a vulnerable status, the Senegal mahogany (*Khaya senegalensis*) has been recorded in the Phase 2 site area and in the road easement area. A nearly threatened species, iroko (Milicia excelsa (Welw.) C.C. Berg) was recorded in the Phase 2 site area. These two (2) species are also listed within the list of endangered species of Togo. Roughly 30% of all the species inventoried is either invasive or exotic invasive.

On the bibliographic basis, there are two (2) other species on the list of threatened plants of Togo: the baobab, *Adansonia digitata* L. (Baobab) and the bramble tree, *Borassus aethiopum* Mart. (Ronier) (Radji & Akpene, 2018) There are also four (4) priority food plants of Togo: mango tree (*Mangifera indica L.*), baobab (A. *digitata*), dwarf tree (*Parkia biglobosa* (Jacq.) R.Br. ex Benth.) and cashew apple (*Anacardium occidentale* L.) (Eyog-Matig et al., 2002a).

The Zio Basin development studies (Tchobo, 2017) report 14 IUCN red list species including 7 vulnerable and two (2) near threatened: wild apple (*Irvengia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill.) and iroko (*Milicia exelsa* (Welw.) C.C.Berg). The seven (7) vulnerable species are: *Afzelia africana* Sm*, Albizia ferruginea* (Guill. & Perr.) Benth, *Cedrela odorata* L., *Hallea stipulosa* (DC.) J.-F.Leroy, *Khaya grandifoliola* C.DC, *Khaya senegalensis* (Desr.) A.Juss. and *Vitellaria paradoxa* C.F.Gaertn. *ssp. paradoxa*. In addition, *I. gabonensis* and *V. paradoxa* are among the priority food plants in Togo (Eyog-Matig et al., 2002b). According to the IUCN classification criteria, although *Cedrela odorata* L. is an IUCN red-listed species, it cannot be considered threatened in Togo because it is an introduced species for its lumber. In addition to this report by Tchobo (2017), two other complementary species were reported in the lower Zio valley area (Djangbedja et al., 2017) on a florid of 186 species: *Carissa edulis* and *Chaetacme aristata*.Sensitivity of habitat and flora is rated as **Moderate**.

5.5.3. Fauna

The survey was carried out for five days in August 2021 and complemented by desktop study.

The wildlife inventory identified a total of 43 animal species distributed among 31 families in the 4 stations. The avifauna is the most represented with 29 species of all terrestrial birds. The avifauna thus represents 67.44% of the species inventoried. We also note insects (11 species), mammals (2 species) and reptiles (1). The absence of aquatic birds could be explained by the scarcity of water points in the

various stations and the paucity of existing water points, notably food for fish. The distribution of major groups of fauna is shown in Figure 74.

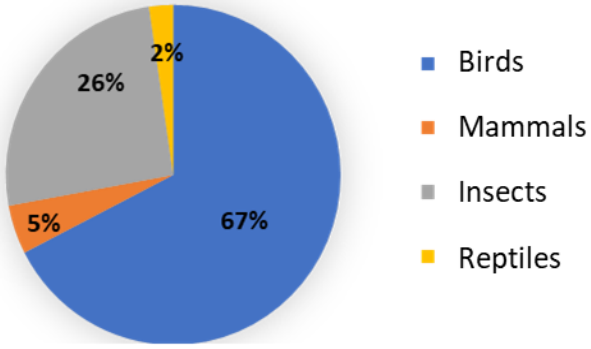


Figure 74 Distribution of the diversity of identified wildlife species

The animals are not evenly distributed in the different stations. The area of influence has the highest specific diversity (24 species). It is followed by the road and buffer zones (19 species) and the classified forest of Bayémé (17 species). Certain animal species such as birds commonly known as the Senegalese coucal (Centropus senegalensis), the yellow-bellied sunbird (Cinnyris venustus), the gray sparrow (Passer greseus), the gendarme weaver (Ploceus cucullatus) and the chain dove (Spilopelia senegalensis) are present in the 3 stations. Other animal species such as the palm rat (Xerus erythropus) and the bird commonly known as the purple sunbird are only present in the zone of influence.

None of the species recorded require special attention according to the IUCN list of Threatened species. Most (80.56%) have a status of Least Concern (LC). The remaining 19.44% are unassessed (NE).

5.5.3.1. Mammals

Mammalian fauna is poorly represented (2 species). A direct observation of the palm rat (Xerus erythropus) and the hare (Lepus lepus) was made in the area of influence and the hare droppings were observed at the level of the road easement. The low presence of mammals and in particular large mammals could be explained by the degradation of the habitat and the strong presence of herds of oxen. Other small mammals such as Arvicantis niloticus, Thryonomys swinderianus and Lemniscomys striatus have been reported by native populations but have not been seen in surveys.

None of them are considered threatened, according to the IUCN status.

5.5.3.2. Avifauna

The avifauna is rich (29 species) thus representing 67.44% of the specific diversity of the study area. Only one species of water bird, the little egret (Egretta garzetta), has been recorded. The other species are all terrestrial. The most frequent species are the yellow-bellied sunbird (Cynniris venustus) (15.21%), the gendarme weaver (Ploceus cucullatus) (9.78%), the gray sparrow (Passer griseus) (8.69%), the Senegalese coucal (7.61%) and the mesh turtledove (7.61%). Nesting birds in the area are weavers and gray sparrows.

Species requiring special attention were not found at the site. No bird species has a special status in Avibase, Birdlife or aficanbirdclub.

The avifauna is more important at the level of the zone of influence (18 species) than at the level of the road and land stripes (15) and the classified forest of Bayémé (12).

The avifauna distribution is shown here below. The next tables show the list of species of birds in the area of influence, buffer zones and the classified forest of Bayémé.

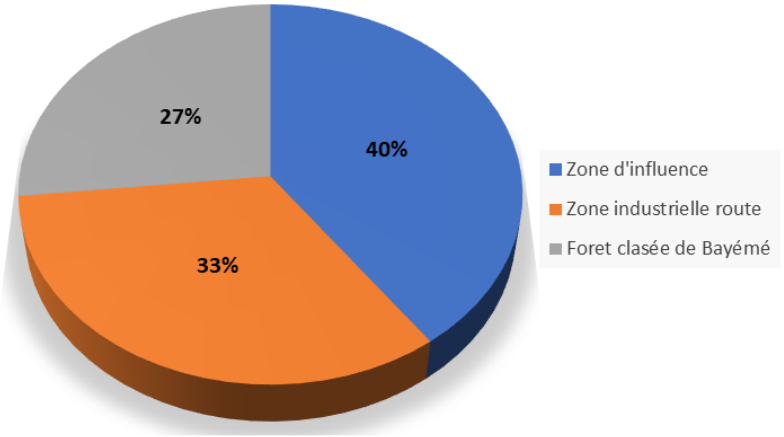


Figure 75 Distribution of birds per station

Table 46 Bird species observed

Families	Scientifics names	Common name (French)	Station			
			Phase 2	Road	Industrial Corridor	Bayémé
Columbidae	*Spilopelia senegalensis*	Tourterelle maillée	X	X	X	X
Laniidae	*Lanius humeralis*	Pie-grièche à dos noir	X			
Nectariniidae	*Cinnyris venustus*	Souimanga à ventre jaune	X	X	X	X
Ploceidae	*Ploceus cucullatus*	Tisserin gendarme	X	X	X	
Columbidae	*Columba livia*	Pigeon biset	X	X		
Ploceidae	*Ploceus pelzelni*	Tisserin pelzeln	X		X	X
Ploceidae	*Ploceus negerrimus*	Tisserin noir				X
Columbidae	*Streptopelia semitorquata*	Tourterelle à collier	X	X		
Bucerotidae	*Lophoceros nasutus*	Calao à bec noir	X			
Cuculidés	*Centropus senegalensis*	Coucal du sénégal	X	X	X	X
Phasianidae	*Pternistis bicalcaratus*	Francolin à double éperon	X		X	
Passeridae	*Passer griseus*	Moineau gris	X	X	X	X
Meropidae	*Merops albicolis*	Guêpier à gorge blanche	X			
Hirundinidae	*Hirundo aethiopica*	Hirondelle d'éthiopie	X	X	X	X
Cisticolidae	*Cisticola erythrops*	Cisticole à face rousse	X			
Accipitridae	*Accipiter badius*	Epervier shikra	X		X	
Nectariniidae	*Cinnyris pulchellus*	Souimanga à queue longue	X			
Pycnonotidae	*Pycnonotus barbatus*	Bulbul commun	X	X	X	
Estrildidae	*Pyrenestes ostrinus*	Pyrénestre ponceau	X	X		X

Families	Scientifics names	Common name (French)	Station			
			Phase 2	Road	Industrial Corridor	Bayémé
Accipitridae	*Milvus migrans*	Milan noir				X
Ardeidae	*Bulbulcus ibis*	Héron garde-boeufs			X	X
Apodidae	*Rhaphidura sabini*	Martinet d'ussher				X
Corvidae	*Ptilostomus afer*	Piapiac		X	X	X
Nectariniidae	*Anthreptes rhodolaemus*	Souimanga à gorge rouge			X	
Viduidae	*Vidua macroura*	Veuve dominicaine			X	
Buphagidae	*Buphagus africanus*	Piquebœuf à bec jaune			X	
Corvidae	*Corvus albus*	Corbeau pie		X		

5.5.3.3. Reptiles, amphibieans and insects

All the different sampling sites proved to be poor in reptiles. The only species of this group observed is the Common Lizard (Agama agama). Other species such as ground monitor lizards (Varanus exanthematicus), chameleon (Chamaleo gracilis), snakes have been reported by resident populations but were not observed during this study. This low presence of reptiles could be explained by the destruction of natural habitats.

Snakes are systematically killed because of the danger they suppose to represent to humans. The most commonly cited families are above all Colubridae (*Philothamnus semivariegatus, Psammophis sibilans*).

Figure 76 Philothamnus semivariegatus killed on the site

The site is poor in amphibians; of the 39 species listed in Togo, only two have been identified on the site (PNAE / MERF, 2002). These are *Bufo regularis* ("square" toad) and *Rana spp*. (Frog). The common toad is not specific to a habitat. However, the frog is found only in the marshy area.

Two species of ocypode crab inhabit the upper sandy part of the site: *Ocypode cursor* and *Ocypode africana*. This fauna is found in the wet / marshy zone.

Eleven (11) species of insects have been identified. These include the solitary wasp (Ropalidia sp.), The butterfly commonly known as the forest queen (Euxanthe eurinome) and the locust (Canocephalus sp). The following table shows the list of insects recorded.

Table 47 Insects species observed

Families	Scientifics names	Common name (French)
Vespidae	*Ropalidia* sp.	Guêpe solitaire
Nymphalidae	*Euxanthe eurinome*	Reine commune des forêts
Tettigoniidae	*Canocephalus* sp.	Criquet
Libellulidae	*Palpopleura* sp.	Libellule
Pieridae	*Eurema hapale*	Herbe des marais jaune
Herperiidae	*Pardaleodes incerta*	Hespérie éclaireuse de la savane
Lycaenidae	*Mimeresia libentina*	Arlequin commun
Cetonidae	*Grammopyga cincta*	Cétoine
Apidae	*Apis* sp.	Abeille

5.5.3.1. Fauna sensitivity

Due to the human presence as well as the presence of herds of oxen, no threatened fauna was encountered in the studies area based on the IUCN Red List. Main species are little mammals and avifauna but none is listed as threatened. The absence of aquatic birds could be explained by the scarcity of water points in the various sampling stations and the paucity of existing water points, notably food for fish. The low presence of reptiles could be explained by the destruction of natural habitats and the common local habit to systematically kill snakes because of the danger they supposedly represent to humans. Because of its “punctual” character, we cannot rule out the possibility of the presence of unobserved species.

Overall, at the scale of the Gulf Prefecture, wildlife habitat is strongly fragmented by the implementation of building infrastructures. Urbanization is occurring at the expense of wetlands and forest ecosystems, which are wildlife habitats.

Adopting a precautionary approach, sensitivity of fauna is rated as **Minor**.

5.5.4. Species requiring special attention, conservation status and pressure exerced

The IUCN Red List Categories and Criteria are intended to be an easily and widely understood system for classifying species at high risk of global extinction. It divides species into nine categories:

- Not Evaluated (NE);
- Data Deficient (DD): a taxon is DD when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status;
- Least Concern (LC): a taxon is LC when it has been evaluated against the Red List criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened;
- Near Threatened (NT): a taxon is NT when it has been evaluated against the Red List criteria and does not qualify for Critically Endangered, Endangered or Vulnerable now but is close to qualifying for or is likely to qualify for a threatened category in the near future ;
- Vulnerable (VU): a taxon is VU when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable and it is therefore considered to be facing a high risk of extinction in the wild;

- Endangered (EN): a taxon is EN when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild;
- Critically Endangered (CE): a taxon is CE when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild;
- Extinct in the Wild (EW), a taxon is EW when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range.
- Extinct (EX): a taxon is E when there is no reasonable doubt that the last individual has died.

With regard to flora, the species listed are of least concern according to the IUCN vulnerability criteria.

Only one species with a vulnerable status (VU), the caïlcedrat (Khaya senegalensis (Desr.) A. Juss.) has been recorded in the Phase 2 site area and Industrial Corridor. A nearly threatened (NT) flora species, iroko (Milicia excelsa (Welw.) C.C. Berg) is found in the Phase 2 site area. These two (2) species are on the list of endangered species of Togo.

Khaya senegalensis (Desr.) A.Juss, also known as "caïlcédrat" is a fast-growing medium-sized tree which can obtain a height of up to 15–30 m in height and 1 m in diameter. The Caïlcedrat is found in riparian forests and higher-rainfall savannah woodlands ans is widely distributed in West and Central Africa. The wood is used for a variety of purposes. It is often used conventionally for carpentry, interior trim, and construction. The bitter tasting bark is used for a variety of medical purposes. Khaya senegalensis has experienced high amounts of exploitation, and little regeneration takes place once disturbance occurs. It is often planted ornamentally as a roadside tree.

Milicia excelsa (Welw.) C.C.Berg, is one of two species (the other being *Milicia regia*) yielding timber commonly known as African teak or iroko. It is distributed across tropical central Africa. Its natural habitat is in wet savannah, rainforest, riverine and low-altitude evergreen forests and it can tolerate an annual rainfall of less than 70 centimetres as long as there is a stream or a ground water source nearby. Many populations of iroko are inbred, which could contribute to why this species is moving closer to being on the "Threatened" conservation list. It is resistant to termites and is used for construction, furniture, joinery, panelling, floors and boats. The tree can be used in the control of erosion, and for providing shade as a roadside tree in urban areas.

On the buffer zones area, two priority food plant species (Borassus aethiopum Mart. And Diospyros mespiliformis Hochst. Ex A.DC.) have been identified. Only one priority food species in Togo, the mango tree, has been identified in the Phase 2 site area.

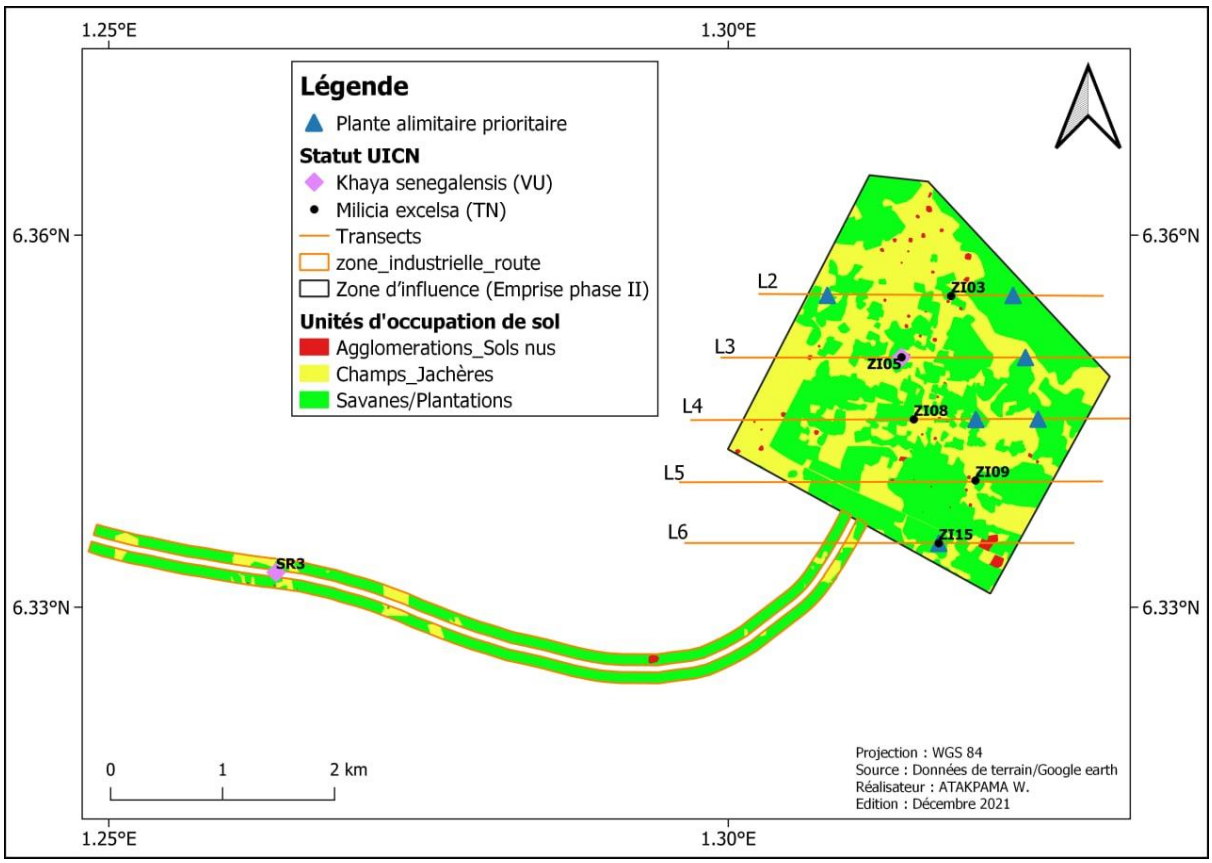


Figure 77 Localisation of species requiring special attention

As for the fauna identified in the study area, no species have threatened status. Most have an IUCN status of Least Concern (LC). Although no animal species recorded are threatened according to the IUCN vulnerability criteria, there is a great diversity of fauna that may be affected by the implementation of project activities.

5.6. Human environment

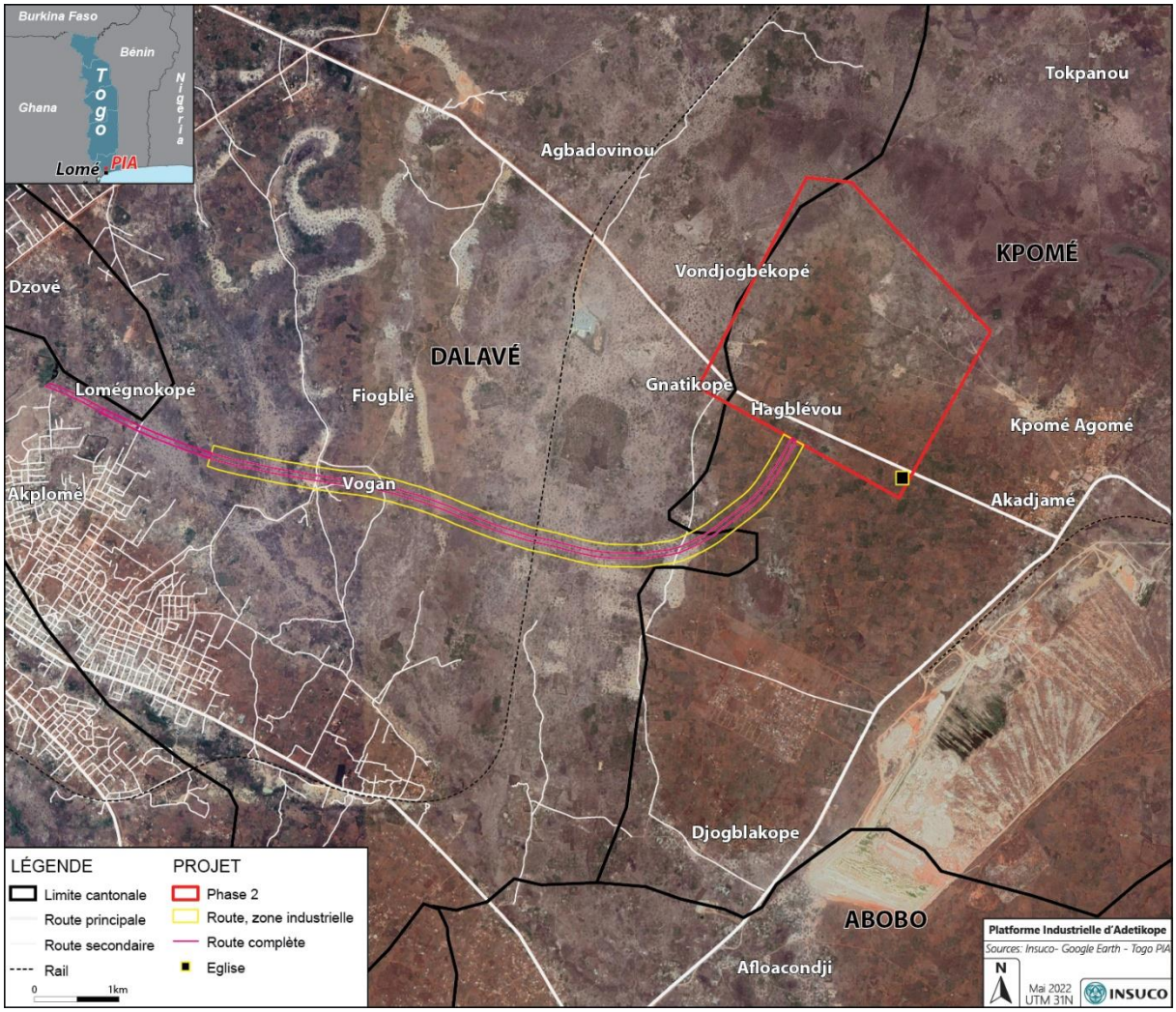
Kpomé and Dalavé are the two cantons affected by the Project. These two cantons are administratively attached to the commune of Zio 1, whose chief town is Tsévié, located in the prefecture of Zio. Kpomé and Dalavé are neighbouring townships that are surrounded on either side by the townships of Djagblé, Abobo, Davié, Gbatopé and Tsévié.

The Phase area is surrounded by two national roads, including National Road No. 1 (RN 1) leading to Burkina Faso and National Road No. 34 (RN 34), Lomé -Vogan.

The project site is surrounded by 10 villages and hamlets. The seven villages are Hagblévou, Tokpanou, Vondjogbékopé, Agbadovinou, Djogblakopé, Kpomé Adjamé and Kpomé Agomé, and the three hamlets are Aflaocondji, Gnatikopé and Fiogblé.

It should be noted that there are villages bordering the site, such as Kpomé-Agomé, Kpomé-Akadzamé for example, whose agricultural land is affected by the project but not the agglomerations. On the other hand, Phase 2 directly affects certain villages (Hagblévou, Vondjogbékopé) and certain hamlets (Gnatikopé) which will be physically displaced.

The investigations carried out covered all of these villages and hamlets, including those directly affected physically, but also those that are nearby and whose agricultural land may or may not be affected by the project.


Burkina Faso
Bénin
Togo
Ghana
Nigeria
Lomé
PIA
Tokpanou
Agbadovinou
KPOMÉ
Vondjogbékopé
Dzové
DALAVÉ
Lomégnokopé
Fiogblé
Gnatikope
Hagblévou
Kpomé Agomé
Vogan
Akplomé
Akadjamé
Djogblakope
ABOBO
Afloacondji
LÉGENDE
Limite cantonale
Route principale
Route secondaire
Rail
PROJET
Phase 2
Route, zone industrielle
Route complète
Eglise
0
1km
Platforme Industrielle d'Adetikope
Sources: Insuco- Google Earth - Togo PIA
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Mai 2022
UTM 31N
INSUCO

Figure 78 Location of PIA Phase 2, industrial corridor and the surrounding villages

Figure 79 Urban symbol of the city of Tsévié, capital of the Zio 1 municipality

5.6.1. Governance

5.6.1.1. Territorial administrative organisation

Togo's administrative organisation is based on several levels, including: the village or neighbourhood, depending on whether the concerned territory is in rural or urban area, the district, the municipality, the prefecture, and the economic region. It is composed of 117 communes, 39 prefectures and 5 regions.

Since the 1980s, Togo has embarked on the path of local democracy implemented through a progressive process of decentralisation at national and communal levels. The administrative organisation of the country has thus undergone numerous reforms marked by the Government's desire to give more responsibilities and liberties to local authorities. Thus, the current territorial administration is composed of:

- **Decentralised territorial collectivities** represented by prefectures and districts headed by prefects and district chiefs. Prefects and district chiefs are positions that report directly to the Minister of Territorial Administration, Decentralisation and Local Government. They are appointed by the Council of Ministers.
- Decentralised territorial authorities which are the municipality and the region.

Since 30 June 2019, when Togo held local elections, the State and local authorities have been involved in the territorial administration of the country in accordance with the provisions of the Togolese constitution.

The municipalities are attached to the prefectures. A municipality generally groups together one or more cantons; it may also be made up of a division of a canton (Article 57 of Law No. 2019-006 of 26 June 2019 on Decentralisation and Local Liberties in Togo) and is composed of the following entities defined by the same law:

- The municipal council, a deliberative body elected under the conditions laid down by law, subject to the specific provisions of this law;
- The executive board of the city council consisting of the mayor and the deputies.

The regional entities are:

- The regional council, a deliberative assembly elected under the conditions laid down by law ;
- The executive board of the regional council, the executive arm of the region. It is led by a president elected by the regional council from among its members.

5.6.1.1.1. Maritime region

Administratively, Togo is divided into five economic regions (see map below): the Maritime Region (RM), the Plateaux Region (RP), the Central Region (RC), the Kara Region (RK) and the Savanes Region (RS).

The project is located in the maritime region in the prefecture of Zio and more precisely in the commune of Zio 1 composed of eight (08) cantons which are Dalavé, Kpomé, Gblainvié, Djagblé, Abobo, Davié, Gbatopé and Tsévié, chief town of the commune and chief of the maritime region.

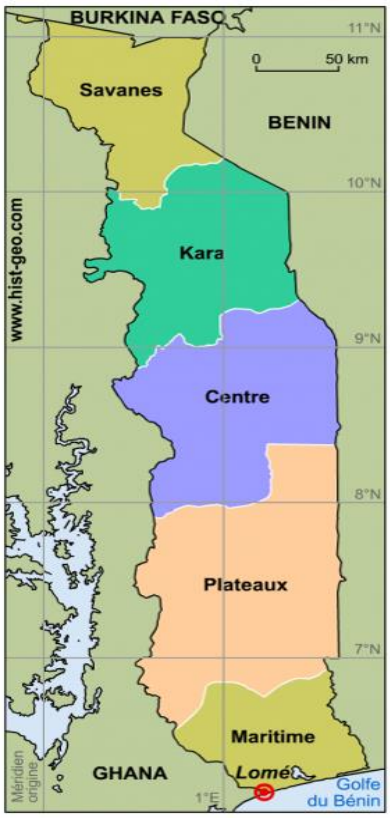


Figure 80 Map of Togolese regions

Figure 81 Map of the maritime region

As for the country as a whole, the administrative structure of the Maritime Region has undergone various changes, since Order No. 212 of 12 August 1927 on the organisation of the districts of the Togolese territory to Decree No. 2017-144 / PR of 15 November 2017 fixing the territorial jurisdiction and the chief town of the communes of the Maritime and Savanes Regions, which determines the current configuration of the administrative map of the region.

The maritime region is thus structured administratively into 8 prefectures whose administrative centres are the main cities.

The table and map below illustrate the configuration of this region.

Table 48 Prefectures, municipalities and cantons in the maritime region

Prefecture	Principal town	Number of municipalities	Number of cantons
Golfe Prefecture	Lomé	6	5
Agoe-Nyive Prefecture	Agoe-Nyive	6	6
Prefecture of Lakes	Aneho	4	9
Bottom - Mono Prefecture	Afagnan	2	7
Vo Prefecture	Vogan	4	10
Yoto Prefecture	Tabligbo	3	12
Zio Prefecture	**Tsevie**	**4**	**17**
Ave Prefecture	Keve	2	9

In total, the region has 8 prefectures, 31 municipalities and 75 cantons.

5.6.1.1.2. Zio Prefecture

The prefecture of Zio is an administrative subdivision of Togo with Tsévié as its capital. It was created as a result of the prefectural division of Zio in order to better reflect the urban and demographic features of the territory. It is located 35 kilometres from the capital Lomé.

It is composed of 4 communes and 16 cantons as shown in the table below.

Table 49 Municipalities and cantons of the Zio prefecture

Prefecture	Municipalities	Number of cantons	Cantons	Capital
Zio	**Zio 1**	**8**	- **Tsévié** - **Gbatopé** - **Davié Kpomé** - **Dalavé** - **Djagblé** - **Gblainvié** - **Abobo**	**Tsévié**
	Zio 2	**4**	- Mission-Tové - Kovié - Wli - Bolou	Mission-Tové
	Zio 3	2	- Agbélouvé - Gamé	Agbélouvé
	Zio 4	2	-Gapé-Centre Gapé-Kpodji	Gapé-Centre

The map below shows both the prefecture of Zio as well as its constituent communes, notably Zio 1 where Phase 2 is located.

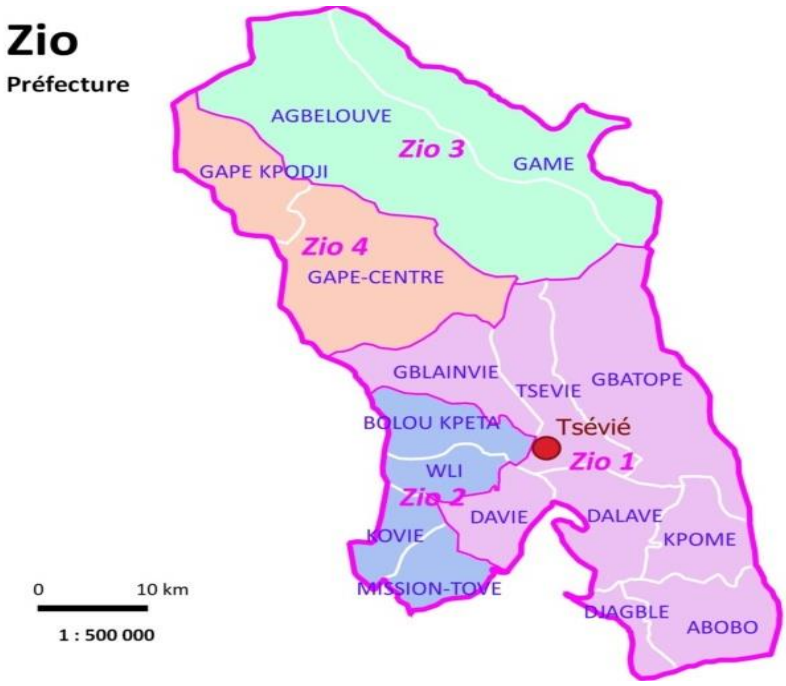
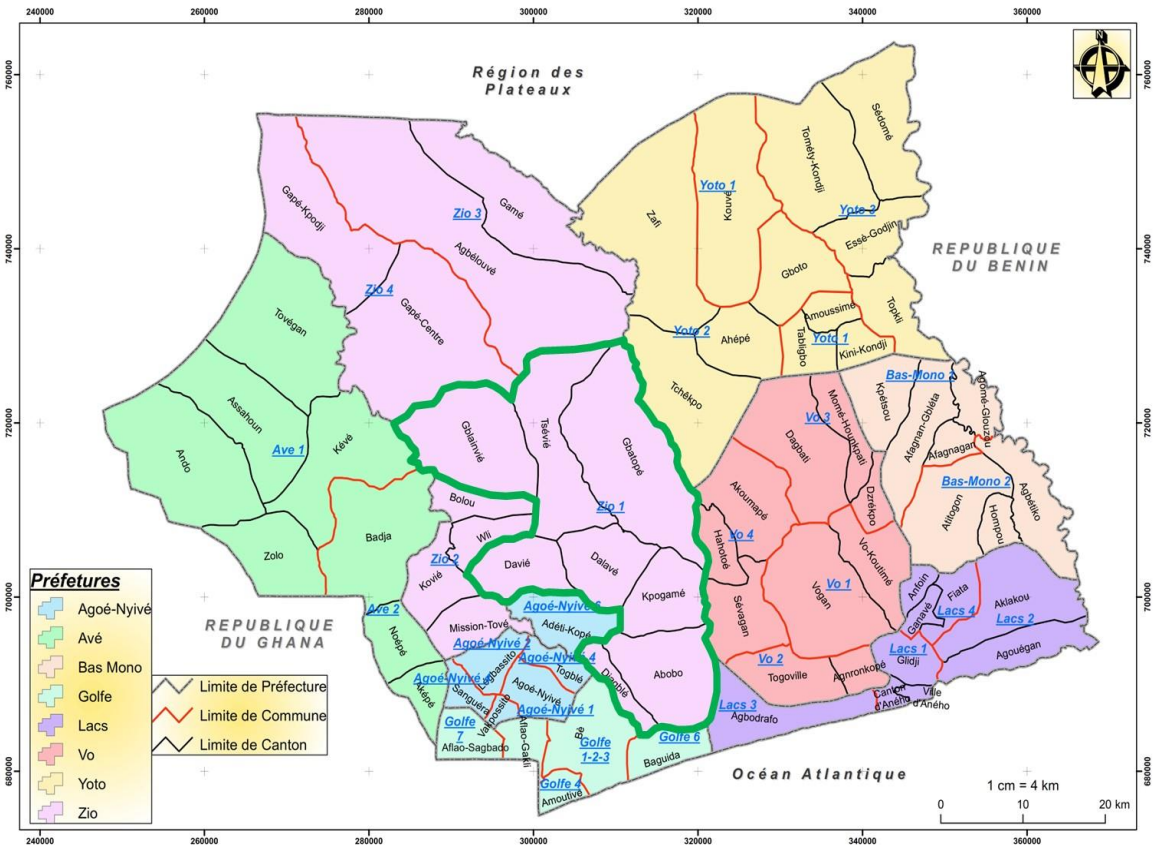


Figure 82 Map of the Zio prefecture



Municipality Zio 1 with its 8 cantons including Kpomé and Dalavé affected by the project

Figure 83 Map of the maritime region showing the boundaries of prefectures, municipalities and cantons

This administrative division shows that there are several communes in the prefecture and these municipalities must collaborate with the representative of the central power, the Prefect.

Article 93 of law n°2019-006 of 26 June 2019 specifies the form of collaboration that should exist between the Prefect and the Mayors. Article 93 of this law states: "The municipal council, upon convocation by the mayor, meets at the town hall, in ordinary session, once a trimester, for a period of fifteen days, at most. The municipal council is summoned in extraordinary session by the mayor, on his initiative or at the reasoned request of one third of its members or that of the prefect. In the event of an unforeseen circumstance, or when conditions require it, the council may meet in a place other than the town hall. This place is subject to the approval of the prefect. In such cases, the deliberations must be published throughout the territory of the municipality.

Collaboration extends to Mayors and canton chiefs as indicated by law n°2019-006 of 26 June 2019 which specifies in its article 92 that "the municipal council is required to consult the canton chief on matters relating to the environment, health, land and the elaboration of the communal development programme".

The Project is located in the cantons of Dalavé and Kpomé in the commune of Zio 1, whose capital is Tsévié.

Figure 84 Tsevié's townhall

5.6.1.1.3. Municipality of Tsévié

As a colonial administrative centre, the town of Tsévié has been a fully-fledged municipality since 4 February 1960. According to the data from the last two censuses, the population of Tsévié has doubled over 30 years. The population increased from 20,325 inhabitants in 1981 to 54,474 in 2010 (RGPH46). According to data from the communal development plan for the municipality of Tsévié (2015-2019)7, the main causes of this average demographic and spatial growth of the municipality are: the low rate of natural increase and the massive departure of working people due to the lack of employment opportunities. This town is also marked by the inadequacy of basic infrastructure and equipment.

5.6.1.1.4. Cantons of Kpomé and Dalavé

Administratively, Kpomé and Dalavé are cantons composed of several villages and administered by a canton chief. The stability of developable land justifies the demand for residential plots from buyers coming from the city and supported by real estate investments.

For the territory in which the project is located, there are therefore several administrative governance authorities to interact with: canton chief, mayor, prefect.

5.6.1.2. Traditional organisation

The basic structure of traditional organisation in the study area is the family unit. Families gather in villages/neighbourhoods headed by a village chief (or neighbourhood chiefn depending on whether the

[6] Recensement Général de la population et de l'habitat, 2010
[7] Plan de développement communal, Marie de Tsévi, 2015-2019

area is urban or rural), and also notables who are older people with practical life experience and assist the village chief in conflict resolution and deliberation

All villages are governed by a village chief and a village development committee (CVD). The neighbourhoods are regrouped according to certain demographic and historical criteria to form the village. The choice of village chiefs is made by notables from the royal lineage. Only village chiefs are subject to induction rituals in accordance with the ancestral traditions and practices of the area.

Law No. 2007-002 of 8 January 2007 on traditional chiefdom and the status of traditional chiefs in Togo governs their mode of appointment and their responsibilities. According to article 10, the appointment of these chiefs can be done by :

- **Hereditary succession**: the appointment of the hereditary chief is then entrusted to the traditional council, composed of the village;
- **Public consultation**, rallying people who have reached the age of majority behind the candidate of their choice.

Traditional chiefs are the guardians of traditional practices and have the power to arbitrate and reconcile parties in traditional matters. They are recognised by an order of the minister in charge of territorial administration on the report of the prefect.

5.6.1.3. The place of women in society

The place of women in Togolese society has evolved positively thanks to the action of the Ministry of Social Action, Promotion of Women and Literacy and the updating in 2018 of the Code of Individuals and the Family, which dates from 1980.

This code takes into account all issues related to gender and discrimination in society. Together with the Reproductive Health Act (2007), which prohibits rape, female genital mutilation, early and forced marriage, sexual exploitation and harassment, this code has helped to better protect women against violence and discrimination.

Among other things, it guarantees :

- Mutual consent in the marriage certificate;
- Minimum age of marriage at 18 years;
- Equal status of women and men in the household;
- The possibility of divorce at the initiative of the woman.

Despite this progress, gender equality is not yet achieved in Togo. The Social Institutions and Gender Index (SIGI), an organisation attached to the OECD that ranks countries according to gender inequality, gave Togo a score of 50% in 2019, placing the country in the high category, i.e. with high levels of discrimination against women, mainly in the areas of family life and civil liberties.

The persistence of traditional patriarchal practice and discrimination against women was observed in the villages in the study area that retain their rural attributes, as it is in rural areas that traditional influences are most present.

5.6.1.3.1. Access to land

According to interviews with women in this region, women have a right to the land. They can also buy land when they have the financial means.

It should be noted that two methods of acquiring land are known in the area, namely inheritance and purchase. With regard to the conditions of access to land by women, it appears that traditional practices still persist in some places in the area. In the past, women did not have access to land, but nowadays things have changed, even if the distribution of inherited land is not equal. It should be pointed out that when a woman feels that she has been wronged in the distribution of land inheritance, she can take her case to the chiefdom, which should in principle restore her rights. However, it must be acknowledged that efforts still need to be made in this direction for the benefit of women in the area.

Several women interviewed on the subject admit that, in reality, implementation has its limits for women. The primacy of men over women does not allow the latter to claim their rights in the current traditional context, especially when a woman's husband dies.

5.6.1.3.2. Education and training

Since 2006, when the government made public primary education compulsory for all, progress has been made in education, but many problems still remain, even though 93%[8] of children have access to school. Some parents refuse to send their children to school and girls are particularly affected. According to the Francophone Institute for Sustainable Development (IFDD), 39% of school-age girls are not in school, compared to 15% of boys[9].

School is also, for a majority of girls, a place where they are victims of sexual and other physical abuse. School is therefore not a safe place for them. According to a 2018 Plan International report, although corporal punishment has been banned since 2000, gender-based violence is still prevalent and widespread. Although there are no reliable figures, cases of sexual abuse, blackmail and rape in schools affect many girls, sometimes as young as twelve years old. Under the pretext of awarding good grades, some teachers do not hesitate to force pupils to have sexual relations with them. This has consequences for the psychological and mental health of children.

According to the data collected during public consultations, many of the women interviewed in the various villages do not attend school due to a lack of financial resources or because their parents choose not to send their daughters to school. Nevertheless, they declare that they have taken vocational training courses (sewing, hairdressing, breeding, processing of local products, etc.) and wish to improve their skills, particularly in terms of literacy.

5.6.1.3.3. Gender based violence

In Togo, according to the 2011 national policy on gender equity and equality, "gender-based violence is present at all levels of society (homes, streets, workplaces and learning environments...). The practice of certain types of violence is linked to the tradition of the perpetrators and the victims".

Violence against women is often inherited from tradition and takes different forms. Togo is thus marked by the persistence of widowhood rites which can lead to inhuman and degrading practices against women (confinement, deprivation, physical or psychological torture). Female genital mutilation is also still widespread, as are early marriages and pregnancies.

In the study area, interviews with women showed that some of them reported being victims of physical violence in marital relationships, which they usually settle within the family.

[8] http://www.ifdd.francophonie.org
[9] http://www.ifdd.francophonie.org

5.6.1.3.4. Economic activities and intra-family income management

In all the villages visited during the consultations and on the basis of discussions with the communities, there is no major distinction between men and women in terms of economic activities. Women claim to carry out agricultural and livestock activities in the same way as men do.

Most domestic responsibilities are managed by both the wife and her husband, although in the socio-economic surveys 86% of the heads of household were men. However, women provide important support in managing the family's needs alongside their husbands. Apart from agricultural and livestock activities, some women engage in small-scale trade from which they also earn additional income to help their husbands meet their family needs.

5.6.1.3.5. Women's place in local governance

During the interviews conducted in the different villages, women recognised and attested by examples that they are increasingly involved in the governance of their local territories. They are thus represented in local dynamics such as the Township Development Committee (CCD), the Village Development Committee (VDC) and their specialised commissions in various positions. They organise themselves freely in associations for tontines but also in economic interest groups, to carry out income-generating activities, make loans, store products, but also cultural activities, etc..

5.6.2. Demographic data

5.6.2.1. National and maritime region population growth

Togo has a population of 7.7 million in 2020, according to the National Institute of Statistics and Economic and Demographic Studies (INSEED), compared to 6 million in the last general population census conducted in 2010. With an estimated annual population growth rate of 2.3%, Togo's population has almost quadrupled between 1960 and 2020. The country is characterised by a very young population (60% are under 65), a high birth rate and a life expectancy of around 66.6 years (CIA, 2020). A slight demographic imbalance favours the female population (about 51% of the Togolese population is female).

The population is unevenly distributed across the country. The population is essentially rural, although there is a trend towards rapid urbanisation, driven by a massive rural exodus, mainly to the south of the country and in particular to Lomé, the country's capital.

Togo is thus strongly marked by the macrocephalic development of Lomé, which concentrates populations, economic activities and political functions.

The migratory flows resulting from Lomé's attractiveness determine and significantly contribute to the growth of its population, which is constantly accelerating. With a population of 1,622,283 inhabitants at the last census in 2010 and a growth rate of 2.77% between 1981 and 2010, Lomé is home to 25.37% of the Togolese population and concentrates more than 60% of the country's urban population. According to projections for 2020, it is estimated to have 1,828,000 inhabitants (CIA, 2020).

A city with the highest primacy rate in the Gulf of Guinea, it was already, at the beginning of the 1990s, among the countries with mature urbanisation (A. Snrech, 1994; Ph. Hugon, 1993) in sub-Saharan Africa and is ranked among the 10 fastest growing cities in relative terms between 2005 and 2010 in Africa (UN-HABITAT, 2010; K. A. Biakouye, 2014).

The exponential growth of the population of Lomé therefore leads to its extension towards the peripheries. This is a system of decongestion of the city which is tending towards saturation.

The maritime region remains much more populated than the others in the country. Indeed, with a population of 2,599,955 individuals for a surface area of 6,395 km² (11.30% of the country's total surface area), it has a density of 407 people/km², compared with 163 people/km² in 1998. This situation can be explained by the fact that the maritime region is home to Togo's maritime façade and thus offers a strategic position in the region. Among the strategic infrastructures, the Autonomous Port of Lomé, installed on more than 900 ha, constitutes a hub of commercial and industrial attraction thanks to a vast Industrial Free Zone (IFZ) where several dozens of companies and industrial production units are established. Moreover, the new Lomé airport, with its capacity to receive more than 2.5 million passengers and 50,000 tonnes of freight per year, has made Lomé a regional hub for air transport. The presence of the University of Lomé and prestigious schools of higher education also makes the coastal area of the country an intellectual and cultural melting pot.

5.6.2.2. Socio-demographic changes in the cantons of the municipality of Tsévié

In terms of demographics, the prefecture of Zio has 297,970 inhabitants (RGPH42010).

According to the data from the last two censuses, the town of Tsévié has doubled its population over 30 years. The population has increased from 20,325 inhabitants in 1981 to 54,474 in 2010. Over the same period, the number of city dwellers has more than tripled in the Maritime Region, rising from 428,978 to 1,610,020 individuals. They represent 62% of the regional population, 26% of the national population and 69% of the national urban population. These figures illustrate the significant urbanisation of the Maritime Region compared to the rest of the country. It appears that the phenomenon of urbanisation benefits more the "Greater Lomé Agglomeration" where 25% of the country's population is concentrated, despite the fact that Tsévié is the capital of the region. This situation does not fail to cause harmful consequences both in the large agglomerations of Lomé and in the secondary towns of the interior, such as Tsévié, which is struggling to play its role as a buffer town and a regional balance centre.

The cantons of Kpomé and Dalavé had 9,330 and 12,030 inhabitants respectively in 2010, making a total of 21,360 inhabitants. The area has seen a rapid increase in population, especially since the early 2000s, following the socio-political turmoil that Togo has experienced.

The municipality has also undergone strong socio-cultural changes due to the ethnic mix generated by the migration of both city dwellers from Lomé and rural villagers who have all settled on the outskirts of the capital. This mixing has led to a socio-cultural recomposition and a change in the dynamics of social cohesion and traditional governance.

5.6.2.3. Poverty and vulnerability

According to the World Bank, although the poverty rate decreased from 61.7% to 53.5% between 2006 and 2017, poverty and inequality remain very high in Togo, especially in rural areas where 69% of households were living below the poverty line in 2015. Poor people are particularly vulnerable because they are exposed to life shocks (illness, death, eviction, unemployment, etc.) that they cannot cope with due to lack of resources or limited means.

In addition to the poor, people living with disabilities are also vulnerable. The last general population census counted about 80,000 people with disabilities, representing 2% of the Togolese population. The census underlines that there are several types of disability within the population. Lower limb disability (30.3%) and visual disability (28.3%) are dominant. Women are also more vulnerable because they have less access to economic opportunities.

In the study area, vulnerable groups include, similar to the national level, people with disabilities, women (especially single mothers and widows) and people in extreme poverty, as well as children.

The socio-economic surveys revealed that 26% of the households surveyed have at least one member with a disability, 8% are managed by a widowed head of household, 12% by a head of household over 65 years old and 38% by an illiterate head of household.

5.6.2.4. Indigenous populations

There are no studies indicating that Togo has indigenous populations. The African Development Bank, which has compiled a list of indigenous peoples in Africa, does not mention Togo in this list.

5.6.3. Culture and cultural heritage

5.6.3.1. Ethnic groups and languages

Togo is characterised by great ethnic diversity. Around forty ethnic groups have been identified and divided into five major groups according to the similarities they share: i) Adja-Ewe-Mina; ii) Kabye/Tem; iii) Akposso-Akebou; iv) Ana-Ife; v) Para-Gourma/Akan.

Although the Ewe are in the majority, the population of the maritime region remains very diverse and includes all ethnic groups in Togo, the main ones being: Adja, Mina, Ouatchi, Kabye, Losso, Lamba, Tchokossi, Tem, Natchaba, Dye, Tamberma, Bassar, Tchamba and Moba, Akposso, Akebou and Ana-Ife.

Each of these ethnic groups has its own language. However, French remains the official language of the country.

The population of the city of Tsévié is characterised by the major ethnic groups recognised as native to the Maritime Region. These are the Ewe, the Mina, the Guin, the Ouatchi and the Adja. In addition to these groups, there are almost all ethnic groups from other regions and countries. The alloctones are essentially farmers, traders and civil servants or people in search of better living conditions. These include the ethnic groups Tem, Kabyè, Moba, Tchokossi, Losso, Bassar, Fon, Ana, Agnanga, Gourma, Yorouba, Zerma and Haoussa.

The cantons of Kpomé and Dalavé are today constituted by a multi-ethnic, even cosmopolitan population, composed mainly of Ewe, Kabye and Losso.

According to the results of household surveys, the vast majority (86%) of heads of household belong to Ewe group. These are the natives who are in the majority in the villages of the study area. They are followed by the Kabyè ethnic group (4%). This configuration shows that the original (aboriginal/native) population is predominantly represented in the project area despite the arrival and settlement of other ethnic groups.

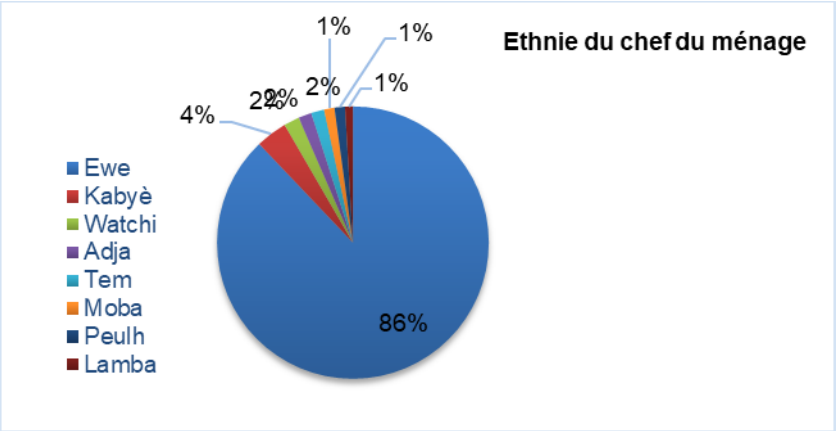


Figure 85 Ethnicity of household heads (source: Insuco field survey - August 2021)

The languages spoken by households in the study area are consistent with the information collected on ethnic groups as Ewe is the language spoken by a majority (95% of households) followed by French (61% of households). The other languages are spoken by a minority.

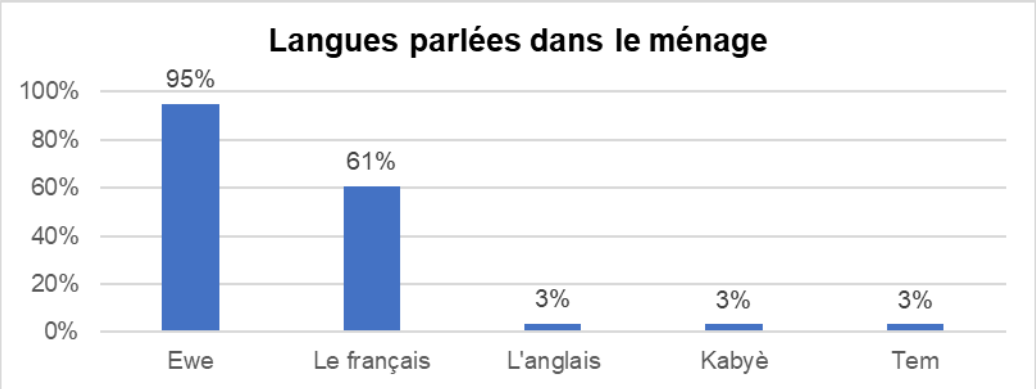


Figure 86 Languages spoken in households (source: Insuco field survey - August 2021)

5.6.3.2. Religions

Togo is a multi-faith country where animism, Catholicism, Islam and Protestantism coexist. Animism and Catholicism are the predominant religions, while Islam and Protestantism are only practised by a limited part of the population.

In the villages of the study area, the socio-economic surveys revealed that the majority (54%) of the household heads are animists. Other important religions in the area are Christianity (26%) and Protestantism (12%). Other religions are minority religions.

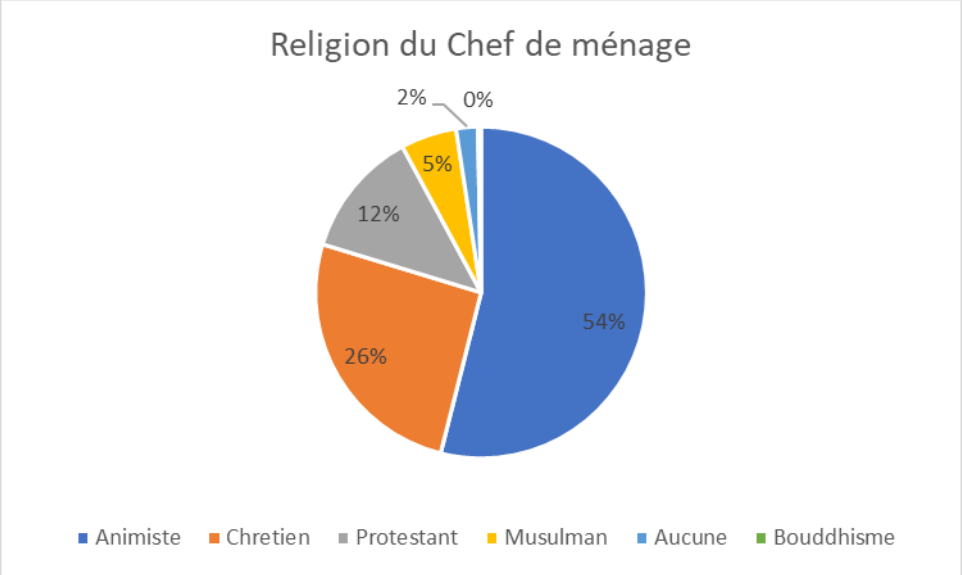


Figure 87 Religion of household heads (source: Insuco field survey - August 2021)

5.6.3.3. Traditions, beliefs, rites, values

According to the history of the Ewe people, the founders of the town of Tsévié emigrating south (exodus from Notsé which would date back to 1720), tired and deprived, decided to plant beans. When it was time to leave, the farmers protested, demanding to wait for the harvest. This is the origin of the present name of Tsévié, which is made up of "Tsé" (to produce) and vié (a little). Ayiza owes its name to the "Ayi" bean and is celebrated every year on the second Saturday of August in Tsévié.

The sons and daughters of the municipality of Zio gather around their traditional festival where traditional songs and dances punctuate the festivities, thus creating great fervour in the community..

5.6.3.4. Presence of sites of significant cultural value

There are no listed cultural heritage sites in and around the Project site. In Togo, archaeological excavations are quite recent and several sites have been discovered. Some of these archaeological sites are included in the national list of cultural properties, a list of all cultural properties identified by the Togolese administration to facilitate official protection. None of the sites identified to date are in the immediate vicinity of the Project site, the first site identified being located more than 100 km from Lome[10].

However, the consultations revealed the presence of cultural heritage sites for the communities. The Phase 2 site contains several fetishes (Kpetchou 1, Kpetchou 2 et Kpetchou 3, which belongs to the village Kpomé Agomé), which will be located in the RAP[11], as well as a church which location is shown in Figure 78.

[10] http://togocultures.com/biens-patrimoniaux-du-togo-monuments-historiques-sites-archeologiques-et-naturels/

[11] At the time of writing this ESIA, INSUCO is completing the RAP

5.6.4. Spatial organisation and urban dynamics

5.6.4.1. Geographical extension of Lomé

A long period of sustained demographic growth and the increasing concentration of the population in the capital of Togo have considerably increased the need for housing and consequently the increase in the surface area of the city. As an outflow of rural migrants, Lomé does not have sufficient and adequate housing for them, as well as for neo-citizens and many other city dwellers in the central districts. The saturation of the pericentral and central neighbourhoods, as well as their congestion, considerably limit the supply of housing and building space: 'not only are building plots scarce in these residential neighbourhoods, but prices are also very high and therefore out of reach for the majority of city dwellers' (KA Biakouye, 2014, p. 180; M. Takili, 2014, p. 129).

Thus, while the price of a 600 m² plot of land varies between 5 and 6 million CFA francs in the periphery, in the central and pericentral districts, this land costs more than 20 million CFA francs. The same applies to room rents, which are soaring and becoming difficult for the population to afford. The near and far peripheries are becoming the default choice for city dwellers seeking building land and property. Residential migration to the city outskirts caused by housing needs and new demands for building land has resulted in a sprawl of more than 50% of the municipal territory. The latter, with its 9,000 ha, now occupies only 41% of the total area of the greater Lomé area.

This area increased from 55 ha in 1914 to 1,275 ha in 1959, to 6,907 ha in 1985 and 11,513 ha in 1995, giving an expansion rate of 460 ha/year. This speed more than tripled between the end of the 1990s and the beginning of the 2000s. The city of Lomé has since surpassed the official communal limits, constituting a vast area of about 28,000 ha whose borders merge with those of the Prefecture of the Gulf (KA Biakouye, 2008, p. 159).

The sprawl of the city of Lomé is oriented towards the north, east and west where hectares of agricultural land are included. The fairly intensive spatial expansion has led to the reduction and loss of arable land, so that in 96 years (from 1914 to the last population census in 2010), Lomé has consumed 27,945 hectares of land suitable for agricultural activities. The inadequacy between the supply of housing and especially building land in the city centre and the rapidly growing needs can only encourage a dynamic on the urbanisation fronts both near and far, hence the proliferation of huge peripheral districts. This frontage dynamic has reached several localities, including Adetikope in the northern part, which is undergoing profound social and economic transformations.

The impressive growth and attractiveness of the city of Lomé is linked to its multifunctional nature. The city of Lomé plays the role of political, administrative, economic and even cultural capital. Indeed, since the colonial period (1884 to 1960), the city of Lomé has accumulated these key strategic functions. Equipped with important socio-economic infrastructures and facilities (pier in 1900, railway in 1905, 1907 and 1911, shops and banks), Lomé has become an important and privileged centre of attraction for the communities of the region and for the populations living in in the country. Various trade and development actors come here to seize the business opportunities offered and to benefit from the goods and services. Today, the city has large hospitals and medical clinics, major business centres, major schools, private and public universities, training institutes, as well as an airport and a deep water port which have recently been expanded to increase their capacity and improve their performance. It also has an industrial free zone which attracts investors and businessmen from all sides.

These infrastructures are all decisive assets that reinforce the attractiveness of the Togolese capital and explain its multiform dynamics and its overflow. Based on these realities, K. Nyassogbo (2010, p. 119), believes that with its influence and thanks to its various infrastructures, 'Lomé has acquired all the characteristics of a macrocephalous agglomeration' and is tending to become a regional sub-metropolis.

However, apart from its political-economic-administrative personality, which determines the city's growth, other factors contribute to the overall dynamic, notably the spatialization of the agglomeration. This is the internal demographic growth that is strongly and constantly fed by a massive rural exodus, which explains the demographic ruralization of the city and the increasing urbanization of the rural areas on the periphery.

5.6.4.2. Urbanisation and transformation of the Tsévié municipality

According to the last two censuses, the town of Tsévié has doubled its population over 30 years, but it appears that the phenomenon of urbanisation benefits more the "Greater Lomé Agglomeration", where 25% of the country's population is concentrated, despite the fact that Tsévié is the capital of the region.

The graph below shows the evolution of the population of the main urban centres of the Maritime Region from 1981 to 2010.

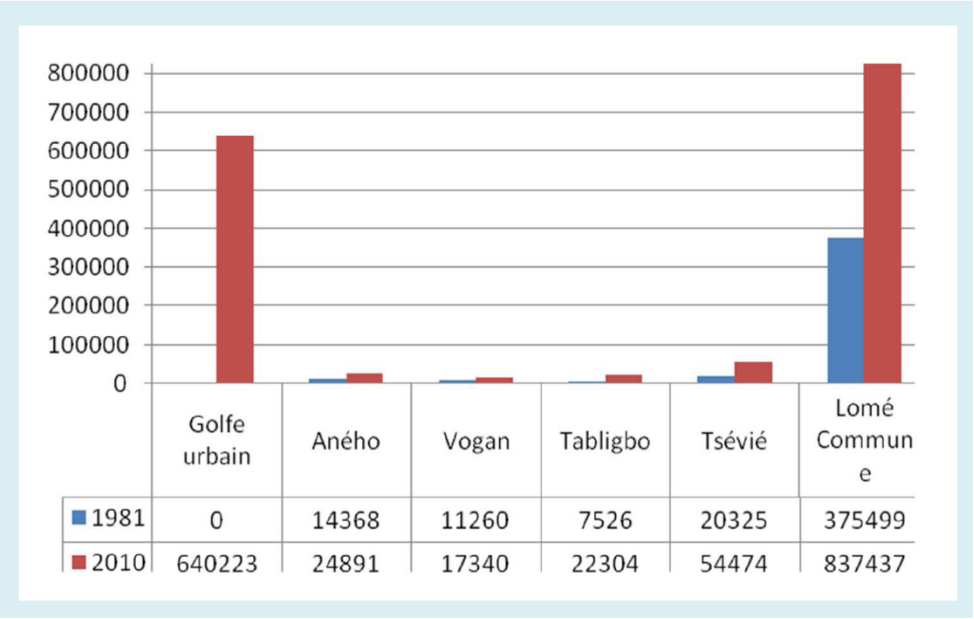


Figure 88 Population growth in the main urban centres of the region (RGPH4)

The main causes of this average demographic and spatial growth in the town of Tsévié are: the low rate of natural growth and the massive departure of working people due to the lack of decent jobs. This town is also marked by the inadequacy of basic infrastructure and equipment.

Under the effect of the urban sprawl of Lomé and the overall demographic growth of Togo, the cantons of Dalavé and Kpomé are tending to leave their original boundaries and their purely rural setting.

The evolution of the urbanisation line towards the rural periphery has given rise to an original, hybrid space, with both semi-urban and rural characteristics. The urban areas thus exist side by side with patches of rural areas that still exist.

The suburbs of the city have also started to acquire economic, commercial and industrial functions with the development of trade, transport, services, markets, industries and public services. They thus benefit from an industrialisation resulting on the one hand from the richness of its subsoil and on the other hand from the lack of space available in the capital to accommodate small and medium-sized industries. Its location near the RN1, a real nerve centre between the port of Lomé and the Sahel, is an important factor in this industrialisation.

The macrocephaly of the city of Lomé is significantly influencing and reshaping the peripheral areas, causing a profound change in the human environment in terms of social practices, economic activities and the livelihoods of the residents.

5.6.4.3. Territorial development

5.6.4.3.1. Village development plan

The villages of Hagblévou, Aflaocondji, Gnatikopé, Tokpanou, Vondjogbékopé, Agbadovinou, Fiogblé, Djogblakopé, Kpomé Akadjamé and Kpomé Agomé, which are the villages impacted by and bordering the Project area, do not have a village development plan. The municipality is currently working on the elaboration of the communal development plan and it is certain that the villages in these cantons will each subsequently develop their own village development plan. Most of the land expropriated for public use for the project is located in a predominantly rural area where the land is not subdivided, hence the term rural land.

However, some of the land is subdivided, which makes it possible to provide streets and reserves for the construction of socio-collective infrastructures, the development of green spaces and places of relaxation and recreation for the local population.

5.6.4.3.2. Municipal development plan

The commune of Zio has a communal development plan which was drawn up in 2015 and which has expired in 2019. This plan highlights the strengths, weaknesses, opportunities and threats of the commune and outlines the planned governance focused on the following sectors: education, health, water and sanitation, sport, culture, leisure, electricity and the environment, all around a vision, namely: "By 2030, Tsévié is a serene commune, with concerted governance, effective and inclusive management, a flourishing local economy that creates jobs, cultural influence, in a spirit of social cohesion, citizen participation, offering quality basic social services in a healthy environment for social well-being.

This 2015-2019 communal development plan is currently being updated and will take into account the needs and concerns of the various villages in the two cantons affected by PIA.

5.6.5. Land resources

5.6.5.1. A land tenure system in conversion

The rapid and sustained demographic growth of large African cities has led to an increase in their surface area and, above all, an increase in land pressure, due to the high demand for land for various uses.

The peri-urban and rural areas adjacent to Lomé, which are zones of agricultural activity par excellence, have become privileged targets for the settlement of urban populations.

While land transactions in Lomé are increasingly similar to those of a commercial property, with an average annual increase in the price of land of between 15 and 30%. ; this urbanisation is not yet fully pronounced in the cantons of Kpomé and Dalavé, although it is beginning to show. There are still large areas of non-residential land, even though a large part of this land has already been sold by the landowners. The installation of industrial units in the area, which has a subsoil very rich in mineral products, is a factor of attraction for economic operators, but it should be noted that a large part of the population continues to depend on agricultural activity as a source of income and means of subsistence.

5.6.5.2. Mode of land access

Traditionally, the customary mode of land acquisition is inheritance and donation. This practice is no longer applied in the area due to the value focus of the land today.

In the area of the PIA Phase 2 site, discussions with people and community leaders during our consultations revealed that the two modes of land acquisition used in Kpomé and Dalavé townships are inheritance and purchase. The majority of land is owned by local communities. However, they have also sold land to new buyers who have now become landowners, sometimes creating frustration among the local people.

The data from the household survey show that the majority of people (63%) who practise agriculture in the area are holders of the land they farm. The majority of landholders are lineage holders (93% of them). Only 13% of landholders own individual plots of land that can be transferred to their children.

The other farmers are simple operators. They have access to land mainly through free loans (45% of them), renting (32%), sharecropping (6%) or other arrangements.

5.6.5.3. Functioning and actors of the land market

The land issue represents the subject crystallizing the debates in the prefecture of Zio. "Land has become the most coveted object, so much that each actor generally plays in favour of his interests"[12]. If land is so coveted in Zio, it is because it is partly located near the capital Lomé. To date, the possibilities of acquiring land for the construction of urban infrastructures are shrinking in the Gulf prefecture. All eyes are now on the prefecture of Zio, which serves as a new land reservoir for the capital.

The prefecture of Zio offers better potential for the urban expansion of Lomé than the other prefectures. Indeed, the coastal erosion which is accelerating on the eastern coast of Lomé and the proximity of the Ghanaian border to the west, respectively limit the urban progression of the capital towards the prefectures of Lakes and Avé. These two prefectures share smaller boundaries with Lomé. These boundaries are each less than 10 km long, whereas the boundary with the prefecture of Zio is more than 30 km long.

It is also important to note the presence of the national road n°1 in the area.

All these parameters have made the demand for plots of land stronger in the Zio prefecture. This high demand is also favoured by the physical potential of the area.

Land transactions have become a very lucrative activity that attracts many intermediaries.

The value of land, combined with acute housing problems, has led to the emergence of an informal property market. This market brings into play several actors with conflicting interests whose actions transform the environment. These include customary owners, speculators, buyers and brokers, commonly referred to as informal estate agents.

5.6.5.4. Land conflicts and their resolution

Interviews with the project's stakeholders have revealed several levels of land conflict resolution. Depending on the nature, extent and forces involved (each wanting to play on these relationships), different authorities are called upon to settle the dispute.

[12] AYARMA Assètina, Doctoral thesis in human geography, « l'insécurité foncière comme obstacle à l'équilibre de l'écosystème et au développement socio-économique de la préfecture du Zio au sud du Togo, 2019

Customary chiefs are involved in conflict resolution, but generally complainants turn directly to the courts to resolve land conflicts. The actors involved in the resolution of conflicts are traditional leaders at various levels, the leaders of the communities that own the land and the competent courts.

Many cases related to land conflicts in the area are currently before the courts and it is up to the judges to decide on these problems, according to the people and community leaders during the consultations.

On the Phase 2 site, 244 ha are currently the subject of land disputes brought before the courts.

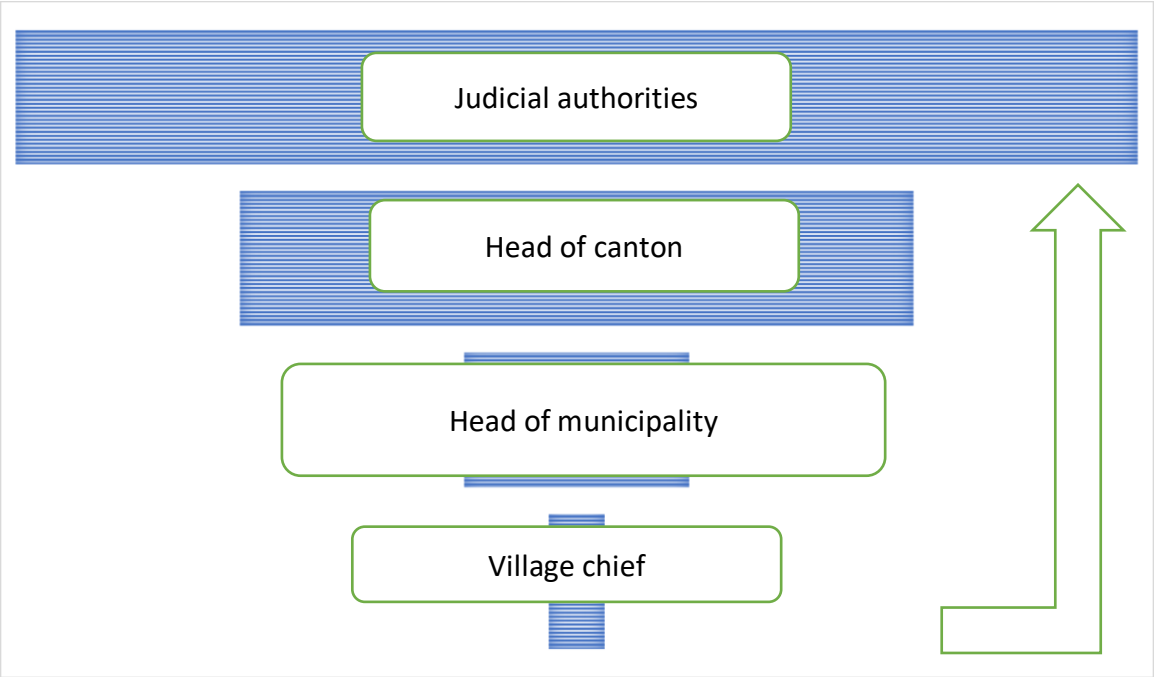


Figure 89 Diagram of the different levels and actors of land conflict resolution (source: consultations August 2021)

5.6.6. Economic activities and livelihoods

The economy of the Maritime region is weak, with a GDP of US$3.52 billion in 2014. It is driven mainly by the agricultural sector, transport infrastructure development and the extractive sector. Its growth rate was estimated at 5.5% in 2014 (Ntagungira & Kazadi, 2015).

The port of Lomé, with its regional vocation, and the phosphate mines in the region are also important poles of activity. Due to its strategic geographical position, the Maritime Region trades with the West African sub-region, Europe and North America. It is also the crossroads of the Abidjan-Lomé-Lagos transport and trade corridor and the Lomé-Ouagadougou-Ndjamena corridor.

The Project area is mainly characterised by primary sector activities. The population lives mainly from agriculture, livestock and fishing. 90% of the households interviewed during the surveys practice agriculture. It is the main activity of 50% of household heads and the secondary activity of 37% of them. 74% of households practise livestock farming. Livestock rearing is not frequently the main activity of heads of household (4%) but is a widespread secondary activity (32%). It should be noted that the majority of households (87%) are pluriactive.

It should also be noted that the area is under the influence of land-based sand exploitation activities that have remarkably marked the topography of the area. There are many abandoned excavations or quarries in operation in the area, especially in Dalavé. The establishment of factories (SNPT, Diamond Ciment) has

to some extent allowed the installation of some industrial economic activities in the Kpomé area and its surroundings.

Sand exploitation is a highly developed socio-economic activity in the Dalavé area, and a significant source of income for the local population, even though the government has now taken steps to regulate the sector by closing down illegal quarries.

With the expansion of the urbanisation fronts of Lomé, agricultural activity is gradually being replaced by commercial and industrial activities. Industrial actors are taking advantage of the space still available to set up with the support of the government.

The proximity of the city of Lomé is at the origin of the diversity of economic activities that are encountered in the area (cybercafés, the development of the sale of articles coming from the port of Lomé, ready-made clothing shops, etc.).

However, the emergence of other economic activities cannot replace, at this stage, the agricultural means of subsistence of the populations of the two townships, which are in rural areas..

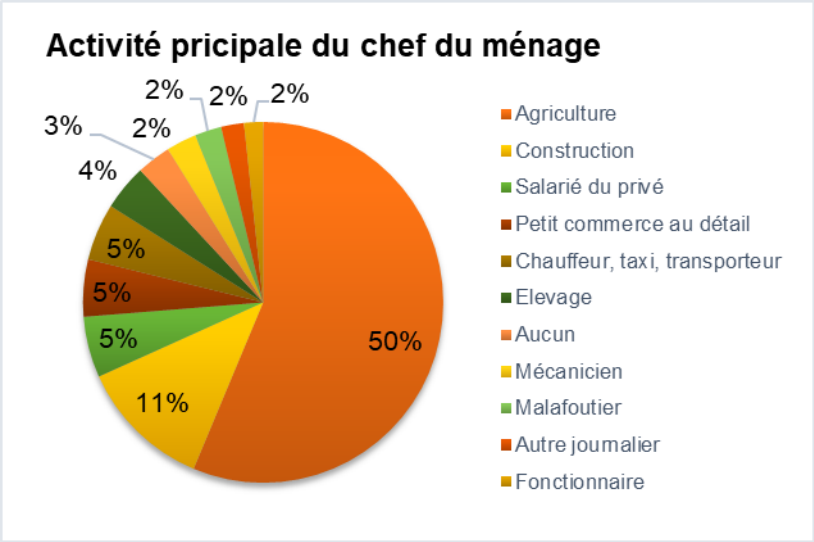


Figure 90 Main activity of the household head (Insuco field survey - August 2021)

5.6.6.1. Agricultural activities

The main economic and subsistence activities practised in Dalavé and Kpomé townships are agriculture, hunting, traditional livestock breeding and crafts. These activities are both social and economic in nature.

With its relatively favourable natural and climatic conditions, Dalavé and Kpomé have economic activities and livelihoods based mainly on agriculture.

According to the results of our socio-economic survey, agriculture is the primary economic activity of the majority of household heads. It is the main activity of 50% of household heads and the secondary activity of 37% of them.

5.6.6.1.1. Agriculture and arboriculture

According to the testimonies recorded during the various interviews, agricultural production is mainly used to feed the family members and to earn money to carry out the necessary exchanges and to obtain basic necessities. Farming was practised by the members of the family units on land inherited from the grandparents but also on plots of land that were lent, rented or even bought.

The main annual crops grown by households are corn (89% of households), cassava/yams/sweet potato (76%), chilli (27%), cowpeas/beans (24%), tomatoes (18%) and groundnuts (13%).

All these crops are generally partly self-consumed and partly marketed. The proportions of marketed and self-consumed crops vary according to the situation of the households and the areas they cultivate. However, some crops are dedicated in larger proportions to marketing or consumption. As far as marketing is concerned, this is particularly true of groundnuts and tomatoes.

Agricultural products are sold on local markets and most often at the market in Tsévié.

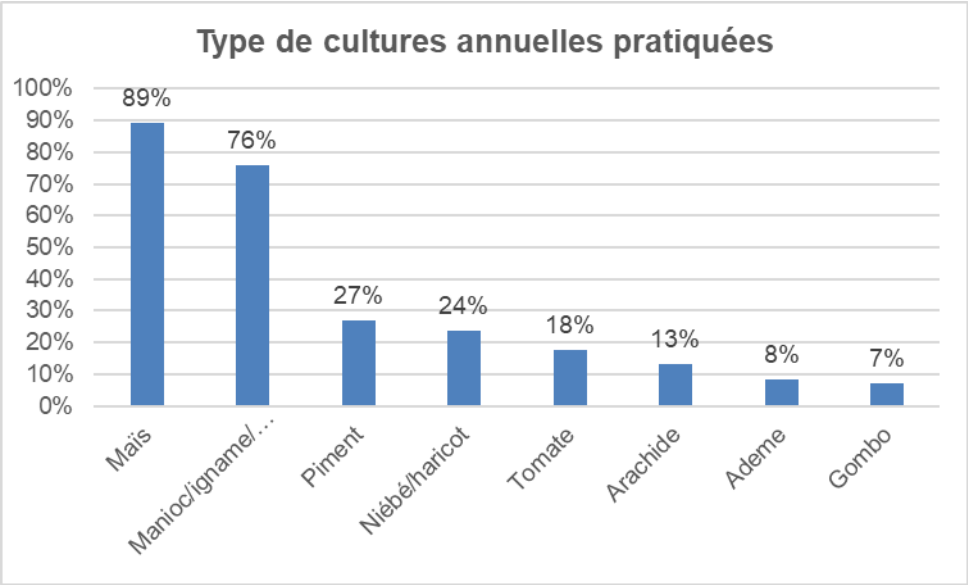


Figure 91 Type of annual crops cultivated (source: Insuco field survey - August 2021)

In addition to the annual crops cultivated, the populations of Kpomé and Dalavé also grow perennial crops. These include oil palm (44%), mango (27%), orange (18%), pineapple (12%), coconut (10%), papaya (8%) and lemon (4%).

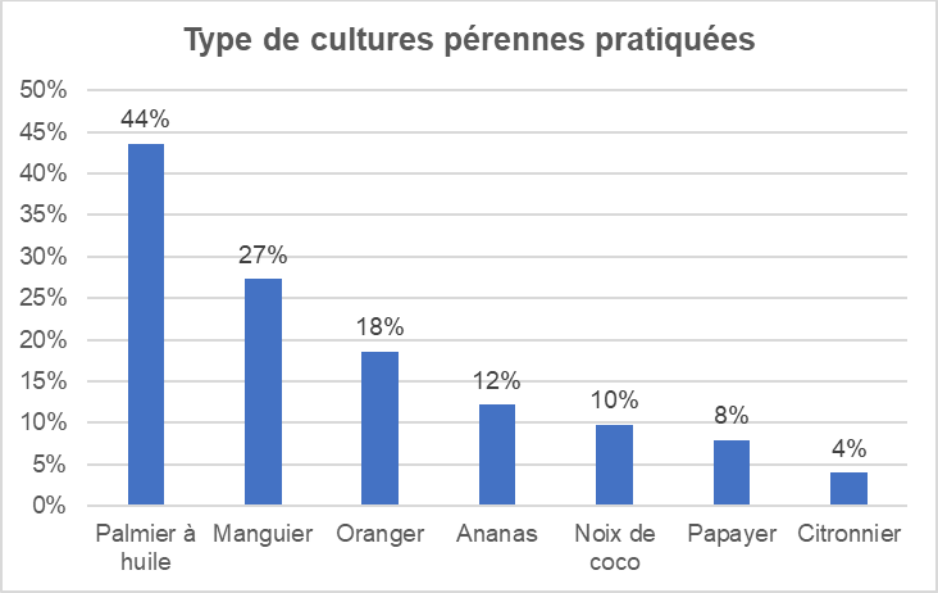


Figure 92 Type of perennial crops grown (Insuco field survey - August 2021)

Market gardening is also practised in the area. Just over half (52%) of the heads of households interviewed carried out this activity.

Today, given the scarcity of arable land in the locality, most farmers have migrated to other rural areas where the availability of arable land is guaranteed. Others have converted to the newly emerging jobs in urban areas to meet the needs of urban dwellers. Cultivation is small scale due to low mechanisation of farming practice and the presence of many industrial projects that have created a lack or insufficiency of available cultivable land.

5.6.6.1.2. Breeding

Zio prefecture is home to a vast agro-pastoral farm called "Terre Bénie" in the canton of Gamé, whose ambition is to become the leader of national poultry production and to materialise the government's projects for the agricultural sector. The project covers an area of 400 hectares and specialises in large-scale layer production, chick and broiler production, and egg marketing. The site has 45,000 laying hens, a production of 80,000 chicks per week and nearly 800 trays of eggs per day. Broiler production was stopped two months ago because of 'unfair competition on the market with imported chicken'. The farm is also involved in agricultural production, mainly using corn and soya for poultry feed and market gardening.

This project, although not located in the commune of Zio1 (the commune receiving the PIA-phase 2 project), is an opportunity to be seized by the young people of the Zio prefecture with a view to creating economic value for the local population.

74% of the households living in the project area are engaged in livestock production. Livestock breeding is not frequently the main activity of heads of households (4%) but is a widespread secondary activity (32%).

Livestock farming in the project area covers the following categories of domestic animals: poultry, goats, sheep, oxen, pigs, etc.

Breeding is an age-old practice that is widespread in the study area, but it is struggling to become an income-generating activity for agro-pastoralists. The proximity of the area to major urban centres

provides an opportunity for the large-scale development of this secondary activity, which could boost the local economy.

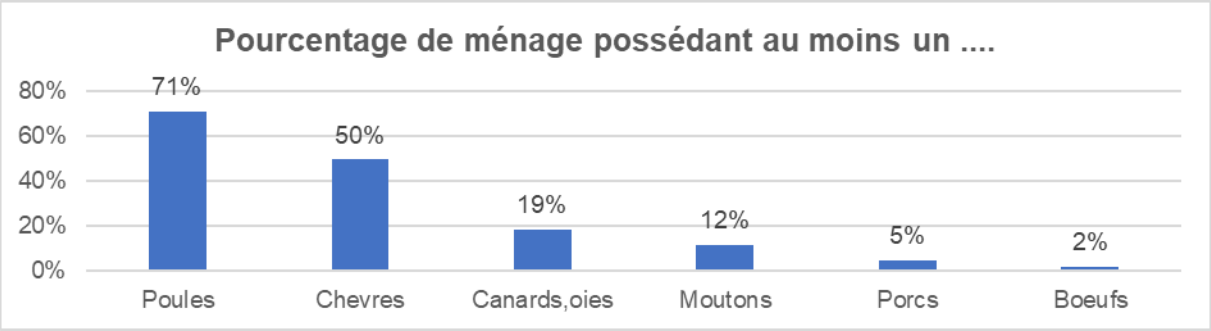


Figure 93 Percentage of households with at least one ….

Poultry is bred for consumption but also for marketing when needed. Beef and goat rearing is done for marketing.

5.6.6.1.3. Fishing

Fish farming is nowadays a promising sector in view of the exhaustion of fishery resources and the degradation of fisheries. Despite the country's many potentialities, the sector is still struggling to develop in Togo.

Togo is one of the sub-Saharan African countries with low aquaculture production, with a national contribution of 0.49% in 2017 (FAO, 2017, p. 19).

Three types of fish farms namely can be distinguished in the maritime region: artisanal fish farming of small-scale market production (PAPPM), chain-type fish farming (PTF) and self-consumption fish farming (PA). The owners and technicians of fish farms are the main actors in this sub-sector.

Located about 20 km from the sea, fishing is not practiced in the project area. However, the presence of women who smoke imported frozen fish has been recorded.

Figure 94 Woman selling smoked fish

5.6.6.2. Commercial activities

The capital of the Prefecture of Zio and the Maritime Region, the town of Tsévié is at the crossroads of several roads, including the National Road No. 1 (Lomé-Burkina Faso international road), the National

Road No. 4 (Tsévié-Tabligbo road), the Tsévié-Kévé-Djolo-Ghana road, the Tsévié-Dalavé road and the Tsévié-Gapé-Centre road. This positioning offers the town interesting trade opportunities.

Commercial activities in the commune of Zio 1 animate the life of the territory. The market of Tsévié and the small markets of the surrounding villages welcome sellers and buyers from Lomé, Tsévié and other neighbouring regions for commercial exchanges.

5.6.6.2.1. Tsévié market

The old market in Tsévié (a town located 35 km north of Lomé) no longer meets the expectations of the population (outdated infrastructure dating from the German era, narrow space, impracticality of some paths during the rainy season). This sub-regional market (run by traders from Benin, Ghana, Burkina Faso and other towns in Togo) is an important lever in the local and national economy. Thus, at the request of the local authorities and traders, a new modern regional market was built in the Adiakpo district of Gblainviémodji with the support of the German Development Bank (KfW) in November 2018 and handed over in June 2021. The market in Tsévié comes alive every Friday where trade in various products is carried out.

In the Zio 1 commune, the municipal authorities are determined to ensure the proper use of the infrastructure, which will boost the commune's revenue and thus its budget to contribute to local development. To achieve this, several measures have been taken: the 'census of traders' for a better relocation, 'the choice of the market's management system, which is direct management', 'the organisation of the market's corporations and associations', 'the taking into account of traders' concerns during the design and execution of the infrastructures' and 'the taking of decisions relating to the municipal taxes' that will be applicable in the new market'.

Figure 95 : New Tsévié market

Figure 96 : Tsévié market's activities (old market)

5.6.6.2.2. Tsévié, commercial intersection

As the capital of the maritime region, the town of Tsévié is a commercial crossroads, due to its geographical position. On the one hand, Tsévié is crossed by the national road n°1 (Lomé- Cinkassé) and on the other hand, it is crossed by the road from Lomé to Tabligbo (the city of clinker).

To satisfy their daily food needs, the urban population of Tsévié and their immediate surroundings turn to this market, which provides products at relatively low prices compared to those charged in the large markets of the capital.

Animals for meat, cereals, tubers, fruits and vegetables for everyday consumption from the surrounding villages make up the bulk of the market's supply. Informal trade in manufactured goods is also developed in this market. Various trades ranging from micro-retail to semi-wholesale on the street, street vendors, stalls of consumer goods and cosmetics, and second-hand clothes shops are very dynamic commercial activities in this city market.

Seasonal variation related to agricultural production is an important factor influencing food prices on the market in Tsévié. It was found that the selling price of local food products is lower at the Tsévié market than at the various markets in the capital, regardless of the time of year. This reality of the price of access

to local food products explains in part the frequentation and affluence of traders in this place of distribution and exchange.

In this market, 3 categories of actors are involved:

- Producer-traders who are mainly local agricultural producers coming from the surrounding countryside and neighbouring villages to sell their agricultural products and obtain imported essential food items such as soap, oil, fish, cubes, salt, matches, etc. This first category usually exchanges local and nearby agricultural and livestock products (poultry, sheep, goats, pigs, etc.) for money. This is in fact a 'food survival' trade that allows farmers to access cash.
- Retail traders who operate shops and sheds in the market and buy from wholesalers. They are more or less permanent and are one of the main actors in the market.
- Wholesalers who are major traders operating shops. They collect food products such as corn, beans, sorghum and chilli etc., store them and sell them at a higher price in times of shortage.

5.6.6.2.3. Hotels and tourism

Hotel and tourist infrastructures are mainly found in the region's capital, Tsévié. Several hotels, motels and inns share the urban space of Tsévié. These hotels host events that are relocated from Lomé such as conferences, workshops etc. The people of Lomé generally choose to leave Lomé and go to secondary towns such as Tsévié to hold their professional activities.

In the villages of the two cantons (Dalavé and Kpomé), the development of street food, small street restaurants and tea and coffee kiosks selling local dishes was noted.

5.6.6.2.4. Arts and crafts

There are many artisans installed along the RN1 or even in the districts of the villages that make up the municipality, including the cantons of Dalavé and Kpomé. There are some who are experimenting with the shaping and decoration of traditional pottery that is sold at the market in Tsévié and elsewhere.

There are also others who devote themselves to small craft trades such as: carpentry, two-wheeler or car mechanics, masonry, carpentry, tiling, upholstery, painting, topography, hairdressing, sewing, etc. Most of these actors are installed in their workshops and take on apprentices who follow vocational training to form the future workforce. There are master craftsmen who supervise the young trainees and who make their products available to customers. Many workshops, especially sewing, braiding and hairdressing, are run by women workshop managers.

They are also present and at the forefront of small service provision units (word processing, photocopying, cybercafé, bar-keepers, glass shops, small street restaurants, sale of local and manufactured products) etc. They animate the local microeconomy by developing income-generating activities (IGAs) of all kinds.

Figure 97: Small workshop and artisan

5.6.6.3. Industrial activities

Zio 1 host a number of industries that are gradually being established in the area. Since the beginning of the 2010s, the inhabitants have witnessed a redeployment and development of certain industrial activities in the area, which were too congested in the urban fabric of Lomé, as well as new projects. These are mainly small and medium-sized industrial units that have sought more space and a cheap labour force that are installed in the prefecture of Zio.
These industries include, among others:

- **Fruit and vegetable processing unit installed in Tsévié:** According to the Togolese authorities, this factory aims to make fruit and vegetable processing "a promising and wealth-creating sector". It will essentially transform tomatoes into purée and pineapples into juice. "The operationalisation of this processing unit opens a new page for the agri-food industry in the country and in particular for the production of fruit and vegetable juices. The unit will enable us to take better advantage of the strategic positioning of the town of Tsévié, especially in relation to the Adétikopé Industrial Platform (PIA) which is gradually being set up, and to support the potential for job creation for young people through entrepreneurship," according to Myriam Dossou-D'Almeida during the inauguration of the said unit.
- **Société Industrielle de Transformation des Produits Agricoles Tropicaux (SITRAPAT) in Tsévié :** The SITRAPAT SA, is a new industrial unit installed on the territory having as objective: the acquisition and the transformation of corn into the following derived products: grits for breweries; flour for human food; semolina; bran and germ for cattle and poultry feed, as well as the marketing of all these products.
- **Société Générale des Moulins du Togo** (SGMT) is a company that processes wheat into flour and milling co-products (semolina, wheat germ, cubed bran, fine bran, coarse bran, remouldings).
- **Africa plastic technology** (APT) in Tsévié: This industry produces PVC pipes for sanitation, drilling, irrigation, telephony.
- **Ciment factory Diamond Ciment,** in the canton of Dalavé: There is a factory for the production of cement not far from Hagblévou;
- **Sand quarries, in the Dalavé area**: these quarries are almost all closed today ;
- **Do-PHARMA**, in Dalavé: a pharmaceutical industry that produces serum;
- **Société Nouvelle des Phosphates du Togo** (SNPT) : a phosphate production factory.

5.6.7. Socio-community services

5.6.7.1. Cantons of Dalavé and Kpomé

The cantons of Dalavé and Kpomé have a few socio-community infrastructures such as schools (public, private, denominational, community) which cover kindergartens, primary, secondary and high schools, not forgetting an agricultural training centre called SICHEM in Zogblakopé. There are 13 educational structures in the canton of Dalavé and 18 in that of Kpomé.

As far as health services are concerned, there is a medico-social centre in Dalave and a health centre in Kpomé.

There are also security services (e.g. the gendarmerie in Kpomé), markets, some microfinance institutions, etc.

Access to water is provided mainly by boreholes, mini-adductions and dams.

Electricity is provided by the Compagnie d'Energie Electrique du Togo (CEET) but the use of solar panels for lighting is common. We note that there are villages that have neither the conventional CEET network nor solar panels.

Mobile phone and internet communications are provided by public (Togocom) and private (Moov Africa) companies. There are also private kiosks selling communication credit and money transfer services, such as Flooz and T-money, and cybercafé operators in the area.

Apart from the national roads RN1 and RN34, which are asphalted, the rest of the transport routes are tracks, not all of which are practicable due to their condition.

The table below gives an overview of the various social and collective infrastructures and facilities that can be found in the two cantons. This list is not exhaustive.

Table 50 Summary of socio-community infrastructures in the cantons of Dalavé and Kpomé

Sector	Infrastructure	DALAVE	KPOME
		Number	Number
Water	Borehole	27	6
	Mini Water Supply	0	1
	Dam	2	0
Education	Kindergarten	1	5
	Primary	8	9
	Secondary	2	3
	Highschool	1	
	Edil	1	0
	Vocational training	0	1
Health	CMS (medico-social centre)	1	0
	Health center	0	1
Microfinance institution	Microfinance institution	2	0
Telecommunication	Telecommunications antenna	2	2
Sanitation	Public latrines	1	0
Social action	Orphanage	1	0
	NGO	3	0
Commerce	Market	0	1

Source: INSEED, List of geographical coordinates of socio-collective infrastructures and facilities, January 2014

5.6.7.2. Villages

The villages affected by the Project and those bordering to it do not have adequate socio-community services. The waste management and wastewater treatment system is almost non-existent in the villages affected by the Project.

The CEET network is present but is not accessible to all households.

It should be noted that in the field of education, there are infrastructures but they belong to private or religious structures. These infrastructures are generally under-equipped.

The same applies to certain peripheral health units or health centres, which do not have enough qualified staff to administer care and treat the various diseases for which patients come for consultation.

These different infrastructure needs were expressed by the populations during the various consultations, who hope that the Project will contribute to the local development of their area through the construction or improvement of these different infrastructures (construction and/or rehabilitation of schools, equipping of health centres, construction of leisure centres, development of tracks, etc.). The populations have many expectations regarding the Project.

5.6.7.3. Community health

5.6.7.3.1. Common diseases in the local environment

In terms of recurrent diseases recorded in the community, malaria is the primary cause of consultation and hospitalisation in this area. In addition to malaria, there are water-borne diseases, diarrhoea, snake bites, etc.

5.6.7.3.2. HIV/ AIDS

The HIV/AIDS pandemic has hit Togo and the entire sub-region hard. With the establishment of a National AIDS Council (CNLS) and the support of the United Nations Programme on HIV/AIDS (UNAIDS), the country has made a lot of progress in prevention, screening and treatment of patients. The care of people living with HIV/AIDS has a medical and, above all, a psychosocial dimension to support patients. Prevalence has fallen: in 2018, it was 2.2% (compared to 4% in 2000). It has been relatively stable for the last 5 years.

5.6.7.3.3. Availability of health infrastructure

The Togolese health system is organised in a pyramidal manner and is based on the deployment of infrastructures at different levels:

- The three teaching hospitals (CHU), which constitute the highest level of reference in the national system;
- Regional hospitals (6), constitute the third level;
- District hospitals (26), are located at the prefectural level;
- Peripheral care units (515), constitute the first level of contact of the population with the health system.

As far as health infrastructures are concerned, the commune of Tsévié is insufficiently equipped. There is a hospital, a polyclinic and private clinics and a Youth and Adolescent Reception, Listening and Documentation Centre, which is a screening and psycho-social care centre for HIV/AIDS. There are also two social medical centres and two medical practices. As far as pharmacies are concerned, there is a state pharmacy incorporated into the Regional Hospital Centre, a pharmacy depot, a private pharmacy called 'Pharmacie de Zio' and a Chinese pharmacy.

In the cantons of Dalavé and Kpomé, according to INSEED data on the list of geographical coordinates of socio-community infrastructures and equipment, January 2014, there is one medical and social centre in Dalavé and one health centre in Kpomé. This situation indicates the inadequacy of health infrastructure in the area, forcing people to travel either to Tsévié or to Lomé for treatment.

The households surveyed stated that they had priority access to the medico-social centre (51% of them), then to a peripheral health unit (30%) and a private health centre (13%).

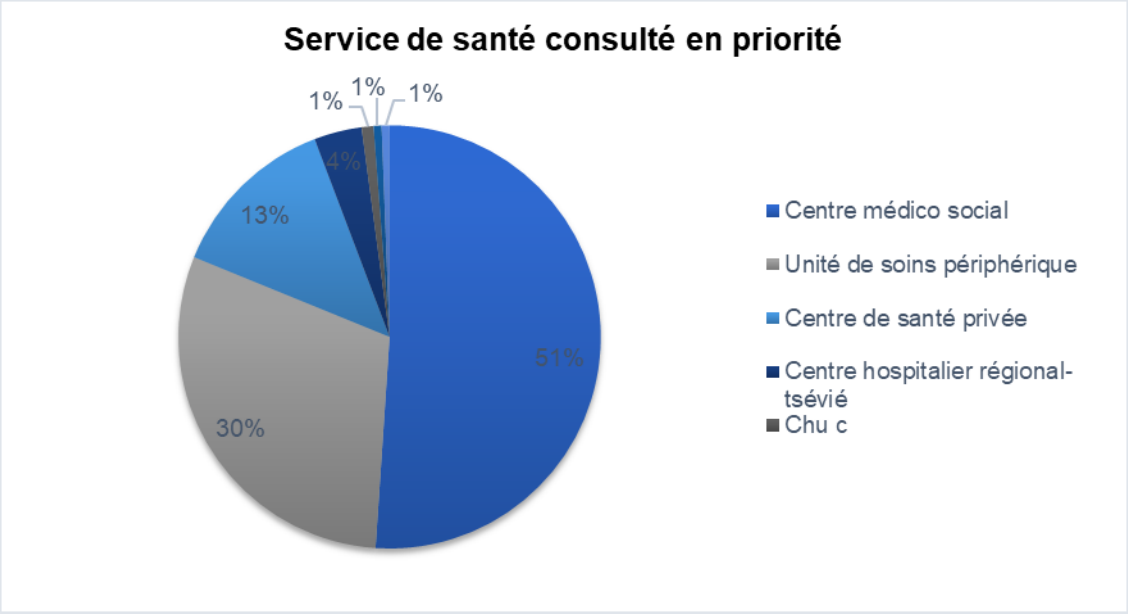


Figure 98 Health service consulted in priority by households (source: Insuco field survey - August 2021)

5.6.7.3.4. Care practices

Health practices in the villages are dominated by self-medication and the use of traditional medicine. People do not systematically go to the health centres, except for serious pathologies.

According to the information gathered in the field, people only go to health centres when traditional medicine and self-medication have not been able to solve the patient's health problem. This situation is mainly due to the unavailability and inaccessibility of health centres, but also to a lack of financial means and cultural factors.

5.6.7.4. Education and vocational training

5.6.7.4.1. Primary education

In almost all the targeted villages of the study, as in the other villages of the district, there is at least one primary school. These schools are either government, private or faith-based. A large proportion of the pupils attend schools located 500 metres or more from their place of residence.

5.6.7.4.2. Secondary education: secondary schools and high schools

There are a few general education colleges (GEC) in both Dalavé and Kpomé cantons, as well as a general education high school.

According to INSEED data, on the list of geographical coordinates of socio-community infrastructures and equipment, January 2014, there are 2 GEC in the cantons of Dalavé and 3 in the canton of Kpomé. The canton of Dalavé also has a general education high school which provides training and education for students in the area.

In view of the insufficient number of these school facilities, some pupils prefer to continue their education outside their home townships, either in Tsévié or Lomé etc.

The problem of insufficient or missing classrooms and teachers is a reality in the project area, particularly in the cantons of Dalavé and Kpomé.

INSEED data show that there are practically no vocational training schools in the cantons of Dalavé and Kpomé. There is only the agricultural training centre called SICHEM in Zogblakopé.

5.6.7.5. Access to water

The need for drinking water is important in the commune of Tsévié. Of the two existing water towers, only one is functional. Of the 25 neighbourhoods, 21 have a drinking fountain. This does not cover the community's water needs, despite the existence of private wells. Water is not always available and easily accessible because of the costs of connection, the distance from the fountains, and the cost of supplying water from private boreholes, which is 50 F for a 25-litre container in normal times and 100 F in times of drought. The quality of the water is also questionable.

As a reminder, all three aquifers are used for water supply in the Project area of influence by the Togolese Water Company (TdE), industries and by private boreholes for all major type of uses: drinking, irrigation and industrial which can create competition between users. A hydrogeological study carried out on the aquifers around Lomé in 2018 (Agbewornu, 2018) indicates that a decline has been identified for the Paleocene aquifer and that this situation is progressively leading to the situation in which this aquifer is getting closer to its exploitation limit.

In the villages affected by the Project, access to drinking water is a recurrent problem. The majority of households reported getting their water from fountains (39%), boreholes (27%) and wells (13%). The quality of this water is not certain due to the poor monitoring of the sector and also due to the fact that the water is not regularly treated.

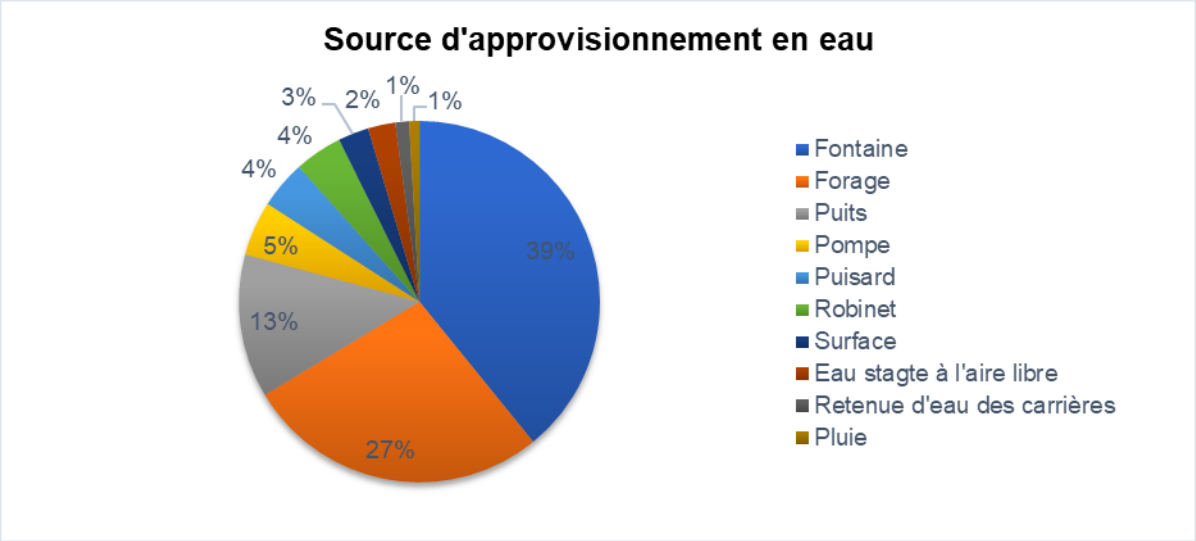


Figure 99 Source of household water supply (source: Insuco field surveys - August 2021)

Women in some localities raised a recurrent problem of lack of drinking water. The water sources mainly used by households dry up during the dry season. 81% of households reported a shortage of drinking water. Household surveys revealed water shortages mainly during the months of January to March.

This may confirm that the local communitis use the unconfined Continental Terminal groundwater horizon for their water needs.

Figure 100 Women's water fetching

5.6.7.6. Sanitation

5.6.7.6.1. Excreta collection system

The data on the list of geographical coordinates of socio-community infrastructures and equipment in the prefecture of Zio in January 2014 indicate that the canton of Kpomé does not have any public latrines. The canton of Dalavé has one (01) public latrine in the village of Ledikopé for the entire population of that village.

It should be noted that there are traditional and semi-modern toilets and showers in some villages.

Of the households surveyed, the majority (62%) did not have a latrine and therefore practiced open defecation. 16% used ventilated pit latrines and 15% used non-ventilated pit latrines.

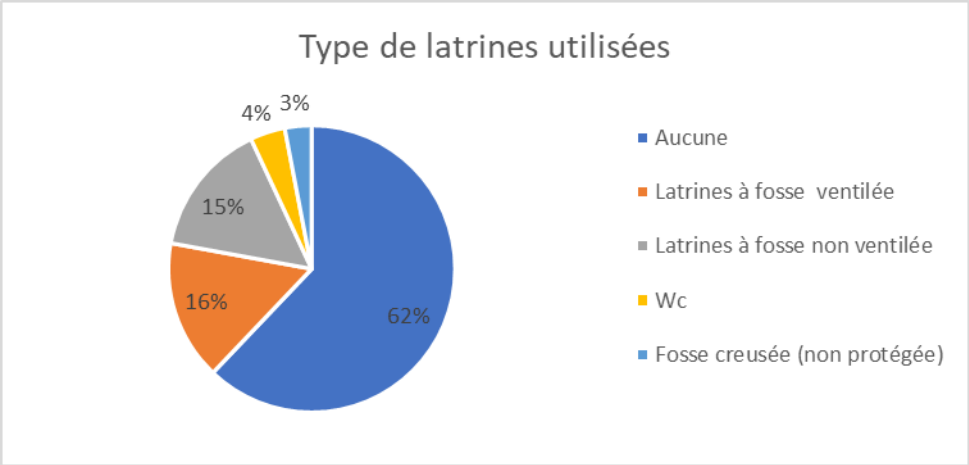


Figure 101 Type of latrines used by households (source: Insuco field survey - August 2021)

5.6.7.6.2. Wastewater collection system

The absence of collective sanitation systems in the villages is at the origin of the poor management of domestic wastewater. Observation of the environment shows that a large proportion of the population discharges its domestic wastewater into the street and the yard of the concession.

Figure 102 Sewage discharge in the street

Wastewater contains plastic particles, microbial pollutants and traces of drugs that can threaten water and food safety, as well as human health, hence the need for appropriate wastewater management infrastructure.

The current sanitary conditions have implications for the shallow unconfined groundwater aquifer and, as a result, the poor drinking water quality derived from it.

5.6.7.7. Solid waste management system

In the project locality waste management is the responsibility of the communes and the Autonomous District of Greater Lomé.

The municipality has the responsibility to deal with household waste, it can also manage non-hazardous industrial waste. However, the two cantons of Dalavé and Kpomé do not have a solid waste management

system. There are no household waste collection structures in the area, leaving each household to organise itself as it sees fit in the management of this waste. There are some illegal dumpsites in the area.

Figure 103 Unauthorised dumping in the area

For the Project site specifically, the municipality of Agoè Nyivé 6 is involved, and is part of the Autonomous District of Greater Lomé (GADL). Waste pre-collection is mainly carried out by associations and NGOs (GRAT-TOGO, MIVADO, ALODO, SROMU, MCC, ADI PRO), which collect waste directly from households and deposit it at an intermediate dump located at the livestock market.

The majority of households surveyed reported dumping their solid waste in landfills. A smaller proportion of them burn it. And a minority buries it.

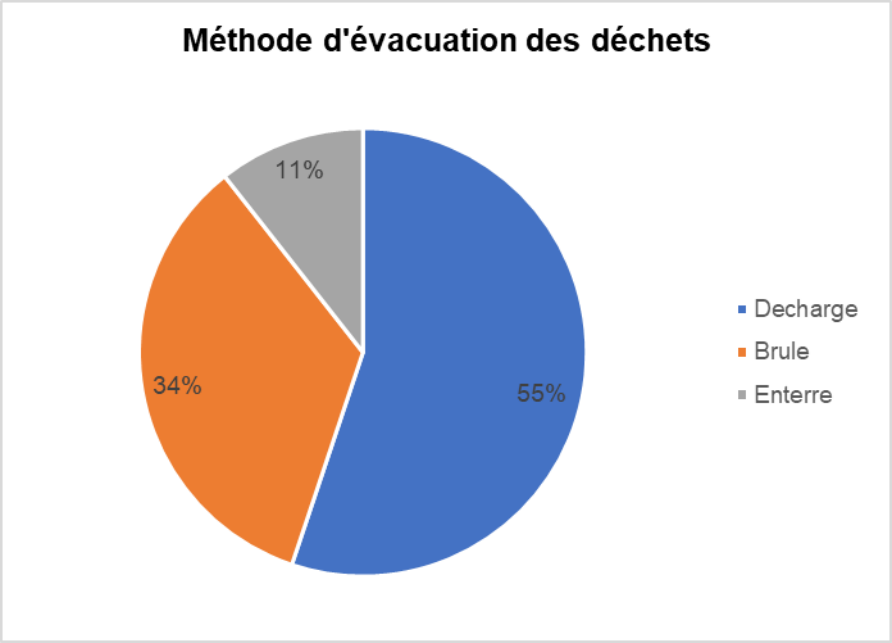


Figure 104 Mode of solid waste disposal (source: Insuco field survey - August 2021)

The waste directed to the Aképé landfill (according to section 3.2.7.2) will travel under the direction of the technical services of Grand Lomé which is in charge of this transfer and the landfill.

This site, opened in early 2018 for a minimum operating period of 20 years, covers 194 hectares (of which 80 for waste reception) and receives on average 20,000 tons of waste per month (domestic, inert, non-hazardous waste). It has been built and operates according to European standards and it is equipped with

storage lockers, cells, a treatment station, flares, a biogas evacuation network etc. The TLC is located approximately 32 km from PIA site, as illustrated in the figure below.

METTOGO is a refinery located on the Tabligbo road, 5 km after Tsevié, approximately 13 kms from PIA site. This company specializes in the recycling of used oils, filters, gas cylinders, and batteries. Among the key installations of METTOGO we find:

- Storage tanks for collected used oils
- Complete refinery unit (entry of used oils---exit of diesel and especially motor oil)
- HENON brand motor oil bottling line
- Storage warehouse for used batteries (emptied of acid) collected
- Battery pitting center
- Melting center (in the oven) and molding of lead components
- Battery plastic casing shredding center

METTOGO is able to collect other types of waste, as detailed in Table 23.

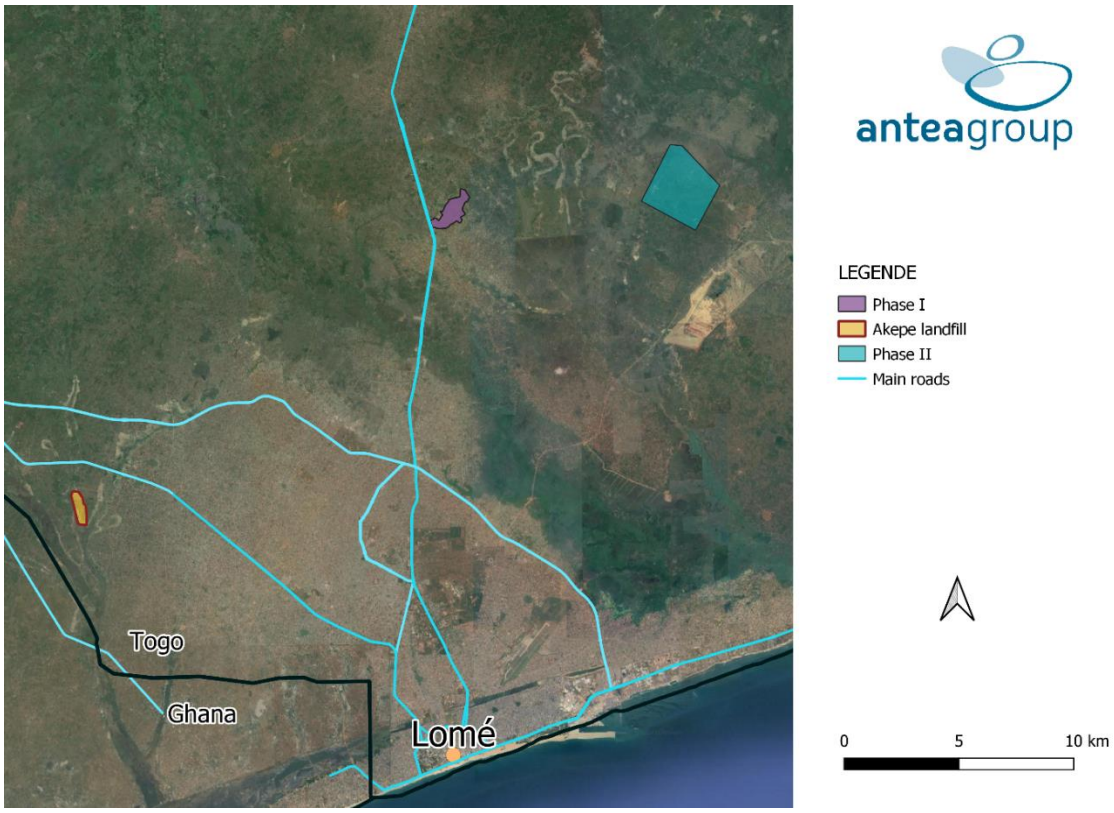


Figure 105 Location of Akepe landfill (Source, Antea, 2021)

In spite of emerging local initiatives, large scale waste recycling is not carried out.

Further details concerning the existing national waste management infrastructure are provided in section 5.6.7.7.

The following paragraphs focus on the waste management system and procedure implemented by PIA.

5.6.7.8. Access to energy

The majority of the villages visited during the field survey are partially supplied with electricity by CEET. The distribution is done in an artisanal way through a system commonly called "spiders". Some villages are supplied by solar panels, while some villages (Agbadovinou, Gnatikopé and Vondjogbekopé) have neither the CEET electricity network nor solar panels, leaving them in total darkness.

During the household surveys, 46% of households said they were connected to the national grid, 7% to solar panels and 1% to a generator. However, 45% of households reported having no source of electricity.

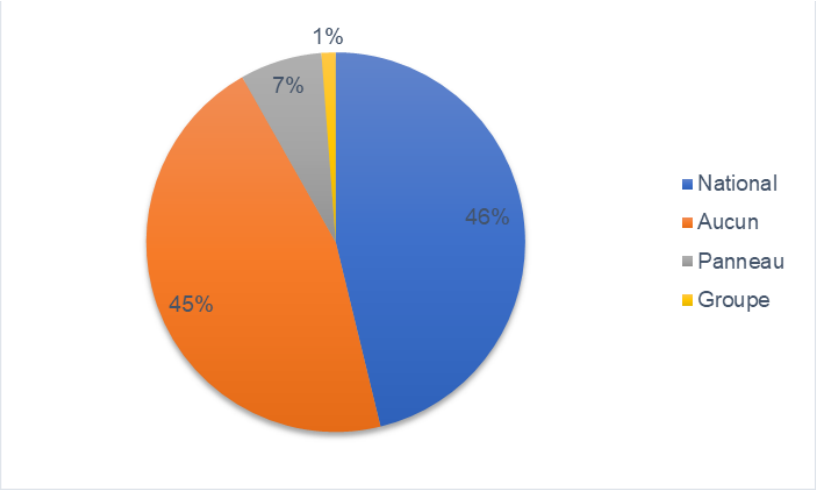


Figure 106 Household access to electricity (source: Insuco field survey - August 2021)

As a result, households connected to CEET use it as a source of lighting. The majority of households without access to electricity use battery or solar lamps.

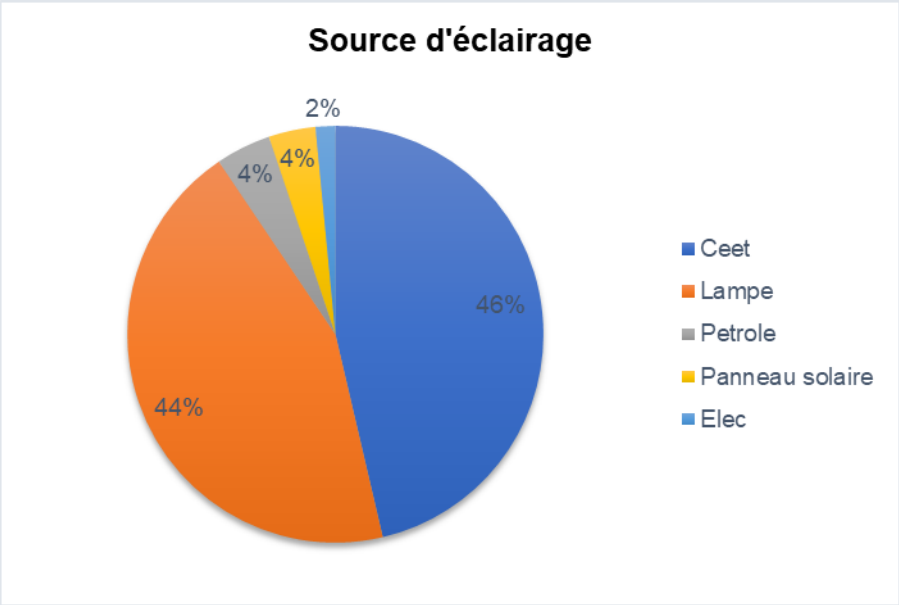


Figure 107 Household lighting source (source: Insuco field survey - August 2021)

The most common source of cooking energy in the area is wood (used by 69% of households), followed by charcoal (29% of households). Gas is used by a very small proportion of households (2%).

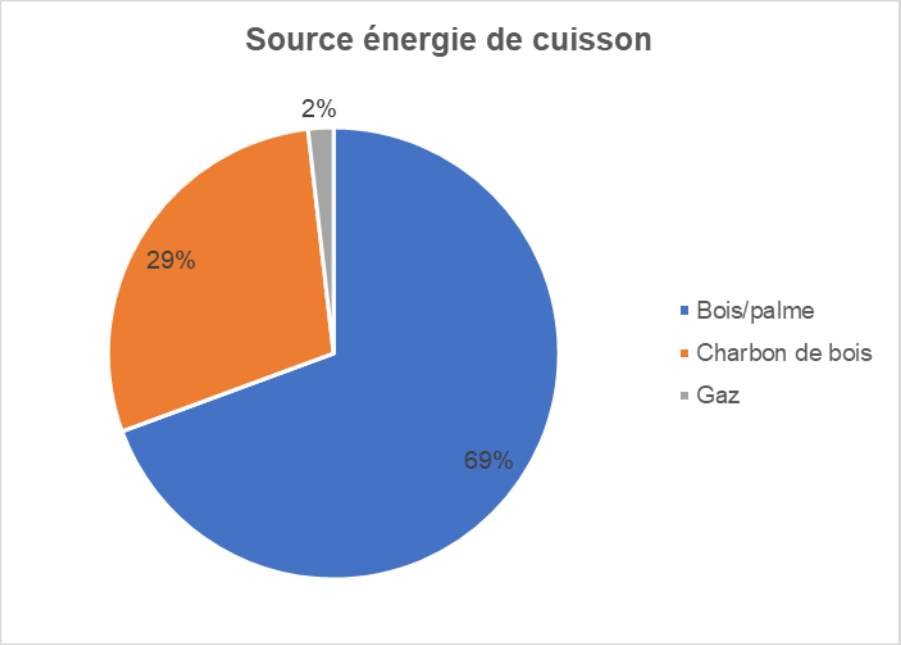


Figure 108 Source of cooking energy (source: Insuco field survey - August 2021)

5.6.7.9. Transport and communications

The transport infrastructure associated with urban expansion in Togo is mainly based on the road and rail network, but the railways dating from the colonial period are practically no longer operational.

Togo has three road corridors that serve the ports of Lome and the countries of the sub-region:

- The RN1 National Road, Lomé-Cinkansé, to Burkina Faso, a section of the Lomé-Ouagadougou corridor 975 km long, 746 of which are in Togolese territory. It is also called the CU9 community road according to the West African Economic and Monetary Union (WAEMU) community road network classification; The RN1 connects Lomé to the northern regions of Togo, including Adétikopé, and to the Sahelian countries, notably Niger, Mali and Burkina Faso, which depend on the port of Lomé for most of their supplies.
- The Lomé-Hillacondji road to Benin and Lomé-Aflao (or Lomé-Noepe) to Ghana, which make up the 52.5 km Aflao-Hillacondji axis, a section of the Abidjan-Lagos Interstate Corridor (1,022 km) which accounts for more than 65% of trade in West Africa. These roads are sections of the WAEMU CU1 community road;
- The WAEMU CU19 community road, Nyamassila-Bagou-Goubi-Kambolé-Balanka-Benin border, 180 km long.

The total length (2014 data) is 11,672 km distributed as follows

- paved national roads (RNR): 1,793 km (15.4%);
- unpaved national roads (RNNR): 1,294 km (11.1%);
- rural road network (PR): 6,802 km (58.2%);
- urban roads (VU): 1,783 km (15.3%).

In 2015, the total length of paved roads within Greater Lomé was estimated at 145.65km (Source: Ministry of Infrastructure and Transport).

Around the project site there are the RN1 and RN34 roads, both of which are paved, as well as numerous unpaved or poorly developed tracks.

The RN 34 is the one that connects Lomé to Vogan through the canton of Kpomé.

The main roads are Davie-Adetikope-Djagble; Adetikope-Dalave-Kpomé. These roads are in very poor condition with potholes, broken crossing structures, sand and dust that make travel mostly difficult.

The various roads and lanes between villages and towns are not passable in all seasons. These roads are used by people using different types of transport: bicycles, rickshaws, motorbikes, tricycles, taxis, buses, minibuses and trucks. According to field observations, vehicles and motorbikes are the most commonly used means of transport.

The location of the main and secondary roads in Greater Lomé is presented in the figure below:

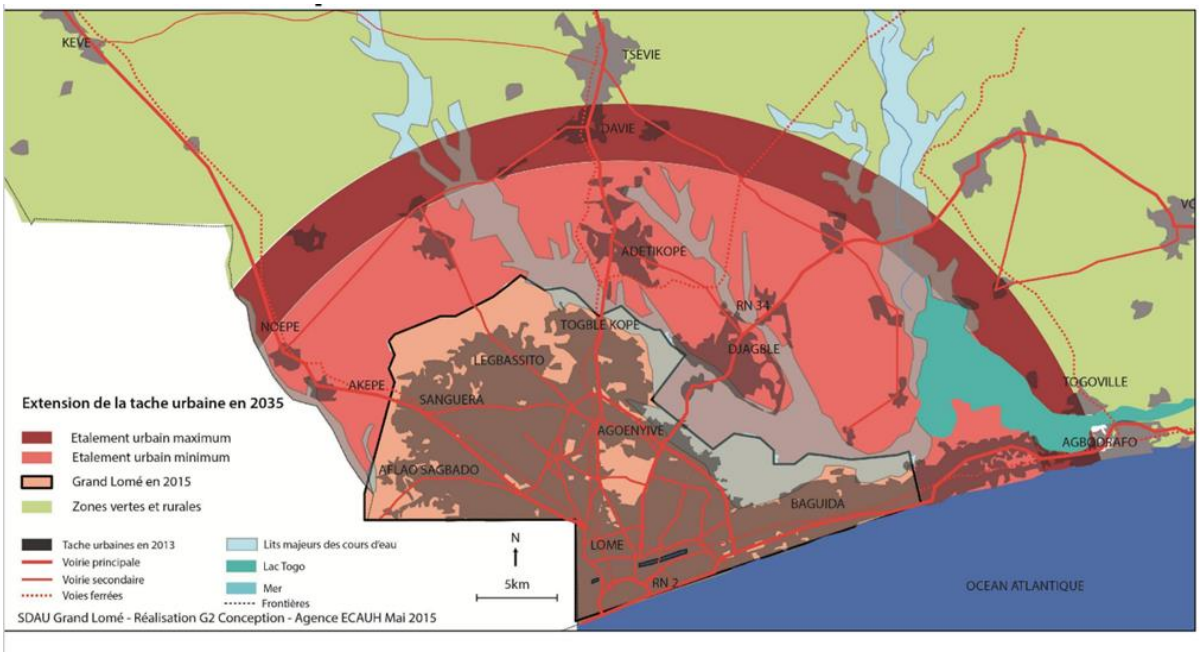


Figure 109 Location of main and secondary roads in Greater Lomé (Source: Articulation Transport - Urbanism in the Master Plan of Development and Urbanism of Greater Lomé, 2016)

The Lomé agglomeration is unique in that two-wheelers largely dominate traffic, accounting for 73 percent of vehicles in circulation. Beyond two-wheelers, five-seater taxis are the most common, followed by buses operated by the Société des Transports de Lomé (SOTRAL) and private vehicles.

Overall, households appear to be more motorized and mobile, in a context marked by urban sprawl and longer distances traveled.

The study on the Togolese corridor forecasts annual growth rates in the number of passenger and freight vehicles from 2015 to 2030. The volume of passenger vehicles will increase by a factor of 3.47 and freight vehicles by a factor of 5.02 in 20 years.

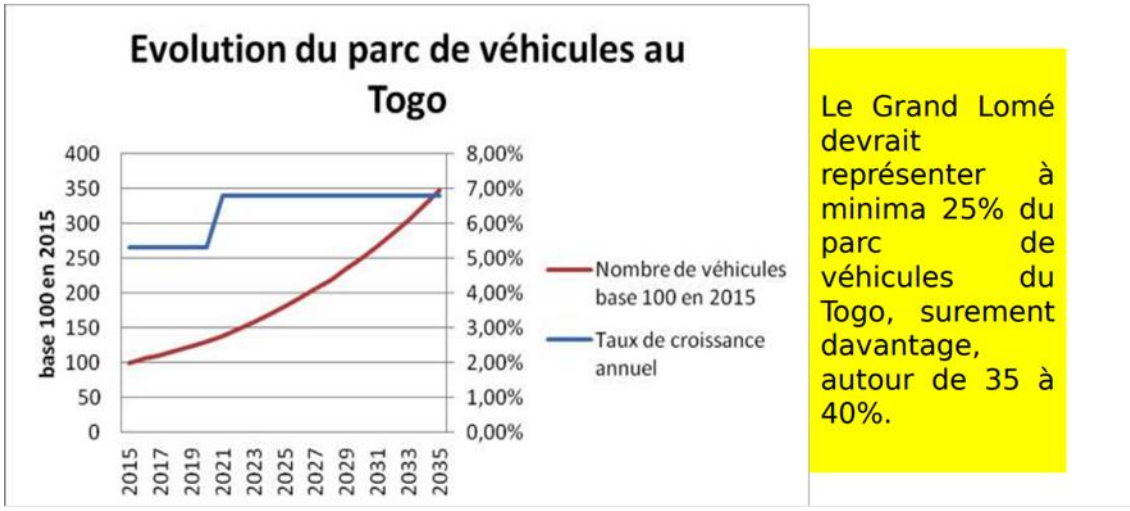


Figure 110 Evolution of the vehicle fleet in Togo (Source: Articulation Transport - Urbanism in the Master Plan of Development and Urbanism of Greater Lome, 2016)

In 2014, urban motorized travel demand in Lomé was estimated at 730,000 trips per day. Half of these trips are made by urban public transport and the other half by private modes. The Société des Transports de Lomé (SOTRAL), with a network of eleven lines and a fleet of 90 buses (45 of which are in operation), recorded an average daily traffic of 10,000 passengers in 2015. The company's market share is only 2.5 percent. In fact, motorcycle cabs carry 62% of public transport traffic.

All types of transport are used for daily travel between the villages in the project area, Adétikope, Tsévié and Lomé. The analysis shows that work-related trips and the purchase of goods predominate in commuting between these villages, Adétikope, Tsévié and Lomé. This predominance is explained by the concentration of administrative services and economic activities in the town centres.

The main problems encountered are the following:

- Non-compliance with traffic laws;
- Non-respect of the traffic lights;
- Overloading;
- Traffic on sidewalks;
- Stopping and parking on the side of the road to get off or pick up passengers;
- Mixed Transportation;
- Driving without a driver's license
- Lack of technical inspection of vehicles;
- Vehicles are often too old

5.6.8. Solidarity and mutual aid

5.6.8.1. Local dynamics

According to the communal development plan, social cohesion between the populations of the commune of Tsévié has crumbled for several reasons:

- The existence of conflicts over traditional chiefdoms in the districts/villages of the municipality;

- The non-demarcation of neighbourhoods/villages also raises a problem of recognition of the territorial basis of the power of neighbourhood and village chiefs in certain localities. This is coupled with a problem of misunderstanding between the chiefs, court officers and the population regarding the execution of legal acts;
- Tensions between non-natives and natives. The concept of ''Tsévié vi dzidzi'' (natives of Tsévié) is very detrimental to living together in the commune. Indeed, those who call themselves natives of the commune find it difficult to accept non-natives. However, these non-natives constitute an important potential for the development of the commune.

These different problems are becoming increasingly alarming because they greatly affect the mobilisation of populations around development projects.

The self-help and solidarity groups that used to exist no longer exist in the same form because they have lost their place to individualism, which has taken precedence over these practices that used to be a strength and a symbol of unity, mutual aid and mechanical solidarity according to Emile Durkheim, for whom solidarity corresponds to the invisible links that bind individuals together and make society "hold together": solidarity is the "cement" of society. It can take two forms: one based on the similarity of individuals' behaviour and society's values (mechanical solidarity) and one based on the complementarity of individuals' activities and functions (organic solidarity).

Despite the breakthrough of individualism, there is a pocket of mechanical solidarity that can be observed through tontine groups, associations of women, men and young people who mobilise around common objectives, even if within these associations the individual develops more than the collective.

5.6.8.2. Places of entertainment

Apart from the main town of Zio 1, where there are entertainment and leisure facilities, almost all the people we interviewed in the various villages stated that their village had no entertainment facilities apart from a few precarious football playing areas. This lack of shared spaces reinforces individualism and reduces cooperation and mutual aid between villagers.

5.6.9. Ecosystem services

5.6.9.1. Ecosystem services

According to IFC PS6, ecosystem services are the benefits that people, including businesses, derive from ecosystems. Ecosystem services are organized into four types:

- Provisioning services, which are the products people obtain from ecosystems. Provisioning services may include food, freshwater, timber, fibers, medicinal plants ;
- Regulating services, which are the benefits people obtain from the regulation of ecosystem processes. Regulating services may include surface water purification, carbon storage and sequestration, climate regulation, protection from natural hazards ;
- Cultural services, which are the nonmaterial benefits people obtain from ecosystems. Cultural services may include natural areas that are sacred sites and areas of importance for recreation and aesthetic enjoyment ;
- Supporting services, which are the natural processes that maintain the other services. supporting services may include soil formation, nutrient cycling, primary production.

Ecosystem services valued by humans are often underpinned by biodiversity. Impacts on biodiversity can therefore often adversely affect the delivery of ecosystem services.

The natural resources mostly used by the communities within The Project area of influence are, among others: land, forest products (flora), water. These different components of the environment have a symbolic importance in Dalavé and Kpomé townships for the population. Generally speaking, the use made of natural resources depends in part on the perception and representation of these key elements of the natural environment.

The local authorities and the carriers of customs and traditions interviewed during the consultations confirmed the existence and practice of rites and customs in their locality. Indeed, according to their statements, ceremonies are periodically performed to invoke or implore the god of rain on their crops. Similarly, the goddess of Mother Earth is perceived and represented differently by the affected population according to the data collected in the field.

5.6.9.1.1. Perception and representations of the territory

Land is perceived as a private asset, a wealth to be exploited according to the wishes and beliefs of the person using it. It is also the source of a person's life and identity. The landowning communities link this asset to a history, that of the parents, the ancestors who first occupied this space, preserved it for a certain number of years and who have now passed it on to their descendants in the form of an inheritance. These people identify with this land, with the history of which they are heirs. However, with the increase in the market value of land, people's vision has changed and land is now the subject of market transactions.

From this analysis, we can understand that the myth of land as an inalienable common good and as a god to be worshipped is undermined by the merchandising of land. Land is then used as a means of survival and a private good that no longer respects the norms and values of customary management of common goods. Double sales and false sales of land are an illustration of this state of affairs, which today causes land conflicts in communities.

Although land management is evolving towards total commercialisation, some relics of traditional practices that make the land a protective goddess and require sacrifice, worship or protection, survive in the area.

5.6.9.1.2. Perception and representations of water

In other communities where rivers are sources of survival, this resource is seen as essential for survival, protection and as a source of income. As the environment is not rich in river systems, discussions were less prolific on the subject. Nevertheless, community representatives in the various consultation sessions recognised that water is a symbol of life ('water is life'), peace, gentleness.

We also note that groundwater is a significant and valuable resource of drinking water for local populations in the study area.

Finally, the liquid discharges of the Project will flow in Togo Lake. Polluted effluents from the CETP or other accidental polluting discahrges may therefore reach the Togo Lake.

5.6.9.1.3. Ecosystem services identification and consultation process

The Project is located in an area where the natural environment has been largely modified by human activities. Despite that, some ecosystem services might still be delivered to the local communities on the Project site.

These services were identified during the social field survey organised in august and septembre 2021. The social specialist used sets of questions to perform services identification.

Because the project is likely to have negative impacts on some of these services, a systematic examination has been realised to identify which ones are high priority according to IFC performance standard n°6 and to propose adequate mitigation measures.

Due to the strong anthropisation of the study area and the ongoing peri-urbanisation, which is manifested by a progressive degradation of the natural environment, the services provided by the ecosystems to the local communities are very limited. The main ones observed on the site are:

- Support services in the form of agriculture (rainfed and irrigated), livestock grazing and firewood collection;
- Prevention of natural disasters (floods) by infiltration of water into unsealed soil.

The supply of game is an ecosystem service used by a small proportion of households in the area. In the surveys, 8% of households reported practising it.

The table below summarises the types of ecosystem services relevant for the Project area of influence.

Table 51 Ecosystem services

Type of service	Existence of service	Use of service
Provisioning services		
Farmland	Yes	Cultivation of cereals, tubers, fruit trees and vegetable crops.
Pasture land	Yes	Grazing of transhumant and sedentary oxen.
Halieutic resources	No	No
Groundwater ecosystems	Yes	Purification of water and its storage in good quality, active biodegradation of anthropogenic contaminants and inactivation and elimination of pathogens, nutrient recycling, and mitigation of floods and droughts
Sand and gravels	Yes	Sand and gravel quarries
Aquaculture	No	No
Wild food: hunting and gathering	Yes	Practiced in a limited way
Biochemical products, natural medicine and pharmaceutical products	Yes	Medicinal plants used by resident populations for the treatment of diseases and for sale in local markets
Wood and wood fibers (teak, eucalyptus, palm tree leaves, raffia)	No	No
Other fibers	No	No
Fuel	Yes	Some limited firewood collection
Fresh water	Yes	Fishing
Genetic resources	No	No
Regulating services		
Regulation of air quality	No	No

Type of service	Existence of service	Use of service
Regulation of global climate Regulation of regional/local climate	No	No
Regulation of water	No	No
Regulation of erosion	No	No
Water purification and waste treatment	No	No
Disease regulation	No	No
Pest regulation	No	No
Pollination	Yes	Swarms of bees and other pollinating insects
Natural catastrophes regulation	Yes	Yes Indirect use. Large agricultural/fallow area favouring water infiltration in the soil
Cultural services		
Sacred sites	Yes	Yes
Religious areas	Yes	Yes
Recreational, tourism or leisure areas	No	No
Supporting services		
Capture and recycling of nutrients	No	No
Primary production	No	No
Connexions for genetic exchanges	No	No

5.6.10. Different types of ecosystem services

Ecosystem services are categorized as two types[13] :

- **Type I: Provisioning, regulating, cultural and supporting ecosystem services**, over which the client has direct management control or significant influence, and **where impacts on such services may adversely affect communities**. Type I ecosystem services will be considered priority under the following circumstances:
  - Project operations are likely to result in a significant impact on the ecosystem service; and,
  - The impact will result in a direct adverse impact on Affected Communities "livelihood, health, safety, and/or cultural heritage;" and,

[13] IFC-Guidance Note 6 p. 45 to 50

- The project has direct management control or significant influence over the service.

- **Type II: Provisioning, regulating, cultural and supporting ecosystem services**, over which the client has direct management control or significant influence, and **on which the operation of the project depends directly**. Type II ecosystem services will be considered priority under the following circumstance:
  - The project directly depends on the service for its primary operations; and

The project has direct management control or significant influence over the service.

5.7. Sensitivity of natural and human environment components

The development of the Project will result in impacts that, when they occur, will be more or less intense, depending on the initial state of the physical, biological, and human components of the study area.

In order to better assess these impacts, it is necessary to identify the sensitivity of these components and to rate them according to a set of standards detailed in § 0.

The table below responds to this objective.Table 52 E&S sensitivities of the Project area

Theme	Description	Sensitivity / Value
	Physical environment	
Climate and climate change related risks	In the global context of climate change, Togo's climate is expected to be impacted mainly by drought episode, rainfall event and associated flood event. As this change on climate could probably impact people around PIA site, therefore, sensitivity of climate is rated as **Moderate**.	Moderate
Geology, topography and soils	The area has a flat topography with a slight slope toward the east of the site. Soil has a sandy clay texture limiting water infiltration and favouring water stagnation, mainly in the east part of the site. The soil at PIA site is of reasonably good quality. Low levels of contamination mainly with some fertilizers, but also isolated exceedances of heavy metals have been identified. As soil around PIA site is used mainly for agricultural activities, representing value to local communities and regional economy, its sensitivity is rated as **Minor**.	Minor
Hydrology (surface water quality and availability)	Surface waters are not commonly used for drinking and domestic purposes and are polluted by uncontrolled local sanitary effluents and waste disposal. However, we can't exclude the possibility of a connection between the surface waters and the shallow aquifers used by populations. Therefore, surface waters sensitivity is rated as **Minor**.	Minor

Theme	Description	Sensitivity / Value
Hydrogeology (groundwater quality and availability)	3 aquifers exist in the project area. Uncertainties exist regarding their connectivity. All aquifers within the Project AoI have high value as they are heavily relied upon for water supply by all users (national water company, industries, and communities). These aquifers are under pressure and to some extent already overexploited. The Maastrichtian aquifer is a deep horizon not easily accessible by rural community. At least 50% of its capacity is utilized, although some users might be unaccounted, including future users such as PIA Phase 2 site. Due to lack of knowledge concerning the potential interconnections among horizons and adopting a precautionary approach, the sensitivity is considered **moderate** The sensitivity of this aquifer may change (minor or major) with time and based on the results of the studies that will allow a better knowledge of the groundwater resource	Moderate
Air quality	The study area is only partly anthropized, characterized by low-intensity agricultural activities and low road traffic. There is no major source of degradation of air quality in the area (as confirmed by the results of air quality measures). Sensitivity of air is rated as **Minor**.	Minor
Ambient noise levels	The study area is only partly anthropized, characterized by low-intensity agricultural activities and low road traffic. There are industrial and agricultural activities and road traffic that are already affecting the local amenity with noise levels significantly exceeding IFC thresholds. Sensitivity of noise is rated as **Minor.**	Minor
Landscape	The landscape of the study area is characterized by mosaics of fields and fallow land. The landscape interest of the site is low due to the absence of panoramic viewpoints or natural sites of tourist interest (lakes, waterfalls, etc.). The Project site does not have a unique or remarkable landscape character. Nevertheless, neighbourhood of PIA is mainly composed of residential areas and housing. Sensitivity of landscape is rated as **Minor.**	Minor
Biological environment		
Habitat and flora	The PIA Phase 2 Project area is half covered by savannas and plantations and half made of anthropized habitat with crops and fallow land. No critical habitat, within the meaning of IFC PS 6, has been observed. Only one species with a vulnerable status, the caïlcedrat (Khaya senegalensis (Desr.) A. Juss.) has been recorded in the Phase 2 site area and in the road easement area. A nearly threatened species, iroko (Milicia excelsa (Welw.) C.C. Berg) is found in the Phase 2 site area. These two (2) species are	Moderate

Theme	Description	Sensitivity / Value
	on the list of endangered species of Togo. Roughly 30% of all the species inventoried is either invasive or exotic invasive. Sensitivity of habitat and flora is rated as **Moderate**.	
Fauna	Due to the human presence as well as the presence of herds of oxen, no specific fauna was encountered. Main species are little mammals and avifauna but none is with a threatened status. The absence of aquatic birds could be explained by the scarcity of water points in the various sampling stations and the paucity of existing water points, notably food for fish. The low presence of reptiles could be explained by the destruction of natural habitats and the common local habit to systematically kill snakes because of the danger they supposedly represent to humans. Because of its "punctual" character, we cannot rule out the possibility of the presence of an unobserved species. Adopting a precautionary approach sensitivity of fauna is rated as **Minor**.	Minor
Human environment		
Demographic balance and migrations	In 2010, the cantons of Kpomé and Dalavé have respectively 9 330 and 12 030 inhabitants. The area has undergone large demographic changes over the past 20 years. Due to the macrocephalic extension of Lome, the area has attracted both rural and urban migrations leading to a strong perirubanisation process. While urbans are driven out of Lome due to land and rent inflations, rural settlers are attracted by the city economic dynamism. This has led to a deep socio-cultural recomposition: the customary laws and traditional social bounds that prevailed in this former rural area tend to disappear nowadays, making way to more individualistic relationships. Sensitivity is rated as **Moderate**	Moderate
Women and gender issues	The Social Institutions and Gender Index (SIGI) which offers a ranking of countries according to gender inequalities, assigned a score of 50% to Togo in 2019. This score ranks the country in the high category, i.e. having high levels of discrimination against women, mainly in the areas of family life and civil liberties. The persistence of patriarchal customary traditions that discriminate against women was observed in the villages of the study area, which in this regard retain their rural attributes, since it is in rural areas that customary influences are most observed. Sensitivity is rated as **Moderate**	Moderate

Theme	Description	Sensitivity / Value
Vulnerable groups	Vulnerable groups include, as on national scale, persons with disabilities, women (especially single mothers and widows) and people in extreme poverty. Of the sample surveyed, 26% of households had at least one person with a disability. Few women were heads of household (14% of heads of household), but 56% of the women heads of household in our sample were widows. Most of the households surveyed are engaged in agriculture (89%) and livestock (67%) and are therefore economically vulnerable. These activities are vulnerable because of the pressure on land in the area and climate change. Sensitivity is rated as **Moderate**	Moderate
Land tenure and land use	Because of the ongoing migrations land has become a very sensitive subject in the villages surrounding the project area. Historically, land was managed by customary authorities but has become a valuable commodity which is subject to important speculation and constant price surges. It causes an increase in land-related conflicts at the family and community levels. Sensitivity is rated as **Major**	Major
Economic activities, livelihoods and local economy (employment)	Economic activities were previously focused on agriculture. However, due to the periurbanisation process, the proximity with Lome and the conversion of farmland into residential areas, as well as land speculation or land grabbing for project development, there is a clear shift towards the development of trade and services activities. Besides, the location of site close to the national road has led to the installation of numerous small and medium-size industries. Local communities must therefore shift their livelihood strategies from farming toward secondary and tertiary sectors. But they do not all have the skills/training to make this change, nor the desire to change activity. This component is therefore under hight pressure and a source of tension as households see their sources of income diminishing and wonder how they will be able to continue their traditional activities. Sensitivity is rated as **Major**	Major
Habitat and settlements	The habitat in the study area is characterized by the cohabitation of historical villages with traditional housings, progressively absorbed by urban settlements which are extending from the main national road up to less populated inland areas. These settlements are usually composed of one to two-storey buildings made of permanent material, built by high socioprofessional categories and liberal professions working in Lome. There are around 115 houses on the Phase 2 project site and villages are rather close to PIA's site. The number of structures estimated for the industrial corridor, is around 100. Some are farms, some are houses. Sensitivity is rated as **Major**	Major

Theme	Description	Sensitivity / Value
Community and workers Health and Safety	The main diseases encountered in the study area is malaria. Villagers mostly rely on small private health care centres set up in the villages due to a lack of public infrastructures in their vicinity (the only public centre is in Adetikope centre). The living environment in the villages of the study area is very unhealthy with the disposal of waste and wastewaters (including excreta) in the streets. Inhabitants suffer from a poor access to good quality water: they mostly rely on superficial wells (with poor water quality) and private boreholes for their daily water needs. There is a lack of public boreholes, waste collection systems and a sanitation network. The regular increase in the population size without adequate investments in public infrastructures worsen those public health issues, along with seasonal floodings. The component is thus under stress with a lack of infrastructure, the presence of poor sanitation practices and some diseases. Sensitivity is rated as **Major**	Major
Cultural Heritage	There are numerous individual and community owned "fetiches", as well as a church. Sensitivity is rated as **Major**	Major
Archaeological heritage	Even though there are no known archeological sites in the Project area, some archeological artifacts (potteries, tools, building foundations, etc.) could be present Sensitivity is rated as **Minor**	Minor
Social climate	The arrival of a project can change the social climate. There are indeed many expectations and tensions with regard to the promoter. The impacts on employment and economic activities are highly expected. Some skills, goods or services may not be available locally. Therefore, labour or goods and services from outside the project's area of influence may be required. This is a very sensitive issue for the local population and will cause social tensions. Sensitivity is rated as **Major**	Major
Ecosystem services	Ecosystem services identified are mainly provisioning services (farmland, pastureland, firewood collection) and regulating services (pollination and flood regulation). The presence of sacred and religious sites (cultural services) has also been verified. Sensitivity is rated as **Moderate**	Moderate
Waste management Infrustructure	Lack of well developed local, regional and national waste management infrastructure. The Aképé technical landfill center is recent (2018) and realised according to European standards. Several waste management actors active in recycling have been identified but there is a global lack of knowledge concerning the actual capacity of their activities as well as standards adopted. Sensitivity is then rated as **Moderate**.	Moderate

6. Analysis of impacts and identification of management measures

6.1. Methodology for impact assessment

6.1.1. Approach

The environmental impact assessment methodology proposed here consists in a systematic method derived from the approaches of the World Bank and ISO 14001 which is based on the use of a simplified Leopold matrix adapted to the challenges of the project.

The Leopold matrix is a qualitative assessment method for environmental impacts created in 1971 and commonly used in environmental assessment. It allows, thanks to a double entry grid, to identify which project activities affect which environmental and social components, then to assess the severity of the expected impact. It provides a visual representation of the impact assessment and helps to synthesize its content in a format accessible to all readers.

The implementation of this methodology is based on three steps:

The **first step** is to:

- On the one hand, identify the **impact factors** i.e. the activities, consumption or emissions of the project which could be the source of impacts on the environment. Identification is done based on the project description and is presented in section 3.2 of this report. Accidental situation are also considered as impact factors but they are discussed in a dedicated section of the report relating to technological risks as they don't correspond to a "normal" situation but a degraded situation.

  Impact factors have been identified in section 3.8.

- On the other hand, identify what the **sensitive components** of natural and human environments can be affected by the Project and then assign them a level of sensitivity/value. The sensitivity of the environment is rated using a 4-level scale, from the lowest to the highest scale of environment's sensitivity.

  The identification of sensitive components was carried out in chapter 5 and resumed in section 5.7.

A summary of impact factors and sensitive components is presented below.

Table 53 Summary of impact factors and sensitive components

Impact factors	
Phase	**Theme**
Preparation	Project land acquisition
Construction	Civil works, including drilling Traffic Solid waste production Green waste production Liquid discharges production Resources consumption (energy, water) Employment Accidental situation
Operation	Easement of IZ Atmospheric emission Solid waste production Liquid discharges production Resources consumption (energy, water) Traffic Employment Accidental situation

Sensitive component	
Environment	**Theme**
Physical environment	Climate and climate change related risks Air quality Noise Hydrology Hydrogeology Geology, topography and soils Landscape
Natural environment	Habitat and flora Fauna
Human environment	Demographic balance and migrations Women and gender issues Vulnerable groups Land tenure and land use Economic activities, livelihoods and local economy (employment) Habitat and settlements Health and Safety Archaeological heritage Access to water Waste management Cultural Heritage Ecosystem services

The **second step** is to identify which **impact factor can affect each sensitive component** of the environment in order to methodically identify what the environmental and social impacts are generated by the project (direct, indirect, cumulative, transboundary). The results are presented in the matrix form of the Leopold matrix type to visualize the issues globally and quickly (6.1). Sensitive elements of the environment are presented in column and impact factors are presented in row by project phase.

The intensity of the impact is afterwards rated on a scale of 1 to 4 using a semi-qualitative method. The **importance of the impact** that results from the combination of the sensitivity level of the component with the intensity of the impact is then determined.

The **third step** is to identify the **avoidance (A) and reduction (R) measures** for the potential impact, then estimate the residual impact once these measures are taken into account. If the implemented measures are sufficient, the residual impact is negligible or minor, therefore no compensatory measure will be proposed and only follow-up can be proposed. The **compensation measures** (C) only intervene in return for a residual impact considered to be significant (moderate and major). Compensation measures (C) are implemented only if avoidance and reduction measures cannot be implemented or are deemed insufficient.

Regarding the residual impacts (after application of the mitigation measures), the Leopold matrix is used again and presents the significance of the impact given the recommended measures. Note that the complexity of the mitigation measure implementation (in terms of technical aspect, cost or recognized effectiveness) might influence the significance of the residual impact.

Substantially, the presentation of the impact assessment within the report will be based on:

- 1- Presentation of the Leopold matrix on the potential impacts of the project.
- 2- Detailed analysis of impacts by major project phase (design / preparation, construction, operation). Presented in a textual manner, this analysis focuses on the affected components. The impacts of the project (all sources of impact combined) are thus detailed in terms of their effect on air quality, quantity of water resources, habitat, employment or livelihood sources, etc. At the end of the description, the impact severity rating is presented in a table and determined by the strongest index in the matrix. Finally, mitigation measures are proposed, and the residual impact assessed.
- 3- Presentation of the Leopold matrix on the residual impacts of the project.

The assessment of potential and residual impacts is ultimately an expert opinion which takes into account both qualitative, semi-quantitative and quantitative aspects to build its judgment.

6.1.2. Impact intensity rating

An environmental or social impact may be described as a change in a pre-existing environmental or social state resulting from human activity or intervention. In order to classify the different impacts and to identify those that are the most important, it is necessary to rate their intensity. The notion of intensity covers the characteristics of the impact, its nature, the type of effects (direct or indirect), its duration and its geographical extent.

The intensity (I) of the impacts is rated on 4 levels from the lowest intensity to the highest intensity. The rating is established by an expert opinion, according to the guidelines presented in the table below.

Table 54 Impact intensity level and criteria

Level of intensity	Guide
NEGLIGIBLE 1	Negative, direct and indirect impact, short-term (a few months), limited (project area and immediate surroundings) Low consumption of raw materials and effluent discharged close to natural levels, non-hazardous. No observed degradation of environment. No negative incidence on local neighbouring communities whatsoever.
MINOR 2	Negative, direct and indirect impact, short-term (a few months), small or medium scale (project area and surrounding areas, some villages) Significant consumption of raw materials and effluent released detectable, but below thresholds recognized as having an effect on health. Waste generation but properly managed. Moderate and acceptable environmental degradation. Small reversible perturbations on the local neighbouring communities (nuisances mainly).
MODERATE 3	Negative, direct and indirect impact of medium duration (upto a year), moderately or widely extended (scale of several villages, of a department). Significant consumption of raw materials with local scarcity and potential conflicts and low biodegradable discharges and/or hazardous substances with chronic human health effects in the event of long-term exposure. Significant production of sorted waste. Significant but reversable changes in environments. Irreversible but limited losses for local neighbouring communities (few houses, crops, etc.). Degradation of public services functioning or access due to the project.
MAJOR 4	Negative, direct and indirect, long-term or irreversible, widespread impact (scale of a region, watershed, river, national park).

Level of intensity	Guide
	Significant consumption of raw materials with local scarcity and potential conflicts and discharges that are non-biodegradable and/or hazardous substances with potential impacts on human health, including death and serious injuries. Significant waste generation without sorting or treatment. Destruction of large areas of habitat, heritage, landscapes. Irreversible, large-scale losses for communities: several villages displaced, loss of valuable farmland on several hectares, loss of public services, etc.
P	Positive impact Favourable impact to socio-economic development or that may benefit the environment.

6.1.3. Impact importance rating

The impact assessment consists first in identifying whether the impact is positive or negative:

- Negative impact: an impact that generates environmental pollution, social disturbance or damage to private assets or valuable fauna and flora.
- Positive impact: positive impact on socio-economic development or bringing environmental benefits.

Then, it requires identifying if it is direct or indirect:

- Direct impact: an impact that expresses a causal relationship between a project activity and an environmental (physical or natural) or social component;
- Indirect impact: the impact that flows from and follows a direct impact in a chain of consequences.

Thereafter, the importance of the impact should be assessed by multiplying the impact intensity (I) and the sensitivity of the receiving environment (SE) according to the matrix presented below.

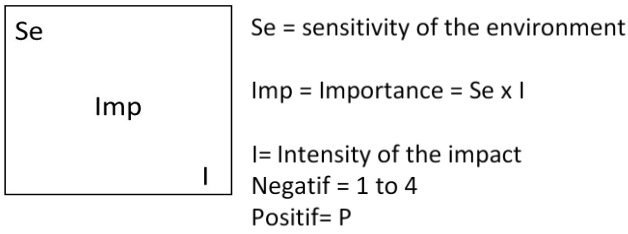


Figure 111 Impact importance rating system

The multiplication result is a figure which indicates the impact importance as per the scoring system presented below.

Table 55 Scoring system for impact importance

Importance Imp = Se x I	Intensity of the impact (I)				
	P	1	2	3	4
Sensitivity of the receiving environment (Se)	1	1	2	3	4
	2	2	4	6	8
	3	3	6	9	12
	4	4	8	12	16

Legend:

Positive impact
P

0 : NO IMPACT	
1-2: NEGLIGIBLE	5 – 9: MODERATE
3-4: MINOR	>9: MAJOR

The importance of the impact can therefore be categorized as follows:

- No impact (white).
- Negligible (blue): the impact is low enough that no mitigation action is required.
- Minor (green): the impact is low, but measures, in particular good environmental and social practices, should be mentioned.
- Moderate (orange): impact that requires avoidance, reduction and compensation measures to become acceptable.
- Major (red): This impact concerns the environmental and social components which are very sensitive or have a very high intensity impact, requiring specific measures to be implemented to mitigate impact to acceptable level.

In the analysis, a table as the one below is presented for each impact to summarize the main evaluation criteria.

Table 56 Scoring system for each impact assessment

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

6.1.4. Identification of mitigation measures

The best way to preserve the environment is to focus first on preventing and **avoiding** the identified impacts. For this purpose, the measures envisaged may concern fundamental choices related to the location and technical design of the project in order to achieve geographical, temporal or technical avoidance. Since negative environmental impacts could not be fully avoided at a reasonable cost, the remaining degradation should be **reduced** by technical mitigation solutions.

As a last resort, **compensatory measures** must be taken to provide a positive counterpart if negative impacts persist, aimed at globally preserving the environmental quality of the environment or achieving "no net loss of biodiversity", or "net gain" based on the values of biodiversity considered. This "Avoid, Reduce, Compensate" or "ARC" approach is good international practice.

The presentation of the measures will therefore be based on the presentation of the avoidance, reduction and then compensation measures.

Compensation measures are used when a residual impact is considered significant (moderate or major importance). They are implemented only in the event that avoidance or reduction measures cannot be implemented or are deemed insufficient.

Table 57 Mitigation Strategy based on the overall impact importance

Impact Importance	Description
NEGLIGIBLE	**Not Significant**. Any impacts are expected to be indistinguishable from the baseline or within the natural level of variation. These impacts do not require mitigation and are not a concern of the decision-making process.
MINOR	**Detectable but not significant**. Impacts of "minor" importance are expected to introduce noticeable changes to baseline conditions, beyond natural variation, but are not expected to cause hardship, degradation, or impair the function and value of the resource/receptor. However, these impacts warrant the attention of decision-makers, and should be avoided or mitigated where practicable.
MODERATE	**Significant**. Impacts of "moderate" importance are likely to be noticeable and result in lasting changes to baseline conditions, which may cause hardship to or degradation of the resource/receptor, although the overall function and value of the resource/receptor is not disrupted. These impacts are a priority for mitigation in order to avoid or reduce the significance of the impact.
MAJOR	**Significant**. Impacts of "Major" importance are likely to disrupt the function and value of the resource/receptor, and may have broader systemic consequences (e.g. ecosystem or social well-being). These impacts are a priority for mitigation in order to avoid or reduce the significance of the impact.

6.2. Impacts and mitigation during the preparation phase

The preparation phase consists in the pre-design, feasibility and design stages. The result is a detailed project and the obtention of formal authorizations by the national/local authorities for its implementation. This include the full and permanent attribution of land access.

The main impacts observed during the preparation phase are caused by the obtention by PIA of full and secured land access to the project site, which is a prerequisite for the project successful completion.

PIA land access will cause large-scale changes in current land uses which will lead to direct and indirect impacts on the human environment (and particularly in terms of economic displacement). Impacts on the physical and natural environment resulting from the implementation of the project (modification of ecosystems, loss of biodiversity, loss of natural resources or cultural heritage, etc.) will actually take place during the construction phase and will then be analysed in that section.

For each phase, the order of presentation is the following: physical, natural and human environment. This order reflects the "effects → impacts → effects" sequence, as the impact on the physical environment has consequences on the natural environment, which in turn has consequences on the human environment.

6.2.1. Impacts on the physical environment

No direct or indirect impacts on the physical environment are expected to take place during the preparation phase. In the absence of impacts on the physical environment, no measure needs to be identified.

6.2.2. Impacts on the biological environment

No direct or indirect impacts on the natural environment are expected to take place during the preparation phase. Hence, no measure needs to be identified.

6.2.3. Impacts on the human environment

6.2.3.1. Impacts on housing and settlements

The data from the inventories carried out by the Togolese State mention that 115 owners of structures, particularly residential ones, are impacted by the Project for the Phase 2. These impacted persons reside mainly in 3 villages located in the immediate vicinity of the site: Hagblévou, Gnatikopé and Vondjogbékopé. The industrial corrdidor will impact some residential structures (houses, farms) and part of a village. An estimate of around one hundred impacted structures has been made, at this stage the distinction between economic and residential structures has not been made. This will be clarified during the development of the RAP. In the absence of compensation and resettlement in adequate conditions, the displaced households will see their living conditions decrease. Resettlement far from the original place of residence will also lead to a deterioration in the social ties of the communities.

The number of people physically displaced and the importance and intensity of the impact mean that the impact on displaced people is considered of **major importance**.

Table 58 Impact of the project on housing and settlements during preparation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures:

- Establishment of a Resettlement Action Plan (RAP) according to IFC/World Bank standards;
- Compensation, preferably in kind, to PAPs. In case of financial compensation, PAPs will be compensated for replacement costs, moving costs and other expenses incurred by the displacement. The amount of compensation will be calculated at market price.

Residual impacts are considered to be minor.

6.2.3.2. Impacts on land and livelihoods

The project requires the use of 925 ha of land, including 552,56 ha for the PV plant. Field missions indicate that 200-250 households cultivate land within the Phase 2 project area. The people whose land is impacted reside in 10 villages around the project area: Hagblévou, Gnatikopé and Vondjogbékopé in the immediate vicinity of the site, Tokpanou and Agbadovinou to the north, Djogblakopé and Afloacondji to the south, Kpome Agomé and Akadjame to the east, and Fiogblé to the west.

The number of impacted household for the industrial corridor can be estimated in proportion to 70 households and will be specified during the preparation of the RAP. The people whose land is impacted reside in Hagblévou, Fiogblé, etc.

The land was already acquired and compensated by the government presenting some limitations for additional mitigation measures. The IFC compliant Supplementary Resettlement Action Plan, that will include an LRP, to be developed will include detailed data to measure the land impact of the project such as the number of plots impacted, their surface area, the nature of the title (formal, customary, informal) and the ownership of additional land.

The consultations revealed that land issues are particularly sensitive for the impacted populations. First of all, villagers expressed their frustration with the compensation received during previous projects, which they considered to be too low. Secondly, villagers expressed concern about the possibility of continuing to farm on the remaining land. Indeed, the successive development of projects in the area reduces the amount of arable land available and leads to speculation about the value of land, making it more difficult for farmers to acquire land. Finally, the project area is located in the territory of two cantons, Dalavé and Kpomé, whose boundaries are not clearly defined. The implementation of the project is therefore likely to exacerbate land conflicts between the communities and cantons.

6.2.3.2.1. Impact on agriculture, food security and economic activities

Economic displacement has two main impacts on PAPs in the affected localities:

- **Loss of economic activity:** PAPs risk losing their means of subsistence insofar as agriculture practised on the land is a source of monetary income, particularly the sale of the fruit of perennial crops. PAPs who have developed a strategy of pluriactivity will be better able to cope with the decrease in income resulting from the loss of agricultural land. In the absence of alternative income-generating activities, PAPs will see their living conditions decline.
- **Food insecurity:** PAPs' food security will be threatened as agriculture is also a source of non-cash income. Socio-economic surveys in the project area indicate that many PAPs practice subsistence farming. In the absence of alternative income generating activities and food sources during a transition period, the loss of land due to the project will threaten the food security of the PAPs and their households.

In the context of land pressure mentioned above and the scarcity of arable land in the area, this impact is considered to be of **major importance**.

Table 59 Impact of the project on land tenure, land use and means of livelihood during preparation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures :

- Respect for the limits of the defined useful rights of way for the development of the project's infrastructure;
- Full compensation to PAPs for lost land, and crops at market value, regardless of land title, in accordance with IFC performance standards;
- Establishment of a Livelihoods Restoration Plan in line with IFC performance standards, which includes the establishment of transitional measures to ensure food security for PAPs and avoid

impoverishment in the period before the development of alternative income generating activities;

- Setting up a training programme to enable PAPs to develop an income-generating activity that does not depend on the availability of land or eventually to be recruited to the project;
- Recruitment that will favour equally skilled PAPs and ensure gender balance;
- Give special attention to restoring the livelihoods of the most vulnerable PAPs.

Residual impacts are considered to be minor.

6.2.3.2.2. Impacts on the living conditions of vulnerable women and PAPs

Despite Togo's increasingly progressive legislation, women are still discriminated against in the area of land. Thus, Togolese law allows women to access land ownership in the same way as men via the two modes of land acquisition, namely inheritance and purchase. However, the persistent application of customary law in rural areas can lead to discrimination or difficulties for women in accessing land, particularly through unequal distribution of inherited land. This results in the following difficulties for women in acquiring land:

- **Exclusion from compensation:** Women owners or users of land impacted by a project may be excluded from resettlement and compensation processes for the loss of land and income generated by their farms because, under customary law, they cannot be considered as beneficiaries. In this situation, compensation could be paid to male members of the household such as husbands, brothers, or nephews.
- **Appropriation of compensation by men in the household:** women may not benefit from the positive spillover effects generated by the payment of compensation as some men use the compensation for personal material expenses and not for productive investments that benefit the household.
- **Exclusions from consultations:** in the absence of specific measures, women may be excluded from consultations and decision-making processes related to resettlement and the implementation of livelihood restoration activities.

These impacts are considered moderately sensitive in the area as Togolese legislation is relatively progressive and village leaders have noted improvements in the situation of women. However, it should be noted that the consultations organised revealed rather limited female participation.

Similarly, vulnerable PAPs who lose access to their land are likely to suffer more from the impacts of resettlement and loss of economic activities due to limited social and economic capital. In addition, these vulnerable people generally face greater difficulties in finding new sources of income. Social and economic factors are often related to physical disability, age, gender - particularly female heads of household, and the poorest households.

Table 60 Impact of the project on vulnerable groups during preparation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures :

The LRP to be developed should take into account the particular rights and needs of vulnerable women and PAPs. These measures include:

- The establishment of processes to ensure women's participation and consultation in decision-making;
- The identification and payment of compensation to women owners and users of impacted land;
- The definition of criteria adapted to the local context to determine the vulnerability of PAPs;
- The establishment of transitional and priority measures for PAPs to restore their livelihoods;
- Planting of species mainly used by women for gathering on a site around the power plant, to be discussed with the communities;
- Payment of compensation in installments;
- Inclusion of women and vulnerable PAPs in the PRMS monitoring committees.

The implementation of these mitigation measures should result in **minor residual impacts** for vulnerable women and PAPs.

6.2.3.3. Impact on cultural heritage

Consultations with the inhabitants of the impacted localities revealed the presence of cultural heritage objects and sites. The impacted sites include a church, and individual and community fetishes located in clods of land and trees. The fetishes were not exhaustively counted and located at the stage of the assessment but will be precisely and completely counted during the preparation of the resettlement action plan. Initial discussions with the population revealed that they would be potentially relocatable.

Given the presence a church and numerous fetishes, this component is considered of major sensitivity. However, the possibility of relocating these assets allows us to evaluate the intensity of the impact as moderate, which allows us to qualify the significance of the impact as major.

Table 61 Impact of the project on cultural heritage during preparation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures :

The IFC Performance Standards require specific conditions for the protection of non-replicable cultural heritage that is to be relocated. These conditions include that there is no alternative to relocation, that the benefits of the project outweigh the potential loss of the cultural heritage and that the relocation of the objects follows international best practice.

A cultural heritage management plan will have to be developed and implemented.

According to the consultations carried out, these cultural heritage objects and sites can be relocated provided that the relocation is managed and that the local, traditional and site owners and families concerned are consulted and involved effectively. It will also be necessary to consult with the relevant local authorities on the relocation of the church. Finally, appropriate rites should be performed prior to relocation in agreement with the families, fetish owners and traditional leaders. Thus, the relocation of

sites and objects in consultation with the relevant persons and authorities will ensure their protection and compliance with the IFC's performance standards requirements.

No cultural heritage site or object may be relocated or destroyed without prior consultation with and permission from its owner.

Mitigation measures should result in a **residual impact of minor** significance on cultural heritage.

6.2.4. Vegetation Dumping site

As the dumping site is considered an associated facility (see section 3.4.1), the impacts of the site selection will affect both the biological and human environment.

To date, the 100 ha land belongs to the government but no information could be consulted concerning the process of acquiring the site. Also, no public consultations have been held to inform the populations.

During the preparation phase, the green waste disposal area that will be retained (around 2 ha) must be the subject of a survey to verify sensitive receptors and required mitigation measures for their management. Where appropriate, the occupations of land that will be identified must be subject to compensation, the scale and terms of payment of which must comply with the IFC Performance Standard 5.

The 2 ha area will be selected based on the criteria presented in paragraph 3.4.1.2 to prevent physical and economic resettlement.

Measures :

Public consultations will have to be conducted to inform the populations of the green waste disposal project.

Inspection, and, if needed a survey, of the provisionally determined low sensitivity areas will be carried out and consultation with local community will be organized at least 2 months prior to disposal. This inspection will have to confirm the presence of social and environmental components that can be affected by vegetaion disposal.

Assuming no physical and economic resettlement is involved, the securing of 2 ha land for the disposal of vegetation will have **minor residual impact**.

6.2.5. Impacts and measures synthesis for the preparation phase

Table 62 Impacts and measures synthesis for the preparation phase

Item	Source of impact	Description of the potential impact / impactful activity	Import-ance of impact	Measures	Residual impact
Housing and settlements	Land acquisition	- 115 estimated physical displacement	Major	- Establishment of a RAP - Compensation according to IFC performance standards, preferably in kind	Minor
Land tenure, land use and means of livelihood	Land acquisition	- Loss of economic activity (agriculture, breeding) - Food insecurity	Major	- Respect for right-of-way limits; - Full compensation to PAPs for land, crops in accordance with IFC performance standards; - Implementation of a Livelihood Restoration Plan in line with IFC performance standards, including transitional measures;	Minor

Item	Source of impact	Description of the potential impact / impactful activity	Import-ance of impact	Measures	Residual impact
				- Setting up a training programme to enable PAPs to develop an income-generating activity that does not depend on the availability of land or eventually to be recruited to the project - Recruitment that favours equally qualified PAPs and ensures gender balance; - Give special attention to restoring the livelihoods of the most vulnerable PAPs.	
Living conditions of women and vulnerable people	Land acquisition	- Exclusion from compensation payments; - Appropriation of compensation by men in the household; - Exclusion of consultations	Major	- Identification and payment of compensation to women owners and users of affected land; - The definition of criteria adapted to the local context to determine the vulnerability of PAPs; - Establishment of transitional and priority measures for vulnerable PAPs to restore their livelihoods; - Planting of species mainly used by women for gathering on a site around the power plant, to be discussed with the communities; - Payment of compensation in instalments; - Ensuring women's participation and consultation in decision making; - Inclusion of women and vulnerable PAPs in PRMS monitoring committees	Minor
Cultural heritage	Land acquisition	- Loss of cultural heritage sites (church) - Relocation of many individual and community fetishes	Major	- Develop and implement a cultural heritage management plan - Payment of compensation to the church pastor - Identification and location of fetishes; - Consultations with the owners of the fetishes, local chiefs ; - Performing appropriate rites; - Carrying out and paying for relocation.	Minor
Vegetation dumping site	Land clearance	- Loss of modified habitat	Minor	- Select area based on the criteria presented in paragraph **Erreur ! Source du renvoi i ntrouvable.** to prevent physical and economic resettlement. - Carry out, if needed, a full biological and social inventory of provisionally determined low sensitivity areas will be carried out - Organize consultation with local community at least 2 months prior to disposal	Minor

6.3. Impacts and mitigation during the construction phase

6.3.1. Impacts on the physical environment and mitigation

6.3.1.1. Impacts on climate and on climate-change related risks

Impacts

This section analyses both the impact of the project on climate (and climate change) and on the risks related to climate change, that may be increased or reduced by the realization of the project itself.

The direct contribution of the projet to climate change, during its construction phase, is strictly related to the removal of vegetation and the emission of greenhouse gases (GHG). Indirect contribution is linked to the emissions to produce materials needed for the construction site (not considered at this level of the analysis).

Based on the analysis carried out, the quantity of sequestered carbon on the surface of the Phase 2 and the Industrial Corridor by soil and vegetation is approximately 4,73 tons CO2eq. By stripping the vegetaion will release this carbon.

The GHG emissions from PV plants are estimated as part of life cycle assessment (LCA). Hundreds of LCA have been carried out in the last years in order to provide an estimation of GHG emissions, which depend on multiple factors (technology, energy used for the construction, maintenance, disposal technology etc), as illustrated in the figure below:

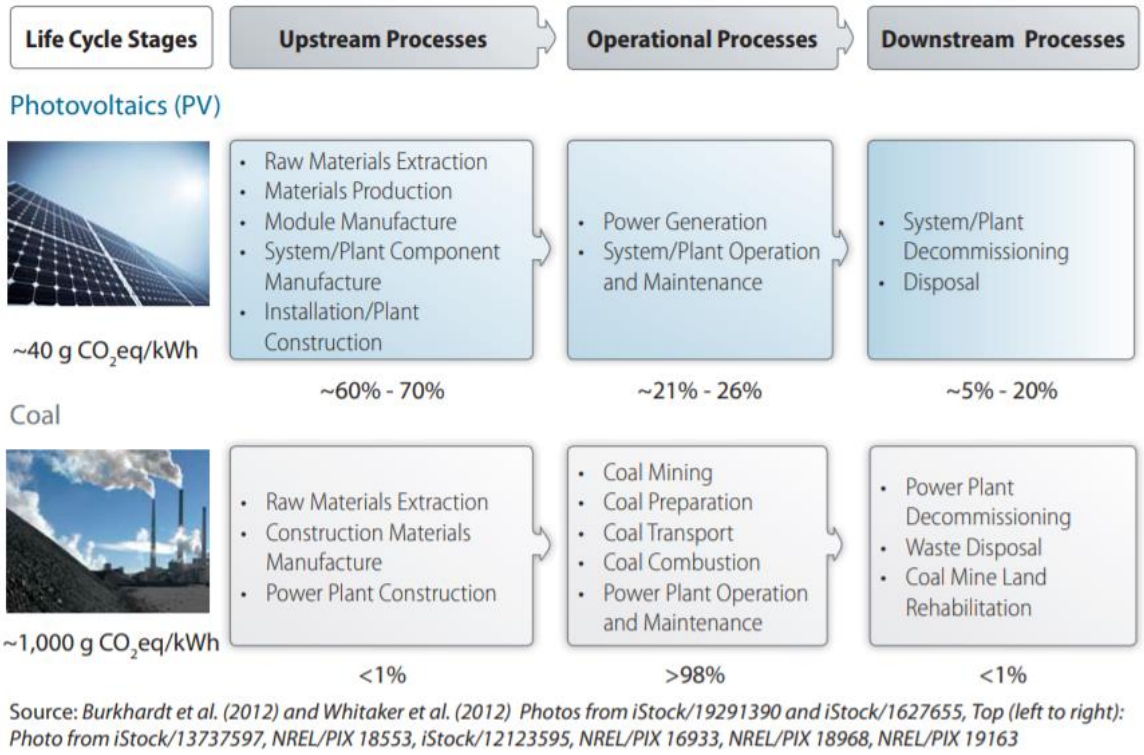


Figure 112 PV plant emissions per phase and comparison to coal poer plant emissions (Source : NREL/FS-6A20-56487 – novembre 2012)

This estimate deeply relies on the energy mix of the country where the PV panels have been built. For panels made in China, the emission is estimated in 43,9 gCO_2eq/kWh. This is the value retained in the present study.

Based on the average P50 energy yield of the PV plant (633616 MWh/year), the emissions of the PV plant over a 25 years lifetime and over its whole lifecycle are estimated in 27815 tons CO_2eq/year (or 695393 tons CO_2eq/25years).

The method used to evaluate the project's greenhouse gas emissions is that of the Bilan Carbone®. The Bilan Carbone® method was developed by the French Environment and Energy Management Agency (ADEME) and the Bilan Carbone Association (ABC) to enable any industrial or tertiary activity to make an estimate direct and indirect greenhouse gas (GHG) emissions resulting from the physical processes necessary for its existence (construction, operational and cessation of activity phases). The carbon method is not limited to the physical site of the site but to all processes, regardless of where they take place, as soon as they are included in the designated perimeter. It is an "inventory which puts on an equal footing all the issues made on behalf of the entity examined, without distinction of place, since their existence is the counterpart of a process which benefits the entity in question".

Since greenhouse gas emissions cannot be directly measured, emissions are estimated from the organization's activity data and from a bank of emission factors14 (EF) thus making it possible to convert the activity data in tons of CO2 equivalent (eq CO2).

GHG emissions = activity data x corresponding emission factor

An example of emission factors for different materials is provided in the following figure.

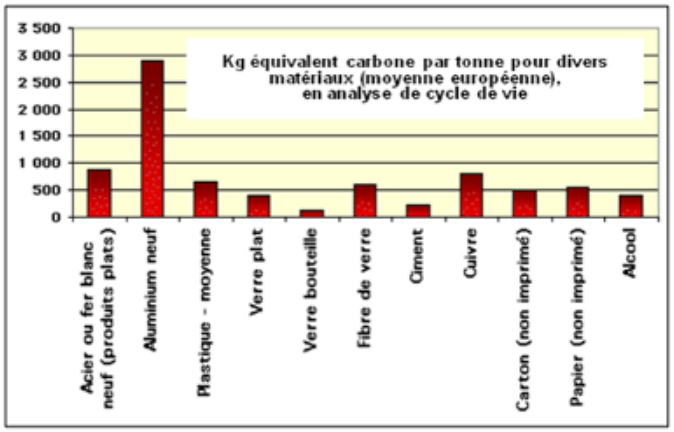


Figure 1 Emission factor for different materials (source ADEME)

This is a "*quantification by estimation* " because an uncertainty is associated with the activity data and the EFs.

This evaluation method is thus intended to provide orders of magnitude on the GHG emissions of the activity or project.

- **Greenhouse gases taken into account within the framework of the Bilan Carbone®**

The *Bilan Carbone®* method takes into account six GHGs:

- carbon dioxide: CO_2;
- methane: CH_4;
- nitrous oxide: N_2O;
- hydrofluorocarbons: HFCs;

[14] These factors come from various bibliographical sources and are marred by an uncertainty specified in the method.

- perfluorocarbons: PFCs;
- sulfur hexafluoride: SF_6.

Since CO2 is the most widespread gas, it has become a reference when discussing carbon balance data. Thus, the five other gases are converted into carbon equivalent and the final result of the carbon balance is expressed in tonnes of CO2 relating to the GHG emissions of these 6 gases.

- **The global warming potential (GWP)**

The evaluation of the emissions of these 6 gases is based on the global warming potential (GWP) of each of these gases. Indeed, the impact of the emission into the atmosphere of a ton of greenhouse gases being different from one gas to another (lifetime of the gas, radiative forcing), the impact is defined in terms of global warming potential (GWP) at 100 years.

The GWP is the ratio between the energy returned to the ground in 100 years by 1 kg of gas and that which would be returned by 1 kg of CO2. It therefore depends on the concentrations and lifetimes of the gases. For example, 1 kg of CH4 warm the atmosphere as much as 28 to 30 kg of CO2 during the century following their emission.

As specified previously, the GWP is reduced to a standard: the carbon dioxide equivalent (eqCO2).

The main emission sources selected for the construction of a solar park are as follows:

- Construction materials: production of solar panels;
- Energy: fuel consumption by construction machinery;
- Clearing: site preparation work (clearing).

Other emission sources exist but were not retained because their quantitative impact is not considered significant on the project's GHG emission estimate in the construction phase.

- **Calculation**

The tool used to calculate this assessment of the project's carbon emissions in the construction phase is the one made available on the AFD website (http://climat.afd.fr).

- **Results of the evaluation of the project's GHG emissions in the construction phase**

The table below presents the elements taken into account for the calculation of the GHG emissions as well as the results obtained for each of the 3 main emission sources selected.

Table 1 Elements for calculating the GHGs of the construction of the Project

Category	Description	Value to enter	Emission $teqCO_2$
Clearing	Deforestation - Environment: savannah and plantations	786.4 ha (85%)	147,900
	Deforestation - Environment: fallow	land 138.8 ha (15%)	1,600
Building materials	BifacialPV solar panels module technologies	260 MWp	635,600
Fuel Fuel	consumption of construction machinery (estimated)	4,500 m^3 Gasoline/Diesel	14,700
		Total	**799,800**

The quantity of main GHG emissions expected for the Project construction is estimated at **799,777 teqCO_2**. This, compared to the annual national GHG emission (8,4 million tons in 2018), constitutes 9 %.

The Project may have an impact on the risks related to climate change, in the way that the Project can aggravate climate change effects, more precisely:

- Flood risk : We know that the potential increase in the frequency rate of extreme events, due to climate change, may result in a subsequent increase of the risk of flooding A small portion of the project is affected by a low to moderate flood risk during the rainy season (Cf. Figure 60). The increase of impermeable surface will keep the water from infiltrating and can increase speed of runoff of water on site. This can result in an greater risk of flooding for the area mainly downstream of the site
- Erosion : the removal of vegetation and the construction activities resulting in soil disturbance and erosion risks, which could be also aggravated by climate change. Erosion impact is assessed in Section 6.3.1.2.

GHG emissions are limited by the duration of the construction phase and erosion and flood risks are related to a limited area of the Project site.

During the construction phase, ditches and temporary rainwater management basins will be created as the work progresses. Also, design measures such as optimisation of permeable and semi-permeable surfaces will minimise the potential impact on the flood risk.

The overall intensity of the impacts is therefore considered negligible and importance minor.

Table 63 Impact of civil works, including land clearing, and traffic on climate and climate-change related risks during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

To face the potential increase in the risk of flooding, the stormwater management system needs to be properly designed. The water management measures described in section 6.3.1.5.4 are of application for reducing the increasingly risk of flooding.

To reduce the risk of increased soil erosion, measures described in section 6.3.2.3 (limit clearing activities, implement revegetation strategies) are of application.

The residual impact importance is considered to be minor.

6.3.1.2. Impacts on geology, topography and soils

Impacts

During the construction phase, soil quality can be affected by an accidental spillage of hazardous liquid products or mismanagement of hazardous materials, waste (hydrocarbons, drain oils, paints, solvents, etc.) or effluents (suspended matters, organic matters and bacteria). These events may result in soil pollution, as well as groundwater contamination through soil infiltration. See section 6.3.1.5.1 for the description of this impact.

The impact of the Project on the geology, topography and structure should be assessed in terms of:

- The removal of superficial/bedrock deposits.
- The superficial/bedrock deposits' stability.

The soil of the Project area will be modified due to grading and levelling activities.

Cut / fill zones may be affected by rain erosion during storage and handling and generate sediment runoff. The management of cut / fill must be anticipated because it involves:

- Temporary storage of non-cohesive materials during construction which may be easily affected by erosion and which may lead to landslides if the deposits are too high, steep or poorly stabilized.
- A surplus of cut to be stored on the site permanently because it cannot be reused.

The work is projected to follow as much as possible the natural topographical conditions of the Project site to maintain the existing drainage patterns. Moreover, temporary soil disturbance can be observed for the development of the works area and base camp within the Project boundary. All cut material will distributed across the project area with no excess soil expected to be disposed off site.

As no large excavation or significant bedrock disturbance is anticipated, impacts on geology and topography are expected to be negligible.

Due to the soil nature, there is an erosion risk strengthened by the clearing activities and the removal of all vegetation. Bare soils are more exposed to erosion, mainly during the rainy period. This risk also concerns storage areas for materials and excavation products. If these areas are not stable (non-cohesive materials), the rains can easily erode the piles. Heavy rainfall can lead to increase the sediment transport from the highest points to the lowest points. Sediment accumulation can therefore be observed towards the lowest parts of the site. Nevertheless, the topography being predominantly flat, impact is expected to be limited.

Table 64 Impact of civil works, including land clearing, solid waste production and liquid discharge on geology, topography and soil quality during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

As for the measures related to soil contamination, those defined in case of spillage in section § 6.3.1.5.1 apply for the soil too.

- For work areas and base camp:
  - Preferentially locate work areas and base camp on flat areas to reduce topographical alterations. If necessary, it is preferable to opt for earthworks in steps to minimise soil excavation.
  - Ensure rehabilitation of all affected area at the end of the works.
- **Stripped soil management**. The soil storage area that will not be remobilised for 6 months will be covered with a thin topsoil to promote the development of herbaceous vegetation. The other temporary storage zones will be protected on their slopes by a synthetic cover. Deposits should

not exceed six meters in height, their slope 1.5H / 1V and be equipped with a mid-height riser (three meters).

- Main excavation work shall be conducted **during low precipitation periods**, as much as possible.
- **Optimization of cut and fill**. The design expectas a neutral cut / fill balance thus preventing soil erosion off site. This optimization also limits costs as well as many environmental impacts such as energy consumption, material consumption from outside, GHG emissions, truck traffic, dust emissions and noise pollution.
- **Implementation of silt fence** to retain the soil on disturbed land until the activities disturbing the land are sufficiently completed to allow revegetation and permanent soil stabilization to begin. A reasonable rule-of -thumb for the proper amount of silt fence is—30 meters of silt fence per 1,000m² of disturbed area (EPA stormwater best management practice). The silt fence shall be placed on slope contours or at the bottom edge of the soil piles to maximize ponding efficiency. Heavy porous filter fabric like geotextile with steel posts shall be privileged.
- **Progressive soil rehabilitation** to avoid large erosion phenomena, especially during rainy season. Revegetation and soil stabilization shall be considered, including for the work area and base camp.

The residual impact is considered to be negligible.

6.3.1.3. Impacts on air quality

Impacts

Air quality can be affected from different sources of pollution:

- Exhaust and combustion emissions

Combustion engines of construction machineries, compressors and electricity generators generate exhaust gases. This kind of emission will be observed in the whole easement of the PIA area. Indeed, during the construction phase, some 50 trucks and construction equipment will use the access roads and drive around the Project site.

Traffic will also represent a source of pollution, although of much less importance. The crossing of the various villages by supply trucks will generate atmospheric emissions in sensitive inhabited areas. Beyond the inconvenience for the persons who live along the road, this point also arises concerns regarding public safety discussed later.

The main impact factor for exhaust gases comes from the clearing activities. Indeed, these can lead to large and uncomfortable smoke emissions in case of burning green waste, although this practice will be prohibited. In that sense, no burning of green waste is expected for the need of the project.

- Dust

This is usually the most disturbing impact of large construction sites during dry periods. Dust is generated on site by earthmoving operations, storage of excavated materials and products, material crushing units and the concrete plant.

The IAQM guidance[15] suggests that if the sensitive 'ecological receptors' are located greater than 50 m from the boundary of the site, 50 m of the route used by construction vehicles, or 500 m from the site entrance, the dust impacts are unlikely to be significant.

[15] Guidance on the Assessment of Dust from Demolition and Construction, Version 1.1. Institute of Air Quality Management (IAQM) (2014)

Onsite, there will be no human receptors (apart for workers), the closest ones that will be affected will be the villages bordering the Project area. This mainly concerns Hagblévou, Gnatikopé, Akadjamé, Tokpanou, Agbadovinou, Vondjogbékopé, Djogblakopé, Fiogblé and Kpomé Agomé. The satellite imagery shows that only a few isolated houses are located within 50 m of the site boundary or 500 m from the site entrance. Other villages transited by vehicles might be affected, especially if it is along unpaved roads.

The level of the potential impact intensity in terms of the air quality at the sensitive receptors, is moderate due to the distances between inhabited areas and the project site, and on the other hand the traffic of trucks and construction machines introduced by the project.

Importance of the impact of civil works, including traffic, on the air quality:

Table 65 Impact of civil works and traffic on air quality during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

The measures to be implemented are:

- Control of the air quality impact with formalized measures, where all construction contractors must implement the ESMP based on this ESIA
- **Limit the vehicles speed** to 30 km/h in all inhabited areas, and, if possible, pave road sections experiencing highest traffic load,
- **Waste reuse, composting and recycling**, **including green waste**. Burning waste (including green waste) is strictly forbidden. Facilitate the green waste recycling (logs and large branches) for composting to minimise its disposal at the dumping site,
- **Humidification**, when necessary, of unpaved village roads crossed by trucks and the excavated soil stored on the construction site in case of severe drought and high winds,
- **Covering trucks** transporting pulverulent materials (fine materials or soils),
- Use of good quality equipment and vehicles, preferably new, and regular inspection and maintenance of work engine and equipment (exhausts),
- **Dust monitoring** undertaken on the site boundary and villages crossed by the main roads used by the Project vehicles and machinery,
- **Grivance /Complaint mechanism** implemented in the nearest villages (Hagblévou, Gnatikopé, Akadjamé, Tokpanou, Agbadovinou, Vondjogbékopé, Djogblakopé, Fiogblé and Kpomé Agomé) will help to address dust issues.

The residual impacts are considered to be minor.

6.3.1.4. Impacts on ambient noise levels

Impacts

Construction activities will take place outside where they will be affected by weather, wind tunnels, topography, atmosphere and landscaping. Construction noise sources, e.g., heavy earth moving

equipment, will move from location to location and will likely to vary considerably in its intensity throughout a workday.

Earthworks, concrete and asphalts fabrication, construction activities will be the main source of noise. Most of the noise from these sources is inherent and difficult to subdue. Traffic will be also a source of noise, and will affect community at the villages near the roads or the project perimeter.

The noise levels of common construction noise sources are well-known and are described below:

Table 66 Noise levels for different contruction machinery

Equipment	Typical Noise level at 30 metres, dB(A)
Scrapper at full load	83 – 92
Dozers ripping	80 – 90
Loaders (100 – 200 kW)	77 – 80
Cranes (small mobile)	74 – 77
Dump trucks	65 – 82
Diesel generator sets (250 kVA)	74 – 81
Welding Sets	69 – 75
Concrete trucks	69 – 78
Pile driver (air hammer)	80 – 101
Chipping hammer on steel	63 – 81
Grinder	63 – 68
Air compressor	65 – 67

Source: World Health Organization

As described in the baseline (§5.4.6), the Project is located in an area where ambient noise levels are already elevated (higher than IFC noise thresholds) due to the presence of various noise sources such as community activities, markets, schools, roads, industries.

Few sensitive receptors (villages) are located less than 200 m from the site boundary where construction activites will take place. As a reminder, the construction activities do not include those for the realisation of industries that will be implanted on the IZ plots.

The distance between a noise source and noise receiver will be sufficient for attenuating sound with reference to most of the sensitive receivers. As for the most exposed receivers, the noise will be limited to the duration of the civil works (12 months).

The impact related to civil works is rated as moderate, whereas the one related to traffic is rated as minor.

Table 67 Impact of from civil works on ambient noise environment during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 68 Impact of traffic on noise environment during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

During the construction works the predicted noise levels should be considered in establishing work site locations, construction techniques and on-site practices. The following principles and proactive noise management measures should be considered for implementation by the main contractor:

- **Limit construction works to daytime hours where reasonable and feasible**. Engines shall not be started and on-site activities shall not be undertaken outside of the daytime construction hours. Low noise generating works can be undertaken at staging areas where works are not adjacent to residential receptors. National regulation states that "noisy activities can only take place between 7 am - 12 noon and 3 p.m. - 6 p.m. on weekdays". No noisy activites will take place on weekends,
- **Using equipment that has been well maintained** so that noise emissions are minimised,
- **Villagers are to be notified a minimum of 2 weeks prior to the commencement of construction works**. The notification would detail proposed construction works, permitted hours of work and potential noise impacts,
- **Transportation vehicles should maintain appropriate travelling speeds** along the roads and should avoid the running of engines for long periods of time when in a stationary position at the Project site,
- **Noise monitoring** to confirm the construction noise levels at representative sensitive receiver locations should be undertaken. This monitoring should be carried out at the start of the construction of the Project and on a quarterly basis,
- **Grievance /Complaint mechanism** implemented in the nearest villages (Hagblévou, Gnatikopé, Akadjamé, Tokpanou, Agbadovinou, Vondjogbékopé, Djogblakopé, Fiogblé and Kpomé Agomé) will address noise issues.

The residual impact is rated as minor.

6.3.1.5. Impacts on hydrology and hydrogeology

6.3.1.5.1. Liquid discharges affecting water quality

Construction activities can influence water quality. Indeed, the risk of degradation of the chemical and biological water quality can be induced by the temporary concentration of construction and population activities.

The Maastrichtien aquifer is deep (150 meters below ground level) and supposed to be confined, thus being protected from external pollution, although various spills and leaks in the proximity of inadequately maintained wells can easily infiltrate into the horizon. Superficial unconfined or partially confined aquifers, where rural wells were drilled, are exposed to pollution and are particularly vulnerable to contamination from latrines and agriculture.

The following table summarizes the various potential sources of pollution resulting from construction activities and indicates the type of risks they are likely to generate, the environment affected and the possible impact.

Table 69 Impacts on water quality from liquid discharges (effluents and waste) during construction phase

Impact factor	Receiving environment	Description	Potential impact
Wastewater from workers accommodation (including base camp)	Soil Groundwater by infiltration Surface water during rainy season	Grey and black water collected in septic tanks. Leaks or accidental discharge may result in infiltration to groundwater.	Degradation of the natural aquatic environment quality (lack of oxygen, turbidity) and impact on aquatic life (direct impact). Risk to human health in the event of consumption of polluted water: superficial groundwater can be affected through soil infiltration of discharges (indirect impact)
Wastewater from concrete / asphalt production, equipment/engines washing	Soil Groundwater by infiltration Surface water during rainy season	No engine washing activities on site. Wastewater from concrete/Asphalt production is contained in drums and disposed of by identified contractors (METTOGO). Failure in containment may result in accidental discharges on ground of water with hydrocarbon, high concentration in SM Infiltration to groundwater Soil leaching until the Haho river through the flood-risk area	Degradation of water quality (lack of oxygen, turbidity, chemical pollution) (direct impact). Possibility of acute toxicity to aquatic life depending on the concentrations (indirect impact). Superficial groundwater can be affected through soil infiltration of discharges (indirect impact)
Waste production from clearing activities, workers accommodation, works	Soil Groundwater by infiltration (leachate) Surface water during rainy season	Leaching of waste storage areas (leachate) and infiltration to groundwater (mainly organic matter) / flood-risk area / Haho river. Dispersion of waste which may be carried by run-off water and flow towards the flood-risk area to the Haho river.	Visual degradation (direct impact) Soil pollution (direct impact) Leachate from waste or spills can affect groundwater quality of unconfined aquifer in case of soil infiltration: degradation of water quality (lack of oxygen, turbidity, chemical pollution) (indirect impact)
Hydrocarbons, used oils, solvents, pesticides and	Soil	Leaks Accidental spills	Acute toxicity to aquatic life (indirect impact)

Impact factor	Receiving environment	Description	Potential impact
other hazardous products (storage and handling)	Groundwater by infiltration Surface water during rainy season	Leaching of polluted or treated areas (pesticides)	Risk to human health in the event of consumption of polluted water: superficial groundwater can be affected though soil infiltration of discharges (indirect impact)

As no permanent surface water is onsite, impacts on surface water quality are expected to be minor, except during the rainy season where the impacts might be higher because of the possible hydraulic connection with the Haho river (through soil leachate and runoff). Nevertheless, due to the distance, and fairly low volumes of dangerous products that will be used and the low topography, impact will be limited.

Regarding groundwater, due to the presence of superficial unconfined aquifer, leachate can infiltrate the ground and affect the water quality (used by the dwellers for drinking purposes). But as the works will not imply large volume of dangerous products and soil of the site has a ferralitic sandy-clay texture, impacts are considered moderate.

Table 70 Impact of liquid discharges on surface water quality during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 71 Impact of liquid discharges on ground water quality during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

6.3.1.5.2. Water resource consumption affecting its availability

During the construction phase, the works will consume water for various activities: concrete making, vehicles washing, tracks humidification and domestic use, etc.

Considering a peak attendance of 1500 workers for the entire site and a specific consumption of up to 50 L / person / day, as well as a consumption of around 10 m^3 / day for site activities, the daily water requirements for the site is described in the table below.

Table 72 Water consumption for the construction phase

Item	Description
Works period (months)	12
Workforce (peak)	1500
Daily needs (m^3)	75
Works needs (m^3)	10
TOTAL for one day (m^3)	85

TOTAL for the work period (m^3)	13 860 m^3 (1155 per month based on 12 months duration)

Water needs can put pressure on groundwater resources and compete with other uses if the volumes are large compared to the operating rates of existing wells in the area (including rural wells for domestics uses).

As a reminder, all three aquifers are used for water supply in the Project area of influence by the Togolese Water Company (TdE), industries and by private boreholes for all major type of uses. A recurring problem of lack of drinking water in the region was raised during public consultations. The only water sources available and accessible to local dwellers are the wells on superficial unconfined aquifer which are already overexploited and may dry up during the dry season.

The water supply for the construction phase will be predominantly from the Maastrichtien aquifer. The work camp will be inside the Project area with water supply from the installed PIA boreholes. As the project will mostly be supplied by Maastrichtien aquifer, the impact on water resource could be limited and short-term. However, it can also impact other two aquifers due to possible interconnectivity between the three aquifer.

Therefore, the intensity of the impact is then considered to be minor.

Importance of the impact of groundwater resource availability is considered moderate:

Table 73 Project Impact on groundwater resource availability during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

6.3.1.5.3. Civil works resulting in drainage pattern modification

The existing drainage pattern largely follows the natural topographical conditions of the Project site that conveys the runoff towards the existing natural channels located on the north and south side of the N34.

Projected earthworks, road development and construction of the IZ utilities will lead to a partial soil sealing. This impermeable area is estimated to be about 27,7 Ha (or 3,9% of the overall area, roads included) as minimum; other commercial and industrial areas may also lead to soil sealing but their easements are yet not known, giving a moderate sealing of the Project footprint area (greenfield).

It is important to note that the large part of the Phase 2 area will be occupied by the solar park (552,56 ha, 77,2%). This area will only be partially sealed, thus allowing natural infiltration and runoff.

Nevertheless, despite some local hydraulic modifications due to grading and levelling, the initial main flow direction will be maintained.

Impact is rated as negligible.

Table 74 Impact of civil works, and drainage pattern modification on hydrology during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

6.3.1.5.4. Measures

The above discussed impacts can be controlled with the implementation of adequate measures at the beginning of works:

Water supply:

- **Use water storage tank to be regularly filled out for works' needs** (car washing, concrete preparation, etc.). This tank should be linked to a rainwater collection system to minimize the extraction from the local aquifer.

Training and planification:

- Develop **Emergency Response Plan** defining intervention measures in case of accidental spillage to limit the pollution.
- Implementation of a **sensitization and training program** for workers on water saving practices, spillage procedures, hazard product.

Design measures:

- Selection of **porous asphalt** or other surfaces of higher permeability to favor water infiltration and reduce runoff water.
- **Develop and implement design concept of the drainage network to reduce runoff volume**, as vegetation swale (vegetated channel area to transport and infiltrate rainwater) on both sides of the roads as well as across and around the solar park and infiltration trenches or ditches within the plot premises. Associate ponds or infiltration basin in order will enable to temporary store stormwater runoff and reduce peak flow rates and allow stormwater infiltration.

Specific measures applied to the work area and base camp including workers accommodation and storage area:

- **Implementation of wastewater treatment systems**: conventional sanitation network with wastewater treatment with installation of conventional septic tanks (sanitary infrastructures) for workers' camp and, because of the large surface of the site and depending on the location of the work area/base camp, installation of systems like dry latrine in the work area might be considered.
- **Use of contained and impermeable areas for chemicals and dangerous products storage**. Storage on dedicated secure platforms: waterproof concrete slab surrounded by a low wall ensuring the retention of a volume at least equal to 110% of the largest container located on the platform (maximum of 10,000 l to be authorized for gasoline or diesel). The platform must be covered, and its evacuation equipped with an oil separator. Selected place shall way from any boreholes and wells and stagnant water area (incl. temporary).
- **Appropriate storage for dangerous products**. Label and store chemicals in designated and secured areas and ensure compatibility of storage (toxicity information and MSDSs available to workers)
- **Identification of appropriate place for engine refuelling, maintenance and washing**. The maintenance and washing of engine and equipment will be limited to areas defined for this use,

equipped with a concrete slab and a peripheral drainage evacuating runoff through an oil separator (hydrocarbon water) and/or sedimentation basins depending (sediment water). Selected place shall way from any boreholes and wells and stagnant water area (incl. temporary).

- **Implementation of PIA Waste Management Plan** to ensure safe collection, treatment and disposal of all produced waste in the work area/base camp and on construction sites. Establish duty of care, transfer notes, and auditing of waste management facilities to prevent liabilities associated with waste mismanagement.
- **Implement monitoring program for water quality discharges from worksite areas** after the oil separators.
- In case of set up of a **discharge of wastewater in the environment,** an application must be submitted to the ANGE (national requirement).
- Implement measures specific to the use of septic tank:
  - Use vacuum trucks or tugs for removal of fecal sludge instead of manual methods and use of appropriate collection vehicles (vacuum tanker trucks);
  - Provide and require use of personal protective equipment (PPE) to prevent contact with wastewater;
  - Consider provision of systematic, regular collection of fecal sludge and septic waste;
  - Facilitate discharge of fecal sludge and septage at storage and treatment facilities so that untreated septage is not discharged to the environment.
  - Periodic inspections and control of the septic tank integrity to ensure zero leakages
  - Control agreement of the Attiegou-Kelegouga site to accept septic tank effluent in accordance with national standards

The residual impact importance for all above mentioned surface water receptors (water quality, drainage pattern) is considered to be negligible; the residual impact importance for groundwater receptors (water quality, water resource availability) is considered to be minor.

6.3.1.6. Impacts on landscape

Impacts

Impacts on landscape during construction phase are mainly related to the presence of the equipment and the good keeping of the working and base camp areas.

Topographic relief is predominaly flat and land use is 50% fallow and 50% agricultural, hence no sensitive points of view on the Project area exists. On the opposite, visual amenity value exists for inhabitants.

The landscape impacts are however very limited in this phase.

The importance of the impact of civil works, including drilling, on landscape is therefore rated as minor:

Table 75 Impact of civil works on landscape during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

Measures to be implemented are mainly related to the good keeping of the works area/base camp and the waste management:

- **Implementation of collection, monitoring and waste treatment plan**, for all produced waste in the work area/base camp and on construction sites (see section 6.3.1.7).
- Grievance/Complaint mechanism implemented in the nearest villages (Adoglove, Akplome, Dzove and Lomegnokope) will address landscape issues.

The residual impact is considered to be negligible.

6.3.1.7. Impacts resulting from solid waste production and management

Impacts

Significant amounts of solid waste will be generated by construction activities, base camps and canteens. The risks of water and soil pollution are high if this waste is not properly managed, with indirect impacts on groundwater, surface water, soil, air quality and development of disease vectors (mosquitoes, flies, rats) harmful to public health. For this reason, the assessment of the importance of impacts on different sensivitive components of the physical environment and resulting from waste production and management is grouped in this section.

Impacts on communities health and safety are analysed in section 6.3.3.6.2.

The pollution risks vary according to the nature of waste: organic matter, bacterial and viral populations, chemical pollutants (metals, hydrocarbons, biocides, etc.), odors, suspended matters, plastic bags, other (visual pollution).

Four categories of waste can be defined:

- Domestic waste: quantity of domestic waste, mainly produced by the work area and base camp can be estimated at 0.62 kg / person / day. This waste mainly includes waste from canteens, packaging and plastic bottles, glass bottles, paper and cardboard. The overall production for 1500 workers (in the case of a maximum workforce) would therefore represent 930 kg of domestic waste per day, i.e., for a density of around 700 kg / m^3, a volume of 1,33 m^3 / d. The illegal dumping of this waste would pose a threat to health in the camps and surrounding areas, as it would lead to unsanitary conditions, unpleasant odors and the development of disease vectors.
- Green waste mainly originates from clearing operations. The Project easement is 925 ha that will be entirely cleared for the easement of the industrial zone infrastructures. Green waste will be disposed of in the dumping site described in section 3.4.1. This waste does not represent a danger to health. However, natural processes such as composting may result in odors and leachate that may infiltrate in the soil or reach the natural streams of surface water.
- Inert waste: they are generated at the Project area but also in the work area in widely varying amounts. They mainly concern soil, wood, packing boxes, scrap metal, plastics and concrete debris. This waste is generally buried in appropriate sites or in inert material disposal site. They do not represent a direct danger to health.
- Hazardous waste: Hazardous waste such as batteries, oil filters, contaminated drums and equipment will be generated by construction activities, including engine maintenance areas. This waste is harmful to the environment and public health and must receive appropriate treatment to ensure that they are eliminated safely.

The estimated amount of non hazardous waste produced during construction phase is 175 m3. No estimate is available for hazardous waste.

The demolition of existing building onsite will lead on the production of waste of the 3rd category above described (inert waste) unless it is contaminated. The description of infrastructures is provided in section **Erreur ! Source du renvoi introuvable.**.

PIA has developed a Waste Management Plan that sets the basis for an effective management of waste generated at the PIA Phase 2 IZ. The plan aims at:

- Describing the practices and procedures that will be used to ensure that the waste- related impacts are prevented and minimised.
- Providing a means for fulfilling PIA environmental commitments.
- Detailing the monitoring procedures associated with the waste management to ensure that the intended objectives of the proposed impact avoidance and mitigation measures are achieved.

Based on the type of waste and activities involved during construction phase as well as the practices that will be implemented by PIA (detailed in section 3.2.7), the impact intensity of solid waste management is considered to be moderate.

Further measures to expand and complete the Waste Management Plan are detailed below.Table 76 Impact of solid waste production and management on soil during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 77 Impact of solid waste production and management on hydrology during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 78 Impact of solid waste production and management on hydrogeology during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 79 Impact of solid waste production and management on air quality during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 80 Impact of green waste production and management on hydrology during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 81 Impact of green waste production and management on hydrogeology during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 82 Impact of green waste production and management on air quality during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Importance of the impact of solid and green waste production and management on publich health is assessed in the human environment section.

Measures

Waste management during construction phases will follow the waste management hierarchy identified by the waste management plan presented in section 3.2.7.

PIA Waste Management Plan will be implemented and framed with formalized measures through the drafting of an operational ESMP to be implemented by the main contractor. The operational ESMP will be based on the ESMP of this ESIA and will be validated by the promoter before starting the activities.

General:

- Ensure all contractors follow PIA Waste Management Plan procedures
- Monitor the capacity of the contractors to manage the waste generated and, if needed, identify further partnerships with local contractors for waste management to ensure all waste streams are correctly collected, handled, treated and disposed of.
- Recover and re-use as much recyclable material as possible;
- Establish a pre-acceptance procedure with the landfill operator in Aképé. PIA must present certain elements to the operator, including

- A description of the origin of the waste concerned
- Volumes and types of waste
- The results of the analysis of the waste concerned (analysis report)

<u>For green waste, before disposal to the dumping site:</u>

- Value of wood with commercial values;
- Provision to the local population of wood that can be used as timber or firewood in a usable / transportable form by the population;
- Compost production with small size crushed vegetation (branch and leaf). Composting can be used during site rehabilitation;
- Waste burning will be avoided. Green waste that cannot be valued, provisioned or composted will be disposed at the dumping site for natural degradation.

<u>For domestic waste:</u>

- Install selective sorting bins at work area/base camp to separate recyclable and decomposable organic material. Create a closed storage area to curtail the risk of waste blowing away and to avoid attracting wild animals;
- Regularly clean waste bins and storage areas;
- Make employees aware of the importance of waste management and workplace cleanliness.

<u>For inert waste:</u>

- Identify a contractor for the management of this waste stream;
- Maximize the reuse of inert waste The material can be used for filling/levelling of low-lying areas or filling borrow pits close to the site.

<u>For hazardous waste or products:</u>

- Elaborate a complete list of hazardous waste produced, stored and collected as well as quantities. Conduct regular audits of waste segregation and collection practices.
- Keep manifests or other records that document the amount of waste generated and its destination
- Verify, via annual audits to be carried out by third party auditors, that all contractors handling, treating and disposing of hazardous waste are licensed by the relevant regulatory agency and follow good international industry practices
- Ensure compliance with applicable local and international regulations among which any national commitment under r the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their disposal (http://www.basel.int/) and Rotterdam Convention on the prior Inform Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (http://www.pic.int/)
- Conduct regular visual inspection of all waste storage collection and storage areas for evidence of accidental releases and to verify that wastes are properly labeled and stored. Monitoring activities shall include
    - Inspection of vessels for leaks, drips or other indications of loss
    - Identification of cracks, corrosion, or damage to tanks, protective equipment, or floors

- Verification of locks, emergency valves, and other safety devices for easy operation
- Checking the operability of emergency systems (if any)
- Documenting any changes to the storage facility, and any significant changes in the quantity of materials in storage

  Document the findings.

- Prepare and implement spill response and emergency plans to address their accidental release
- Avoid underground storage tanks
- All waste containers designated for off-site shipment should be secured and labeled with the contents and associated hazards, be properly loaded on the transport vehicles before leaving the site, and be accompanied by a shipping paper (i.e., manifest) that describes the load and its associated hazards
- Hazardous waste (including chemical products and hydrocarbons) will be stored in dedicated, secure areas. These areas will be sealed and equipped with retention basins to prevent any risk of leakage to the environment. Fixed facilities containing liquid pollutants will also be placed inside retention basins (e.g. electricity generators, compressors, etc.).
- No waste or hazardous product storage facility will be located in an area subject to flooding or near a drinking water source.
- In case of production of hazardous waste**, an application must be submitted to the ANGE** (usual national good practices).

The residual impacts are considered to be minor (for surface- and groundwater) and negligible (soil, air quality).

6.3.2. Impacts on the biological environment and mitigation

6.3.2.1. Impacts on habitats and floristic richness

The main threat to biodiversity is the advance of the urban front and the exploitation of wetlands. The banks of the waterways, particularly the Zio River, are almost completely bare. This situation leads to the silting up of the watercourse. The few islands of woody formations in the area are cut for firewood used in households or sold. Several activities that generate sources of income for the resident populations (construction, fields, market gardening, harvesting of firewood and energy, medicinal plants, use of herbicides and insecticides, fishing, sand extraction, vegetation fires) constitute a threat to biodiversity. According to Tampo et al (2015), the use of chemical inputs in agriculture increases the gradient of water pollution as one moves from upstream to downstream. This poses a threat not only to aquatic biodiversity, but also to the health of livestock and the human population.

Habitats

The different kind of habitats by the Project are the following:

Table 83 Project easement and natural habitats

Project easement	Surface (Ha)	Affected habitat (type and surface)	Comment
IZ area (industrial, commercial, solar park, utilities, facilities, green space, internal roads)	716	Savannas/plantations (369,31 ha or 51,58%) and fields/fallows (342,25 ha or 47,8%).	Agricultural land - modified habitat
		Agglomerations and bare soil (4,44 ha or 0,62%)	Tracks, habitations, and bare soil - modified habitat
Road connecting PIA Phase 1 and 2 / Buffer zones / Land stripes along the connecting road	209,18	Savannas/plantations (178,8 ha or 85,48%) and fields/fallows (28,97 ha or 13,85%).	Agricultural land - modified habitat
		Agglomerations and bare soil (1,42 ha or 0,68%)	Tracks, habitations, and bare soil - modified habitat
Works area / base camp	Unknown	-	Expected outside of the Project area. Temporary occupation, rehabilitation (revegetalisation at the end of the Project)

The overall Project area is used for agricultural activities and is essentially made up of 57,6% of low crops and 41,8% of fallow land, as shown in the Figure 62. Only 0,6% is covered by bare soil or agglomerations.

As the entire area will be rearranged by the construction works (clearing activities and earthworks), all habitats will be impacted and removed. The intensity of the impact is considered major – permanent, irreversible loss of vegetation cover over 925 ha land. However, the terrestrial modified habitat (agricultural land, bare soil and inhabited area) is common in the area and it has low ecological value, i.e. it is not likely to host species with high level of conservation values (classified in the national protected species list or global IUCN red list, migratory species, threatened and/or unique ecosystems).

Human activities pressure has led to the fragmentation of the natural habitat. To date, the natural habitat in the Project area is not significantly represented.

Failure to maintain site boundaries may imply an accidental and additional removal of vegetation, including crops.

Floristic richness

Based on current knowledge, the Project will remove all floristic species in the Project area. Field investigations have shown:

- No endemic or critical habitat indicator species;
- A total of 150 species recorded, including 4 species on the list of priority alimentary species of Togo;
- 56 species recorded in the global IUCN red list, including:
  - 4 species “data deficient – DD”
  - 1 species is “Near Threathened – NT“ (*Milicia excelsa,* also known as Iroko)
  - 50 species “least concern – LC”

- 1 species "vulnerable – VU" (*Khaya senegalensis,* also known as "caïlcédrat").

Apart from the impacts related to the Project's footprint, the works will have limited impacts, especially if the site is properly managed. The impact factors during the construction phase on flora are quite generic:

- The accidental or non-accidental introduction of invasive alien species. Indeed, the use of soil coming from areas external to the Project as well as the transit of engines among different locations increase the risks of introducing invasive species. The consequences of this introduction vary depending on the species introduced and the capacity of the environment to regulate them. Several invasive and exotic invasive species were already observed onsite (see 5.5.2.3.3). The risk here is that the excavated soil including seeds and seedlings of invasive terrestrial may be moved to other sites or reused elsewhere. This is particularly valid for the vegetation dumping site, which will receive the green waste resulting from the Project land clearing.
- In case of uncontrolled (also referred to in this document as "spontaneous") migration, additional significant anthropic pressure can be observed on useful wood species as energy sources and building materials and the need for farmland (new land to be cleared).

The Project is not likely to disturb a significative portion of floristic population with high ecologic values.

The promoter plans to develop numerous green spaces on the site, covering a surface of 11,71 ha, along certain roads and also to delimit the lots allocated to businesses. These green spaces will partially offset the Project's negative impacts on vegetation.

Table 84 Impact of civil works including land clearing on habitats and flora during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 85 Impact of spontaneous migration on habitats and flora during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

6.3.2.2. Impacts on faunistic richness

Unlike flora, animal species are not fixed, but evolve in their habitats in varying ways from one species to another. However, many fauna species have limited mobility, so the removal of their habitat will affect the resident species existence. Human settlement will reduce fauna diversity and distribution.

For example, the conversion of a few hectares of forest and shrubland into a modified zone is not likely to modify the populations of mobile fauna which have not saturated its environment. Species can find refuge in the surrounding areas which presents mostly the same habitat characteristics.

During the investigations, no protected fauna, according to both national regulation and IUCN red list, was identified.

The most sensitive nesting birds species are those known as ground-nesting because they are less visible. Among the species recorded, none is known to nest on ground.

Birds, specially eggs and juveniles, may be affected by the clearing activities and earthworks if the construction work start during the nesting period.

Mammals, reptiles and amphibians known to occur on-site will be directly and indirectly affected by the clearing activities and the loss of their habitat. No species with high ecological value were observed during the filed investigation occurred in August. None is included in the IUCN red list or are protected by the national regulation.

Apart from the impacts related to the Project's footprint, the works will have limited impacts, especially if the site is properly managed. The impact factors during the construction phase on fauna are quite generic:

- Land clearing operations. These operations can cause the death of species with reduced mobility or which cannot move for behavioural or developmental reasons (juveniles, protection of the nest and young feeding, territorial species ...) and which could not escape away from engines. Among the most sensitive species, we find species of amphibians and ground-nesting birds.
- The presence of the base camp can lead the workers, or the local population supplying the workers, to hunt bushmeat. This will increase poaching in the sector and will harm certain species. No bushmeat really occurs in the Project area, impact is thus limited.
- In case of uncontrolled spontaneous migration, additional significant anthropic pressure can be observed on bushmeat or other species. Alien species may also be imported by workers.
- Fencing may result in fragmenting migration corridors adopted by the preexisting fauna.

The Project is not likely to disturb a significant portion of faunistic population with high ecological value.

Table 86 Impact of civil works and land clearing on faunistic richness during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 87 Impact of spontaneous migration on faunistic richness during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

6.3.2.3. Measures

The impacts related to the Project easement and clearance are inherent in the Project itself and its location and cannot be avoided.

Regarding clearing operations:

- Minimise bush clearing areas by maximising usage of existing cleared areas for constructing tracks, work area and base camp.
- **As far as possible, keep the *Khaya senegalensis* safe (by avoiding cutting it)** during the clearing operation**.**
- **Submit a request for land clearing application** to the **Prefectural Direction of the Environment** prior to the start of the work.

In terms of works planification:

- **Recruit a forestry expert** to support the revegetalisation program and the green spaces.
- **Implement before the clearing operations a plant nursery** for the species and plants which can be used during the revegetation program of the work areas, camp site and the development of the IZ green spaces. 10 Ha of green spaces are already anticipated where native large canopy trees will be planted with native flowering plants and ornamental trees along the road and in the green pockets.
- **Selection of indigenous and native** flowering plants and ornamental trees to be planted in the nursery. Species to be considered which are good candidate species: the caïlcédrat (*Khaya senegalensis),* the vein (*Pterocarpus erinaceus Poir*.), a threatened species, the ling (*Afzelia africa Sm*.), the Khaya (K. *senegalensis, K. grandifoliola, K. anthotheca*) and the shea tree (*Vitellaria paradoxa CFGaertn. ssp. paradoxa*). The use of priority food plants such as: baobab, tamarind, mango, nere (*Parkia biglobosa (Jacq.) R.Br. ex Benth.*), Black tamarind (*Dialium guinneense Willd*.), Wild apple (*Irvingia gabonensis (Aubry-Lecomte ex. O'Rorke) Bail*l.), Butter tree (*Pentadesma butyracea Sabine*) would also be well indicated.

As for the solar park area:

The construction of the solar park will determine the full removal of vegetation and habitat on a large area. Once the construction of the solar plant completed, several measures shall be implemented to compensate the impacts:

- **Implement a revegetation of the cleared surfaces.** This should be done with native vegetation instead of gravel, concrete, or turf grass. The development of floral and herbaceous species will be favoured by the shade offered by the panels themselves.
- **Recruit a forestry expert** to support the revegetalisation program.
- **Selection of indigenous and native** flowering plants and ornamental trees to be adopted for the revegetation. Specific plant species shall be chosen to host bees, butterflies and other pollinators underneath and around solar panels. Native plants will also help reduce the dust lifted from the ground by the wind (which may deposit on the panels, thus requiring more frequent cleaning), reduce stormwater runoff, increasing infiltration and avoiding soil erosion.
- **Implement solutions of "agrivoltaic systems"** thus integrating solar power production and crops.

In addition to measures regarding spontaneous migration detailed in section 6.3.3, following measures shall be applied:

- **Formally prohibit hunting for all employees** from in the Project area, as well as weapons and traps within the base camp and works area,
- **Formally prohibit the consumption of bushmeat** within the base camp and works area; a regular supply of animal protein will compensate the bushmeat and will be provided in the canteens / butcher / commissary of the base camp.

- **Provide training to workers concerning the natural environment awareness**, with specific instructions on what can be done and what must be avoided to protect the natural environment

Regarding the management of invasive species, it will be necessary to:

- **Avoid the movement of soil and material from one region to another**. Chose, if necessary, a supply quarry near the site to limit the risk of bringing invasive species,
- Before transporting the engine from / to the Project site, **clean the engine (interior and exterior) to ensure the absence of invasive plants**,
- **Revegetation of works rights-of-way using only species naturally present in Togo** (indigenous) without invasive character.

For fauna:

- **Implement a fencing solution allowing the free access to small fauna** to avoid the fragmentation of migration corridors.

The residual impact is considered to be minor (for habitat and floristic richness) and negligible for fauna.

6.3.3. Impacts on the human environment and mitigation

During the construction phase, the project has the potential to generate positive impacts on the human environment due to the economic activity and jobs created. However, the influx of workers and construction-related nuisances may affect the health and safety of the population. Women and vulnerable people may be negatively affected by discriminatory recruitment practices and the presence of a large number of male workers. The proposed measures aim to limit the negative impacts generated by the construction phase while trying to increase the positive effects.

6.3.3.1. Impact on economic activities, livelihoods and local economy (employment)

The main positive impact of the project during the construction phase is the creation of jobs and the stimulation of the economy of the Adétikopé area. Indeed, the project is expected to create 1500 jobs during the construction phase. PIA estimates that 70% of these jobs will be local, which will generate many jobs within the impacted communities. In addition, the presence of many workers and subcontractors will increase the consumption of goods and services in the Adétikopé region.

In order for this impact to be perceived as positive locally, it will be necessary to encourage recruitment in the local villages and the use of goods and services provided by local companies.

Table 88 Impact of the project on economic activities, livelihoods and local economy during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures :

Some measures can contribute to increasing local economic benefits and job creation in the Adétikopé region, including:

- The inclusion of clauses for the recruitment of local workers and subcontractors in the tenders for contracts related to the construction phase;

- The establishment of a priority recruitment programme for local and project-affected workers, with equal skills;
- The establishment of a transparent procedure for the management and communication of tenders with local subcontractors via the municipality and local communication media (radio, newspapers, notice board);
- The priority use of subcontractors based in the Adétikopé region if this is economically and technically reasonable;
- The implementation of an Human ressources management plan that promotes female employment, provides for the recruitment of women and ensures equal pay;
- The establishment of a stakeholder engagement plan and a complaints management mechanism.

6.3.3.2. Impact on the social climate

Several factors may limit the positive impacts of the project in terms of employment and economic spillover and may create tensions between the local communities and the Promoter.

First of all, the Adétikopé area does not specifically host the companies offering the services necessary for the construction of the project, or they do not necessarily have the required HSE qualifications. PIA may therefore be forced to select subcontractors based outside the project area, which may generate frustration and misunderstanding among local companies.

On the other hand, the recruitment of workers during the construction phase may not match the skill level of the local population. Thus, qualified positions, particularly those of work supervision, may be allocated to foreign workers or those coming from Lomé. In addition, other less skilled positions may be allocated to workers who are not from the project area. This situation is likely to cause great frustration among members of the impacted communities insofar as the priority employment of local PAPs and young people is a demand systematically expressed during the consultations. The consultations also indicated that if members of the impacted communities do not benefit from employment within the project, frustration and anger would lead to acts of vandalism and degradation of facilities and equipment.

Thus, the employment impacts of the project are positive, but this is an extremely sensitive issue for the communities, which can have negative impacts on the social climate. The intensity of the impact can be considered minor as it will be temporary, but as the environmental component has a major sensitivity, the impact will be of moderate importance.

Table 89 Impact of the project on the social climate during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures:

Some measures will need to be implemented to reduce the significance of this impact:

- The inclusion of clauses for the recruitment of local workers and subcontractors in the tenders for contracts related to the construction phase;
- The establishment of a priority recruitment programme for local and project-affected workers, with equal skills;

- The establishment of a transparent procedure for the management and communication of tenders with local subcontractors via the commune and local communication media (radio, newspapers, notice board);
- The priority recourse to subcontractors based in the Adétikopé region if it is economically and technically reasonable;
- The implementation of training programmes for PAPs in the framework of the LRP for occupations related to the construction phase.

These mitigation measures will result in a minor impact.

6.3.3.3. Impact on the demographic profile, migration and the quality of life of the population

The development of the project and the resulting economic opportunities will attract workers from neighbouring regions for the duration of the construction, i.e. 12 months. These migrants will seek daily work in the area. Although the influx of migrants seeking work and entrepreneurs and merchants will contribute to the dynamism of the Adétikopé region, it could also increase pressure on social infrastructure and access to basic services.

In particular, it should be noted that the Adétikopé health centre is already unable to meet the needs of neighbouring communities. In addition, the influx of workers is likely to increase the proliferation of sexually transmitted diseases such as syphilis, hepatitis, HIV, an increase in respiratory illnesses due to increased crowding, and an increase in diseases related to water quality and sanitary conditions. However, it is worth mentioning the availability of health centre at the PIA Phase 1.

The increase in population will also lead to an increase in solid and liquid waste and the degradation of access to water, which may lead to conflicts with established villages. Howerver base camp within the site boundary will be fully equipped with sanitary facilities.

Finally, the influx of migrants due to construction may lead to an increase in entertainment and alcohol consumption, which may increase insecurity.

As the pressure on the health and sanitation infrastructure is already high and is likely to increase with successive project developments, the sensitivity of the environment is considered moderate. The relatively limited number of jobs directly required for the construction period means that the intensity of the impact is considered moderate. Its importance is therefore moderate.

Table 90 Impact of the project on demographic balance, migration, and quality of life during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures :

In order to limit the impacts of migration, certain measures should be put in place, including:

- The prohibition of direct on-site recruitment;
- The development of a transparent recruitment campaign that will reduce timely migration;

- The establishment, with the municipality of Adétikopé, of an information programme on the jobs available, the recruitment process and the priority given to local workers;
- Monitoring the number and conditions of installation of new arrivals in the villages in collaboration with the chiefs of the host villages;
- Raising awareness among staff and new arrivals of local customs and practices;
- Monitoring the prices of basic products (palm oil, sugar, rice, petrol, etc.) to detect possible inflation;
- Provide sufficient health services to workforce to prevent any additional pressure on local health and sanitation infrastructure;
- Development and implementation of Waste Management Plan to ensure adequate collection, treatment and disposal of all waste streams;
- The implementation of a Community Development Plan to meet the needs of the population in terms of infrastructure, particularly social infrastructure;
- Monitoring of satisfaction indicators regarding access to ecosystem services and public health services. These indicators will be calculated through user satisfaction surveys and interviews with the relevant services.

These mitigation measures will result in a minor impact.

6.3.3.4. Impact on women and vulnerable people

There are two types of negative impacts of the construction phase on women and vulnerable people.

- Difficult access to positive income impacts

Firstly, women and vulnerable people will be less likely to benefit from the positive economic effects generated during the construction phase. For example, women are likely to be confined to jobs that are traditionally reserved for them (cleaning, cooking, etc.). Vulnerable people, because of their position in society, may also not be in a position to take advantage of the opportunities associated with the construction phase and the subsequent economic development. For example, elderly and disabled people will not be in a position to benefit from the jobs created for the construction of the site. Also, vulnerable people and women are likely to be excluded from decision making.

- Increased insecurity and violence

On the other hand, women and vulnerable people may face increased insecurity due to the influx of male workers. For example, they may face harassment or attacks in and outside the work site. The presence of large numbers of male workers may force women and girls into prostitution out of economic necessity or solicitation. Finally, women are likely to experience more domestic violence from men who are likely to increase their alcohol consumption because of the stress and pressure of the project but also because of an increase in their income.

Children are likely to be employed in occupations that threaten their physical integrity and to suffer from Violence Against Children due to the presence of foreign workers.

Because of the existing structural discrimination against women and vulnerable people, the significance of this impact is considered to be moderate.

Table 91 Impact of the project on women and vulnerable groups during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact

POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

Some measures can be taken to limit discrimination and violence based on gender or against vulnerable people. These include:

- Compliance with the standards set by ILO conventions and national legislation concerning discrimination against women and people with disabilities;
- Implementation of positive discrimination measures favouring the employment of women and people with disabilities;
- Access to dedicated (e.g. women's toilets) or adapted (e.g. staircases with access ramps) infrastructures;
- Provision of Personal Protective Equipment (PPE) adapted for women;
- Implementation of awareness campaigns on gender equality and the principle of non-discrimination;
- Ensuring strict control to avoid the employment of children under 14 years of age and ensuring that the tasks entrusted to children over 14 years of age do not endanger their physical integrity and health;
- Establishment of a community monitoring system for the protection of children;
- Establishment of a complaints and grievances management mechanism accessible to workers to monitor the number of cases of harassment or deviant behaviour against women or vulnerable persons;
- Inclusion of representatives of women and vulnerable people such as people with disabilities in the monitoring committee of the environmental and social management plan.

These measures should significantly limit these impacts. **The residual impact is considered minor.**

6.3.3.5. Impacts on health and safety of workers

Impacts

On large construction sites, the health and safety of workers can be significantly affected by several major activities or situations that will cause an exposure to accidents and/or diseases:

- the storage and handling of hazardous products, particularly hydrocarbons for the site electrity system based on generators, with the risk of spills, fire, explosion and injury. Poisoning or burns to the skin or eyes when handling hazardous materials such as solvents, hydrocarbons and other chemicals may result;
- heavy road traffic on the job site with several large vehicles (excavators, bulldozers, trucks etc.) that for some have important blind spots;
- traumatic accidents caused by unsafe working conditions (joint trauma due to carrying heavy loads or manual work, fall from height/scaffolding, fall of objects, etc.);
- workers' exposure to STDs and HIV/Aids if they associate with sex workers outside their working hours;

- workers' exposure to communicable and potential epidemic diseases (cholera, dysentery, smallpox) due to unhygienic conditions on the work site (lack of restrooms, water and soap for instance, uneffective management of solid waste).

Worker's rights in terms of salary, contractual arrangement, working hours, rests, sick leave and pay, collective action, worker's union mobilization, might also not be respected by contractors.

These risks are amplified by the fact that the construction works will involve several companies working alongside through contracting and subcontracting schemes and that there will be around 1500 workers at peak, working on the same site but for different companies. This represents an important risk in terms of HSE site supervision.

However it is moderated by the proximity of the construction site with Lome, which provides a wide range of hospitals and clinics able to treat emergencies, traumatic injuries and others issues very rapidly.

The importance of the impact of the construction phase on health and safety of workers is rated as moderate.

Table 92 Impact of the project on health and safety of workers during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

The measures to be implemented are:

- include clauses on HSE requirements in the Tender Documents for the works with obligations applying to contractors and their subcontractors;
- manage the workforce and ensure working conditions in accordance with Togo's national regulations (Labor Code), IFC HSES guidelines and ILO conventions ratified by Togo;
- make personal protective equipment (PPE) available to workers and ensure that they are worn;
- set up and implement an Occupational Hygiene, Health and Safety Plan;
- set up and implement a Waste Management Plan and a Hazardous Products Management Plan;
- set up and implement a Traffic and Road Safety Plan;
- recruit one or several HSE coordinator in charge of monitoring the proper application of the plans;
- implement the Stakeholder Engagement Plan (SEP) and the complaint management mechanism with a dedicated mechanism for construction workers.

After the implementation of corrective measures, the **residual risk level will be minor.**

6.3.3.6. Impacts on health, safety and security of community

With regard to the **health** of populations, they will be exposed to an increase in the circulation of sexually transmitted diseases (HIV, hepatitis, etc.) due to the influx of male workers and job seekers. These influxes can also contribute to the deterioration of health conditions and the emergence of epidemics in the workplace and their spread among populations. The influx of workers and job seekers may also lead to

the development of prostitution. Air emissions, noise, waste management and liquid discharges may as well affect communities' health.

In terms of **safety**, the population will be mainly exposed to an increased risk of road accidents on the RN34 and other secondary roads. Indeed, the construction phase will generate a significant increase in vehicle and truck traffic to and from the project area. This may increase road accidents with local users who use light means of transport (motorbikes or bicycles) and are therefore highly exposed, as well as with pedestrians.

The **security risks** concerning the project are limited as the political situation in Togo is relatively stable. The security risks related to the construction phase include mainly unauthorised entry to the site, increased vandalism, petty theft or damage to equipment and facilities. The construction of a concrete wall, planned before the start of the works, will seriously limit these risks. The Promoter will also deploy a security system with the presence of armed guards. However, the presence of armed security personnel may pose a risk to the community if the personnel use excessive force, particularly during community protests.

6.3.3.6.1. Impact of spontaneous migration and influx of workers

As previously mentioned, the spontaneous migration of workers and job seekers towards the construction site may affect the health, safety and security of local communities.

These impacts are considered moderate due to the number of workers.

Table 93 Impact of the project on health and safety of the community during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

Health and safety measures reduce risks to the health, safety and security of communities:

- Implementation of a health and safety programme;
- Implementation of a traffic and road safety plan;
- Construction of a wall or fencing around the site;
- Establishment of a 24/7 security system;
- Establishment of checkpoints for access to the site and certain areas;
- Establishment of a security personnel management plan to ensure appropriate use of force by guards;
- Organisation of information campaigns in the villages in the immediate vicinity of the site concerning hygiene, health, epidemiological measures, environmental protection and cultural differences with the new arrivals.

The residual impacts are considered to be minor.

6.3.3.6.2. Impact of waste management

The works will generate various wastes, which will be deposited in temporary storage areas within and outside project area before moved for futher treatment or disposal at national waste management facilities.

The construction phase will also generate hazardous wastes (oil, contaminated containers, batteries etc.).

If these are not managed properly, they will inevitably affect directly and indirectly the health and quality of life of the people living both near the project area and in the areas where waste is dumped.

Table 94 Impact of waste management on the health and safety of the community during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

For green waste associate to the dumping site, refer to section 6.3.1.7. The importance of the impact of dumping site on the health and safety of the community is rated as moderate.

Measures

The following mitigation measures should be implemented to reduce this impact:

- Development and implementation of a Waste Management Plan;
- Development and implementation of a wastewater and effluent management plan;
- Development and implementation of a Storage and Management Plan for oils, hydrocarbons and other pollutants.

The residual impact after application of the mitigation measures will be minor.

6.3.3.6.3. Impact of traffic

The main transport-related impact concerns accidents on the National Road 34 (RN34), which crosses the project area and serves the localities of Gnatikopé, Hagblévou, and Akadjamé. These communities are therefore likely to face an increasing number of vehicles transporting construction materials to the site, which increases the risk of accidents between these vehicles and local users. In addition, the increase in the number of trucks may slow down traffic on the RN34, especially if trucks and heavy vehicles travel at peak times.

This impact is of moderate importance.

Table 95 Impact of traffic on health and safety of the community during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

- Development and implementation of a Traffic Management Plan that takes into account the use of the RN34 road by the population, notably the off-peak and peak periods of use;
- Limit the vehicles speed to 30 km/h in all inhabited areas, and, if possible, pave road sections experiencing highest traffic load;

- The organisation of informative campaigns in the villages located in the immediate vicinity of the site concerning road safety measures;
- Use of road signage.

Residual impacts are considered minor.

6.3.3.6.4. Impact of water resource consumption

During the construction phase, the increase in population and the use of water for construction activities may put additional pressure on access to water, cost of bottled water, which could lead to tensions with local communities (metal health) and scarcity of water for consumption.

The low availability of water at certain seasons was mentioned by local people. The Project will use water from the Maastrichtian aquifer, not used by local communities but by national water company. However, the likely impact on community health may not be excluded as uncertainties exist concerning the connections among aquifers.

As the influx of workers will be limited (Cf. section 6.3.1.5.2) but the resource sensitive, the risk is considered to be of moderate importance.

Table 96 Impact of water resource consumption on health and safety of the community during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures :

- Measures presented in 6.3.1.5.4 can be applied here as well;
- Monitoring of satisfaction indicators regarding access to water in the villages near the site. These indicators will be calculated through satisfaction surveys of the villagers as well as through interviews with the relevant technical services.
- Construction of additional drinking fountains if necessary.

The residual impacts are considered to be minor.

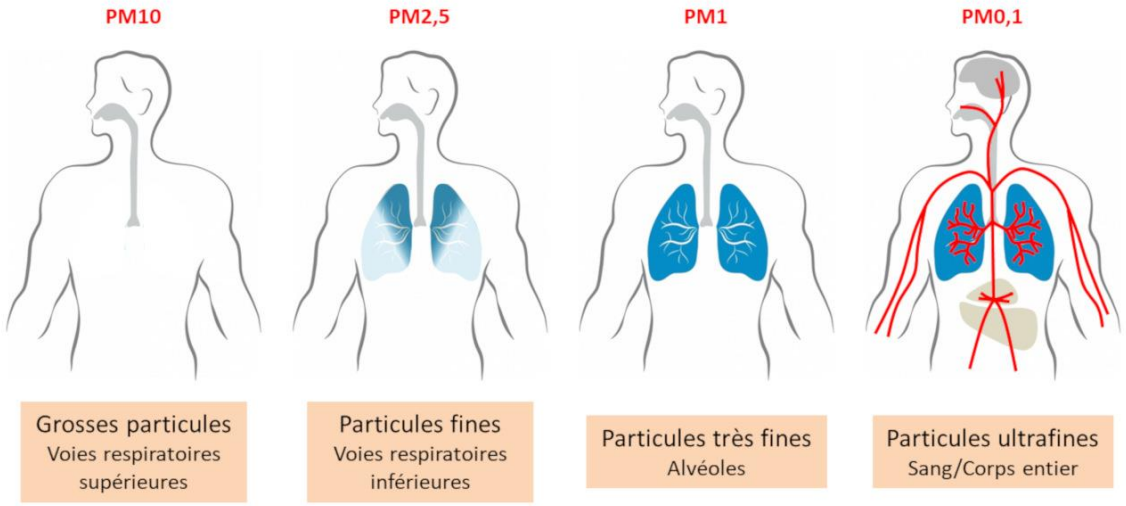
6.3.3.6.5. Impact of air and noise emissions

The movement of machinery and vehicles and the functioning of construction site installations (generators or concrete mixers) will produce air emissions mostly composed of dust particles and, to a lesser extent, olfactory emissions (exhaust gas).

Dust particles will also be caused by the stripping of topsoil, soil excavation, soil handling and storage and might settle on the vegetation and houses. Olfactory emissions could be caused by bitumen production, degradation and putrefaction of organic wastes, odors from the latrines and restrooms of the workers, etc.

Large dust particles can affect upper respiratory tracts while finer particles can infiltrate the lungs and blood, as shown on the picture below. Olfactory emissions could trigger discomfort among residents.

The IAQM guidance[16] suggests that if the sensitive 'ecological receptors' are located greater than 50 m from the boundary of the site, 50 m of the route used by construction vehicles, or 500 m from the site entrance, the dust impacts are unlikely to be significant. Onsite, the closest people that will be affected will be the villages bordering the Project area. This mainly concerns Hagblévou, Gnatikopé, Akadjamé, Tokpanou, Agbadovinou, Vondjogbékopé, Djogblakopé, Fiogblé and Kpomé Agomé. The satellite imagery shows that only a few isolated houses are located within 50 m of the site boundary or 500 m from the site entrance. Other villages transited by vehicles might be affected, especially if it is along unpaved roads.



Source: Encyclopedie de l'Environnement

Figure 113 Penetration of dust particles in the respiratory system

The execution of the works and the traffic on site will also cause a degradation of the sound and vibration environment (see section 6.3.1.4). The disturbances related to the sound environment will be felt by the populations living in the houses closest to the Project site.

The construction works are located in a moderately populated area. Works will mainly deteriorate air quality and and generate nuisances for the populations living in the close proximity of the construction site, and mainly for the inhabitants of Hablévou et Gnatikopé.

Given the current baseline condition (5.4.5), this impact will be moderate.

The importance of the impact of the construction phase on human health due to air emissions is rated as moderate.

Table 97 Impact of air emissions on health and safety of the workers and the community during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

The importance of the impact of the construction phase on human health due to noise emissions is rated as moderate.

[16] Guidance on the Assessment of Dust from Demolition and Construction, Version 1.1. Institute of Air Quality Management (IAQM) (2014)

Table 98 Impact of noise on health and safety of the workers and the community during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

The measures proposed are to:

- apply measures developed in § 6.3.1.1 and 6.3.1.4;
- locate working zones (workshops) far from houses and villages;
- avoid noisy work during off-duty hours;
- limit the speed of trucks to 30 km/h in all populated areas;
- use good quality vehicles, preferably new, with engines in good condition;
- work with equipment that meets the required standards in terms of noise emissions.

The residual impact will be considered minor.

6.3.3.7. Impact on the archaeological heritage

The project area is located approximately 80 km from the nearest known archaeological ruins, the ruins of Notsè. Thus, the project is unlikely to impact Togo's cultural heritage during the construction phase. However, incidental archaeological finds may occur, including pottery, tools or building foundations. These remains could be destroyed during the construction works.

Given the distance of the project from known archaeological sites in Togo, the impact is of minor importance.

Table 99 Impact of the project on cultural heritage during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

Implement Chance Find Procedure for managing incidental archaeological finds. The implementation of this procedure will ensure that impacts on cultural heritage during the construction phase are minimised. In accordance with the IFC standards, the procedure requires that work be stopped in the event of an incidental find, the relevant authorities be alerted, and the find be protected and maintained until the significance of the object and the necessary measures are determined.

Such a procedure will ensure that residual impacts are negligible.

6.3.3.8. Impact on the waste management infrastructure

A thorough assessment of the impact on the waste management infrastructure, and in particular the Aképé landfill, is not possible due to the lack of information on its capacity to accept the waste generated during the construction phase of PIA. However, the amount of waste produced during contruction phase seems to be relatively small not to represent an issue for its disposal at Aképé.

Impact intensity is then rated as minor.

Green waste resulting from clearing activities will be handled and disposed of via the dumping site. The impact on the waste management infrastructure is rated as negligible.

For further details refer to sections 6.3.1.7 and 6.3.3.6.2.

Table 100 Impact of solid waste management on the waste management infrastructure during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 101 Impact of green waste management on the waste management infrastructure during contruction phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

The same measures described in sections 6.3.1.7 and 6.3.3.6.2 apply for this topic.

The residual impact is considered to be minor.

6.3.4. Impacts and measures synthesis for the construction phase

Table 102 Impacts and measures synthesis for the construction phase

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Potential Impact	Mitigation measure	Residual impact
Climate and climate-change related risks	Civil works including land clearing Traffic	Greenhouse gas emissions from construction machineries, compressors and electricity generators, traffic and green waste burning Soil sealing affecting the flood risk downstream the IZ. Soil stripping and vegetation removal causing carbon release and soil erosion	Minor	-Avoid burning of green waste -For additional measures refer to surface water and soil sections below in this table	Minor
Air quality	Civil works including land clearing Traffic	Production of exhaust and dust from construction machineries and electricity generators as well as from traffic. Dust emissions from earthmoving operations, storage of excavated materials and products, material crushing units and the concrete plant.	Moderate	-Limit the vehicles speed in inhabited area (30 km/h) -Humidification of roads / soil stored when necessary -Covering trucks transporting pulverulent materials -Dust monitoring -Complaint mechanism to address dust issues	Minor
	Solid waste production	Emissions of gas and odors from waste	Moderate	-For solid waste management measures, refer to groundwater section below in this table	Negligible
	Green waste production		Minor	-Avoid burning of green waste -For green waste management measures, refer to groundwater section below in this table	Negligible
Noise	Noise from civil works, including drilling	Acoustic nuisance for people leaving or working in close proximity of the Project	Moderate	-Limit construction works to daytime hours where reasonable and feasible, as the national regulation asks -Using equipment that has been well maintained -Construct physical noise barriers around main the main source of noise -Transportation vehicles should maintain appropriate travelling speeds -Noise monitoring on a quaterly basis -Notification of villagers 2 weeks prior to the commencement of construction works. -Complaint mechanism will address noise issues	Minor
	Noise from traffic	Acoustic nuisance for people leaving and or working in close proximity to the Project and the roads mainly used by vehicles to/from the Project	Minor		

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Potential Impact	Mitigation measure	Residual impact
Hydrogeology (groundwater)	Liquid discharges production Wastewater from workers accommodation	Liquid discharges from general construction activities (ex. drilling) Grey and black water collected in septic tanks. Leaks or accidental discharge may result in groundwater quality degradation Accidental spillage of hazardous products (hydrocarbons, chemicals, hazardous waste, etc.) on the ground resulting in the contamination of groundwater by infiltration	Moderate	-Implementation of wastewater treatment systems. -Water quality discharges monitoring program from worksite areas after oil separators -In case of set up of a discharge of wastewater in the environment, an application must be submitted to the ANGE (usual national good practices) - Develop Emergency Response Plan/Procedure covering all emergency scenarios including spillages. -Implementation of a sensitization and training program for workers on water saving practices, spillage procedures, hazard product -Identification of appropriate place for chemicals and dangerous products storage - Use of contained and impermeable areas for dangerous products -Identification of appropriate place for engine refuelling, maintenance and washing -Implement measures specific to the proper management of septic tanks: - Use vacuum trucks or tugs for removal of fecal sludge instead of manual methods and use of appropriate collection vehicles (vacuum tanker trucks); - Provide and require use of personal protective equipment (PPE) to prevent contact with wastewater; - Consider provision of systematic, regular collection of fecal sludge and septic waste; - Facilitate discharge of fecal sludge and septage at storage and treatment facilities so that untreated septage is not discharged to the environment. - Periodic inspections and control of the septic tank integrity to ensure zero leakages - Control agreement of the Attiegou-Kelegouga site to accept septic tank effluent in accordance with national standards	Minor

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Potential Impact	Mitigation measure	Residual impact
	Solid waste production Green waste production	Contamination of groundwater by the waste leachate infiltrating in the ground in case of waste mismanagement or accidental situations	Moderate	-Ensure all contractors follow PIA Waste Management Plan procedures -Monitor the capacity of the contractors to manage the waste generated -Recover and re-use as much recyclable material as possible -Establish a pre-acceptance procedure with the landfill operator in Aképé <u>-For green waste</u>: -Analyse and implement the possibility of the local population to recover green waste when feasible For domestic waste: -Install selective sorting bins at work area/base camp, clean them regularly and train employees on proper waste management procedures to adopt <u>For inert waste</u>: -Identify a contractor for its management and maximise its reuse <u>-For hazardous waste or products:</u> - In case of production of hazardous waste, an application must be submitted to the ANGE (usual national good practices) -Elaborate a complete list of hazardous waste produced, stored and collected. -Store in dedicated, secure and above ground areas, far from drinking water sources and area subject to flooding. -Conduct regular visual inspection of all waste storage collection and storage areas for evidence of	Minor

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Potential Impact	Mitigation measure	Residual impact
				accidental releases and to verify that wastes are properly labeled and stored. -Prepare and implement spill response and emergency plans to address their accidental release -All waste containers designated for off-site shipment will be secured and labeled with the contents and associated hazards, be properly loaded on the transport vehicles before leaving the site, and be accompanied by a shipping paper	
	Resource consumption	Additional pressure on the groudwater resource availability	Moderate	-Water supply for works activities with tank with rainwater collection (linked to a rainwater collection system)	Minor
Hydrology (surface water)	Civil works including land clearing	Modification of existing hydraulic patterns resulting from land clearing, earthworks and soil sealing	Negligible	-Selection of porous asphalt or other surfaces of higher permeability to allow infiltration -Develop and implement design concept of the drainage network to reduce runoff volume	Negligible
	Liquid discharges production Wastewater from workers accommodation	Liquid discharges from general construction activities (ex. drilling) may affect surface water quality Grey and black water collected in septic tanks. Leaks or accidental discharge may result in surface water quality degradation Accidental spillage of hazardous products (hydrocarbons, chemicals, hazardous waste, etc.) reaching the surface water	Minor	Refer to measures identified for hydrogeology (groundwater)	Negligible
	Solid waste production	Contamination of groundwater by the waste leachate infiltrating in the ground in case of waste mismanagement or accidental situations	Moderate	Refer to measures identified for hydrogeology (groundwater)	Negligible

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Potential Impact	Mitigation measure	Residual impact
	Green waste production	Contamination of groundwater by the waste leachate infiltrating in the ground in case of waste mismanagement or accidental situations	Minor	Refer to measures identified for hydrogeology (groundwater)	Negligible
Geology, topography and soil	Liquid discharges	Contamination of soil by the discharge of polluted effluents	Minor	See above measures regarding water quality.	Negligible
	Civil works including land clearing	Erosion and/or sedimentation from large volumes of non-reusable excavation products stored permanently strengthened by the clearing activities and the removal of all vegetation	Minor	-Stripped soil management. -Main excavation work shall be conducted during low precipitation periods. -Optimization of cut and fill. -Implementation of silt fence. -Progressive soil rehabilitation. -Revegetation and soil stabilization -Choice of appropriate location for base camp to minimise topographical alterations and soil excavation -Rehabilitation of affected areas at the end of construction works.	Negligible
	Solid waste production	Contamination of soil by the waste leachate infiltrating in the ground in case of waste mismanagement or accidental situations	Moderate	Refer to measures identified for hydrogeology (groundwater)	Negligible
Landscape	Civil works including land clearing	Loss of existing visual amenity for people leaving in close proximity of the Project Degradation of visual amenity in case of waste mismanagement	Minor	-Implementation of collection, monitoring and waste treatment plan. -Grievance/Complaint mechanism implemented in the nearest villages (Adoglove, Akplome, Dzove and Lomegnokope) will address landscape issues	Negligible

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Potential Impact	Mitigation measure	Residual impact
Habitat and floristic richness	Civil works including land clearing	Loss of terrestrial modified habitat composed of approximately 150 species including 1 listed as VU in global IUCN red list (*Khaya senegalensis*) Risk of propagation of alien species due to earthworks	Moderate	-Implement a biodiversity and revegetation plan -Recruit a forestry expert to support the revegetalisation program and the PIA green spaces. -Implement a plant nursery before the clearing operations -Revegetation of works rights-of-way using only species naturally present in Togo -Selection of indigenous and native flowering plants and ornamental trees including *Khaya senegalensis*. -Submit a request for land clearing application to the Prefectural Direction of the Environment prior to the start of the work -Avoid the movement of soil and material from one region to another. -Clean the engine to ensure the absence of invasive plants	Minor
	Uncontrolled (spontaneous) migration	Additional significant anthropic pressure and potentially additional land clearing (for farmland, building materials or energy sources)	Moderate		Minor
Faunistic richness	Civil works including land clearing	Loss of habitat for mobile fauna	Minor	-Formally prohibit hunting for all employees. -Formally prohibit the consumption of bushmeat. -Provide training to workers concerning the natural environment awareness	Negligible

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Potential Impact	Mitigation measure	Residual impact
	Uncontrolled spontaneous migration	Additional significant anthropic pressure on fauna (bushmeat) and on resources used by fauna	Negligible		Negligible
Economic activities, livelihoods and employment	Employment	Creation of direct and indirect jobs Use of local subcontractors Boosting the economy of the Adétikopé area	Positive	- The inclusion of clauses for the recruitment of local workers and subcontractors in tenders; - Priority recruitment programme for local workers affected by the project, with equal skills; - Transparency of tender procedures (management and communication via the commune and local media (radio, newspapers, notice board); - Priority recruitment of subcontractors based in the Adétikopé region if economically and technically reasonable; - The implementation of an employment management plan that promotes female employment, provides for the recruitment of women and ensures equal pay; - Stakeholder engagement plan and complaints management mechanism;	

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Potential Impact	Mitigation measure	Residual impact
Social climate	Recruitment of labour and contractors	- The appearance of social tensions following the recruitment of staff from outside the area or the use of external service providers; - Acts of vandalism and damage.	Moderate	- Training programmes for PAPs under the LRP for occupations related to the construction phase; - Inclusion of clauses for the recruitment of local workers and subcontractors in tenders for contracts related to the construction phase; - Establishment of a priority recruitment programme for local and project-affected workers with equal skills; - Establishment of a transparent procedure for the management and communication of tenders with local subcontractors via the municipality and local communication media (radio, newspapers, notice board); - Priority use of subcontractors based in the Adétikopé region if economically and technically reasonable.	Minor
Demographic balance	Employment	- Pressure on social infrastructure - Proliferation of diseases, including STDs - Increase in solid and liquid waste, deterioration of sanitary conditions - Increased insecurity (alcohol consumption, assaults)	Moderate	- Prohibition of direct on-site recruitment; - Transparent recruitment campaigns to reduce opportunistic migration. - Establishment, with the municipality of Adétikopé, of an information programme on the jobs available, the recruitment process and the priority given to local workers; - Monitoring the number and conditions of installation of new arrivals in the villages in collaboration with the host village chiefs; - Raising awareness of local customs and practices among staff and new arrivals - Monitoring the prices of basic products (palm oil, sugar, rice, petrol, etc.) to detect possible inflation;	Minor

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Potential Impact	Mitigation measure	Residual impact
				- Provide sufficient health services to workforce to prevent any additional pressure on local health and sanitation infrastructure;. - • Development and implementation of Waste Management Plan to ensure adequate collection, treatment and disposal of all waste streams. - Implementation of a Community Development Plan to meet the infrastructure needs of the population, particularly social infrastructure; - Monitoring of satisfaction indicators regarding access to ecosystem services and public health services.	
Women and vulnerable groups	Employment	- Limited benefits from the opportunities created by the project - Increased insecurity - Discrimination in employment - Harassment and violence on and off site - Incitement to prostitution	Moderate	- Compliance with the standards set by ILO conventions and national legislation concerning discrimination against women and people with disabilities; - Positive discrimination measures and hiring quotas favouring women and people with disabilities; - Access to dedicated (e.g. women's toilets) or adapted (e.g. staircases with access ramps) infrastructures; - Personal protective equipment (PPE) adapted for women - Awareness campaigns on gender equality and the principle of non-discrimination; - Strict control to avoid the employment of children under 14 years of age and to ensure that the tasks entrusted to children over 14 years of age do not endanger their physical integrity and health;	Minor

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Potential Impact	Mitigation measure	Residual impact
				- Establishment of a community watch for the protection of children; - Mechanism for managing complaints and grievances accessible to workers; - Monitoring the number of cases of harassment or deviant behaviour against women or vulnerable persons; - Inclusion of representatives of women and vulnerable people such as disabled people in the monitoring committee of the environmental and social management plan.	
Community health and safety Worker health and safety	Civil works Liquid discharge production	- Exposure of construction site workers to accidents and diseases caused by various factors (HSE risks) - Nuisances caused by air emissions (including dust and odors) and noise affecting the populations living in the close proximity of the construction site	Moderate	- Manage the workforce and ensure working conditions in accordance with Togo's national regulations (Labor Code) and the ILO conventions ratified by Togo; -Make personal protective equipment (PPE) available to workers and ensure that they are worn; -Set up and implement an Occupational Hygiene, Health and Safety Plan; -Set up and implement a Waste Management Plan and a Hazardous Products Management Plan; -Set up and implement a Traffic and Road Safety Plan; -Recruit one or several HSE coordinator in charge of monitoring the proper application of the plans; - Include clauses on HSE requirements in the Tender Documents for the works with obligations applying to contractors and their subcontractors; -Implement the Stakeholder Engagement Plan (SEP) and the complaint management mechanism with a dedicated mechanism for construction workers	Minor

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Potential Impact	Mitigation measure	Residual impact
				- Organize awareness campaigns in villages in the study area on hygiene measures to be respected -Deploy an awareness program for villagers on road risks and the safety measures required -Set up and implement programme to raise awareness among the local population of the risks of contamination by STDs and HIV/Aids through an NGO with expertise in the field - Locate working zones (workshops) far from houses and villages - Keep equipment (generators, concrete mixers, etc.) away from residential areas; - Avoid operation of equipment and vehicles outside working hours; - Use good quality vehicles, with engines in good condition; - Watering of the work area, vehicle and machine traffic lanes when crossing residential areas to reduce dust; - Use of equipment that meets noise standards.	
	Spontaneous migration	- Transmission of diseases from the site to the communities, including STDs; - Increase in traffic accidents; - Unauthorised entry to the site, vandalism, damage, petty theft; - Presence of armed security personnel and risk of excessive use of force.	Moderate	- Implementation of a health and safety programme; - Implementation of a traffic and road safety plan; - Construction of a wall or fencing around the site; - Establishment of a 24/7 security system; - Establishment of checkpoints for access to the site and certain areas; - Establishment of a security personnel management plan to ensure appropriate use of force by guards;	Minor

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Potential Impact	Mitigation measure	Residual impact
				- Organisation of information campaigns in the villages in the immediate vicinity of the site concerning hygiene, health, epidemiological measures, environmental protection and cultural differences with the new arrivals.	
	Waste management	- Production of solid and liquid waste which, if poorly managed, can degrade the living environment of local residents.	Major	- Development and implementation of a Waste Management Plan; - Development and implementation of a wastewater and effluent management plan; - Development and implementation of a Storage and Management Plan for oils, hydrocarbons and other pollutants.	Minor
	Traffic	- Accidents with heavy vehicles - Increased traffic - Traffic slowdowns - Nuisances related to air emissions and noise due to traffic, affecting the populations living in the close proximity of the construction site	Major	- Development & implementation of a road traffic management plan - Limitation of the vehicule speed to 30km/h in all inhabited areas, and, if possible, pave road sections experiencing highest traffic load; - Informative campaigns in the villages; - Use of road signage.	Minor
	Water resource consumption	- Decreased access to water due to construction use and influx of workers	Moderate	- Monitoring satisfaction with access to water - Construction of additional drinking fountains if required - Measures presented in 6.3.1.5.4 can be applied here as well	Minor
	Waste management infrastructure	- Production of waste to be transfred to the Aképé landfill, hower lack of information of its capacity makes it difficult to assess the impact	Moderate	- The same measures described in sections 6.3.1.7 and 6.3.3.6.2 apply for this topic	Minor

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Potential Impact	Mitigation measure	Residual impact
		- Production of green waste to be disposed of at the dumping site	Minor	- As above	Minor
Archaeological heritage	Construction work	- Incidental discovery of archaeological remains	Moderate	- Development and implementation of a procedure for the management of incidental finds - Development and implementation of a Cultural Heritage Management Plan	Minor

6.4. Impacts and measures during the operation phase

This phase involves the operation of all the shared utilities and common infrastructure (electricity network including transmission line, stormwater and water supply systems, and wastewater treatment plant, connecting road etc.).

6.4.1. Impacts and measures on the physical environment

6.4.1.1. Impacts on climate and on climate-change related risks

Impacts

This section analyses both the impact of the project on climate (and climate change) and on the risks related to climate change, that may be increased or reduced by the operation of the project itself.

The direct contribution of the projet to climate change, during its operational phase, is strictly related to its greenhouse gas emissions. These emissions will mostly come from the industries implanted on the industrial zone. The capacity and typology of these industries are not known yet (we may assume they will mostly operate in the textile and agri-business sectors) and their emissions will be evaluated in independent ESIAs. However, the Project will utilise 100% renewable energy produced by the 260MW solar plant.

Moreover, a substantial excess of power (220MW) will remain in the national electric grid for the use by Togolese population, enterprises and industries. This will help Togo to reach national GHG objectives and combat climate change.

Considering that solar panels can last for over 25 years, the avoided emissions are significant. The emissions of a PV plant are mostly related to the construction of PV modules and other components. This impact has been evaluated in section 6.3.1.1: considering an emission of 43,9 gCO_2eq/kWh, the emissions are estimated in 27815 tons $CO_2eq/year$.

On the other hand, during operation phase the PV plant doesn't generate any greenhouse gas. It is therefore possible to estimate the emissions avoidance made possible by the operation of the PV plant. According to the data provided by the International Renewable Energy Agency (IRENA), 67% of electricity generation in Togo in 2019 came from non-renewable sources (62% from oil and 38% from gas). Based on the emissions for gas (443 gCO_2eq/kWh) and oil (778 gCO_2eq/kWh), we can estimate that electricity generation in Togo causes an average emission of 650 gCO_2eq/kWh. Over a lifetime of 25 years, the emissions avoided per year thanks to the construction of the PV plant correspond then to 411 850 tons $CO_2eq/year$.

The **net positive balance** for over 25 years (emission avoided minus PV lifecycle emissions) is estimated to be around **9 500 000 tons CO_2eq.**

As for the operation of the industrial zone, greenhouse gas (GHG) may result from the following:

- Vehicles: vehicles of IZ employees, but also all other employees of the area, residents, visitors, delivery trucks, etc.

- Electric substations: substations may be at the origin of release of SF6[17] (sulfur hexafluoride) gas mainly during maintenance and removal of equipment, or leakage from equipment in operation. SF6 is used as an electrical insulator in high-voltage equipment.
- Emergency generators, as diesel engine are expected to release GHG as Nitrogen Oxide (NOx), Carbon Monoxide (CO) and particulate matter (PM). Due to the very punctual use of these equipment, significative emissions from them are not expected and will be considerably lower than those from traffic.

Food and biodegradable waste are expected to be potentially one of the main types of waste produced by PIA infrastructures. This waste will be disposed of at the Aképé landfill. Food that has been wasted and left to rot away on landfill results in methane gas emissions. Since methane has a global warming potential (GWP) twenty times higher than carbon dioxide, its emissions are a major contributor to the climate change. As the produced waste volume is not yet known it is not possible to estimate these emissions. Nevertheless, Aképé landfill has biogas treatment equipment that is expected to reduce the impact of methane.

Overall, the emissions of greenhouse gases from the Project operation, including operation of the industrial zone (considering that implanted industries will rely on the electricity produced by the PV plant) are considered negligible. The net impact of the project on climate change is therefore positive.

As mentioned, the project will have an impact on the risks related to climate change, and more precisely:

- Flood risk, because of the impermeabilisation of large areas (as detailed in section 6.3.1.1).
- Water resource consumption : the project appears to be both a contributor to and a victim of declining water resources. On the one hand, a reduction in water availability would affect the proper functioning of the activities implanted on the IZ. On the other hand, the operation of the industrial zone induces a significant water consumption, thus adding pressure on the resource. This pressure may sum up to the pre-existing and future pressure on the ressource related to agricultural activities and personal usage of the inhabitants. Climate change (increase in temperature and evapotranspiration) will add further pressure on the water resource.

On the other hand, the shade provided by the solar panels lowers soil surface temperature and evaporation, and the vegetation planted under and around solar panels would reciprocate by keeping the panels cool. Solar PV Panels begin to wane in efficiency at high temperatures, hence the vegetation presence is conducive to their yield.

Finally, the revegetation of the solar park area will contribute to carbon sequestration, contributing to mitigate vegetation loss due to land clearing and furtherly reducing the project impacts on climate change.

Table 103 Impact of the Project's renewable energy generation for the contribution in the fight against climate change

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

[17] SF6 is a potent greenhouse gas; over a 100-year period, SF6 is 23,900 times more effective at trapping infrared radiation than an equivalent amount of carbon dioxide. SF6 is also a very stable chemical, with an atmospheric lifetime of 3,200 years.

Table 104 Impact of the Project GHG emissions (including traffic) on climate during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 105 Impact of water resource consumption on climate-change related risks during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

The measures to be implemented are:

- **Obligation to fulfil a dedicated ESIA for each industry** establishing in the area. Impacts and measures related to climate change shall be studied and assessed appropriately.
- **Routine maintenance checks** will be undertaken regarding electric substations and emergency generators. Especially for the equipment using SF6 gas that has to be done properly and periodically in accordance to the specification and operation manuals.
- As there is no available alternative to ban SF6, the judicious use of SF6 with **careful closed-loop handling and full recycling upon equipment retirement** have to be privileged.
- To face the potential increase in the risk of flooding, **the stormwater network (including basin and surface cover with increased permability) needs to be properly designed.** The measures described for an effective management of stormwater are of application for reducing the increasingly risk of flooding.
- **Limit to a minimum the vegetation removal and revegetate the area of the solar park** may also help reduce runoff and increase infiltration, thus mitigating the flood risk downstream.
- It is relevant to use **light colored paints or materials on the walls of the buildings** on the site and plantations along the walls to decrease the phenomenon of heat islands on the site.

Measures concerning the risk of overexploitation of the water resource are identified and described at section 6.3.1.5.4 and 6.4.1.5.3 and will be of application also for this subject.

Measures regarding waste management can also contribute to reduce atmospheric emissions (see section 6.3.1.7).

The residual impact is considered to be:

- **major for what concerns water resource consumption;**
- **minor for atmospheric emissions and traffic**

Compensation measures:

A moderate residual impact demands for compensation measures to be identified. Such measures concern water resource consumption and are detailed in section 6.4.1.5.3.

6.4.1.2. Impacts on geology, topography and soil

Impacts

With regard to potential project operational impacts on soils, these are mostly related to potential contaminants entering the soil during accidental spills from the following infrastructures:

- Discharge of hazardous liquids from the electrical substation; chemical and waste storage areas,
- Mismanagement of discharges from the wastewater treatment plant (accidental situation),
- Stagnant water in drains,
- Poor management of runoff from waste storage areas
- Poor management of washing water following a product spill on the road, after a truck/vehicle accident for example.

The transformers contained in the transformer and distribution stations as well as the generators will be installed on retention tanks with a capacity greater than the quantity of oil contained, which avoids any risk of leakage into the natural environment.

Figure 114 Example of retention tank

Limited range of chemicals is expected to be used for general operations of the Project area (excluding industries). There will be no storage of chemicals for maintenance, the products will be transported as needed.

The maintenance of green spaces could also lead to environmental degradation of the soil in case of use of chemical products. PIA plans to used treated effluents for watering plants.

In case of spillages, main issues will be about the groundwater and surface water contamination through soil infiltration or runoff. See section § 6.4.1.5 for impacts description.

All accidental (or not) discharges from the future industries cannot be defined yet as their process are unknown. Each of these industries will have to assess the impacts resulting from their discharges in a dedicated ESIA. Nonetheless, industrial effluents will be controlled prior being discharged to CETP for further treatment.

In potentially 'hazardous' zones (i.e., refueling, chemical storage), where rainwater is likely to be loaded with pollutants, closed drainage systems are to be installed and connected to the CETP for further treatment.

Rainwater collected on solar panels can cause soil erosion once it reaches the ground. Revegetation of the soil underneath and around solar panels will reduce runoff and prevent soil erosion.

Table 106 Impact of liquid discharges production on geology, topography and soil quality during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 107 Impact of accidental situations on geology, topography and soil quality during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

The measures to be implemented are:

- **Obligation to fulfil a dedicated national ESIA for each industry** establishing in the area. Impacts and measures related to discharges shall be studied and assessed appropriately. PIA General Operation Guidelines will have to be followed by all industries including ESMP from this ESIA.
- **Monthly soil monitoring** to ensure that treated effluents using for watering plants it is not accumulating contaminats (mainly Heavy metals, total hydrocarbon);
- **Use of pesticides shall be prohibited.** Mechanical method for green spaces maintenance shall be privileged;
- **Revegetation of the surface underneath and around solar panels** by planting or sowing native floral species compatible with the solar power plant to limit soil erosion and the deposit of dust on solar panels;
- In all areas where rainwater is likely to be loaded with pollutants, closed drainage systems are to be installed and connected to the CETP for further treatment. Polluting and large scale industry will be required to carry out analysis of stormwater discharges at their outlets connected into the PIA common drainage network. The characteristics of stormwater effluents will have to comply with the discharge standards applicable to the project presented in Table 10.

For the measures related to soil contamination, those defined in case of spillage in section 6.4.1.5 may as well be applied for the soil.

The residual impact is considered to be negligible (minor for accidental situations).

6.4.1.3. Impacts on air quality

Impacts

The atmospheric emissions resulting from the Project general operations and facilities are mainly related to the CETP and power generators that will be occasionally exploited. Further emissions will result from traffic related to the operation and maintenance of the PIA infrastructure and utilities, and transportation of workers.

Air emissions and traffic related to PIA facilities and common services provided (waste management, common technical buildings, maintenance, …) will however be marginal compared to those induced by the operation of the industries implanted on the IZ. These emissions are out of the scope of the present ESIA.

However, the Project represents a major industrial zone and, based on reasonable expectations, we may assume that impacts on traffic will be significant. A large number of additional vehicles (both for workers transportantion and for incoming and outcoming goods and materials) will transit on the main road axis that will allow the access to the Project (N1 via PIA Phase 1 and the connection road and N34, with direct access to the Project). This will result in a significant additional pressure on the existing road infrastructure with reference to traffic conditions, maintenance and safety issues. A detailed traffic study is recommended to fully analyse the expected traffic volume and ass the potential need of improvements.

As for air emissions, an estimate would need to take into consideration the significant number of industries as well as their typology (textile, agrobusiness, light industries) as well as their technical installations and processes. However, we may assume that the expected type of industry will mainly rely on the electrical power provided by PIA via the solar park. No significant air-emissions for power production are then expected. At this stage no clear assumption may be done on the potential emissions of other substances (ex. volatile organic compounds), strictly depending on the activities and processes. Based on these basic evaluations, we can assume that the cumulative air emissions will be moderate.

To comply with PIA regulations, each of these industries will have to assess their own impacts in terms of atmospheric emissions in a dedicated ESIA.

The sources of atmospheric emissions (coming from the combustion of thermal engine) have been listed at point 6.4.1.1.

The CETP is a major source of odors. A detailed essessment of odors propagation would require design details that are not available at the time of writing this report. However, the closest residential area being located around 1 km est of the CETP, it is likely that odors will not be perceived at these receptors.

Thanks to the roads coating, dust emissions will be largely reduced.

Table 108 Impact of air emissions and traffic on air quality during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

Due to the fact that the large part of vehicles will not be under PIA control, no reduction measure for vehicles GHG emissions can be applied.

The measures to be implemented are:

- **Obligation to fulfil a dedicated national ESIA for each industry** establishing in the area. Impacts and measures related to atmospheric emissions shall be studied and assessed appropriately.
- **Monitor atmospheric emissions** of fixed sources for common infrastructure and CETP to ensure they comply with General EHS Guidelines: environmental (IFC, 2007) for air emissions and ambient air quality (Table 7).
- **Identify an optimal location for CETP** maximising the distance with sensitive receptors (housing) to reduce the risk of odors related nuisances.
- **Implement a monitoring and grievance mechanism for odors** produced by the CETP or any other common infrastructure managed by PIA.
- **Carry out a traffic study** to properly evaluate the volume of traffic induced by the industrial zone and consequently assess the impacts on the road infrastructure, air and noise emissions and identify potential improvements required for the transportation system (traffic signals, intersections, safety for all users).

The residual impact is considered to be maintained at minor level.

6.4.1.4. Impacts on the ambient noise

Impacts

During operation, noise will mostly be generated by the various industries settled in PIA area and come from the operation of the machinery and industrial equipment present at each industrial unit as well as the traffic generated by the operation of these industries (delivery and expedition of materials and finished products, traffic of workers, etc.).

PIA common utilities are not expected to create significant noise emissions, except electrical substation and CETP. However, the substation is located in the industrial area close to the road, and it is likely that its noise emissions will be covered by the traffic noise generated by activites on PIA site. Based on the information available at the time of writing this report, it was not possible to assess the noise emissions of the CETP in a quantitative way. The CETP is located on the border of the IZ (Figure 5). The closest residential areas are located at around 1 km to the east of the CETP (Figure 31). At such distance, the noise emissions of the CETP (which mainly result from pumps) will most likely be non detectable or negligible. Noise emissions may also be significantly reduced by adopting specific measures during design phase (choice of low noise emission pumps, construction of sound barriers etc).

Noise from traffic on the road connecting Phase 1 to Phase 2 will be mostly screened by the light industries that will be implanted on large part of the road itself, thus reducing the potential impact on isolated habitations near-by.

Adopting a precautionary approach, the the impact is rated as minor.

As analysed in the previous section, noise emissions related to PIA facilities and common services provided (waste management, common technical buildings, maintenance, …) will however be marginal compared to those induced by the operation of the industries implanted on the IZ. These emissions are out of the scope of the present ESIA.

However, the Project represents a major industrial zone and, based on reasonable expectations, we may assume that impacts on noise (resulting from industrial equipments and traffic) will be significant. However, considering the receptors' distance and the possibility to implement effective noise reduction measures at the design stage, we can then assume that the cumulative emissions will be minor.

All activites will have to assess their own impact on the noise to be sure that they comply with national and international regulation (Table 8).

Table 109 Impact of the project on noise during operational phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

Due to the fact that the large part of vehicles will not be under PIA control, no reduction measure for vehicles noise emissions can be applied.

The measures to be implemented are:

- **Obligation to fulfil a dedicated national ESIA for each industry** establishing in the area. Impacts and measures related to noise emissions shall be studied and assessed appropriately.
- **Carry out a CETP noise emissions assessment** to evaluate the noise emissions of the CETP and identify the measures that may be integrated at the design stage to effectively reduce noise emissions (choice of low-emissions equipments, design of noise screens, …).
- **Identify an optimal location for CETP** maximising the distance with sensitive receptors (housing) to reduce the risk of noise related nuisances.
- **Implement a monitoring and grievance mechanism** for noises produced by the CETP or any other common infrastructure managed by PIA.
- Speed limit in line with the road's classification,
- Acoustically isolate the electrical substation.

Residual impacts are assessed as negligible.

6.4.1.5. Impacts on hydrology and hydrogeology

6.4.1.5.1. Project footprint

Impacts

During operation phase, no modification of the stormwater drainage network is expected to take place (except for the drains that will be realised on each industrial plot, which do not belong to the scope of the present ESIA).

However, with time, the functionality of the drainage system may reduce due to drains clogging or mismanagement. Such problems could result in overflow, water logging or soil erosion, which in turn increase sedimentation loads on the surface waters.

Based on the hypothesis that the stormwater will be properly designed and maintained, the impact is rated as negligible.

Table 110 Impact of project footprint on hydrology during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

Additional measures may be implemented to monitor and assure the functionality of the drainage system:

- **Monitor any malfunctions of the stormwater drainage system** that may result in soil erosion, overflow or other physical effect.
- **Implement a maintenance plan aimed at assuring the proper functioning of the runoff drainage system,** including cleaning of any critical point that may get clogged (in particular after intense rainfall events)

The residual impact is rated as negligible.

6.4.1.5.2. Liquid discharges affecting water quality

Impacts

Various activities of the PIA infrastructures may lead to water degradation due to various contaminants being discharged, both during routine and non-routine/accidental modes. Impacts on water quality may concern both surface water (as the outfalls of both the stormwater drainage system and the CETP convey effluents directly into the environment) and groundwater (indirect imaoct through ground infiltration). Such impacts may result from:

- Stormwater from roads, parking areas and other waterproof surfaces that will discharge into the open drainage system and into the environment through putfalls (routine dicharges);
- Stormwater from non-hazardous chemical and waste storage areas that will be collected and discharged to the outfall (routine dicharges);
- Treated effluents from CETP will discharge into the water basin located at the Phase 2 area and consequently through outfall (OF-1) into the natural drainage channel leading to Togo Lake;
- Accidental events that could lead to a spillage of hazardous products or a release of untreated wastewater, seeping through the ground to contaminate the water or reaching the environment (rivers and other water bodies) (non-routine discharges);
- Non-treated effluents from the treatment plant discharged accidentally (accidental/ non-routine discharges).

Both domestic and industrial effluents are expected to be mixed, collected and treated at the same CETP. Polluting industrial units are expected to **undertake preliminary treatment** of their process wastewaters prior to their discharge into CETP. All incoming into CETP industrial effluents will have to meet Inlet water quality criteria specified in section 3.2.5. The final effluent quality from CETP will comply with the stringent standards before being discharged into the environment (see section 2.5.3).

It is expected that 5300 m³ of treated water will be discharged per day from the CETP. This corresponds to a flow of ~60 l/s. No risk of standing water is expected.

Impact intensity is qualified as moderate.

Accidental situations may result in the release of untreated water directly reaching the surface waters and potentially leading to indirect contamination of groundwater (as no retention basin has been designed). Therefore, the impact intensity is assessed as moderate.

Table 111 Impact of liquid discharges (including accidental situations) on surface waters during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 112 Impact of liquid discharged on groundwater quality during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

- **Adequately designed CETP to meet established Project Standards for discharges into the natural environment.**
- **Design and integrate in the conceptual scheme of the CETP an emergency retention basin** to collect untreated wastewater in case of accidental situations.
- **Respect inlet influent requirements to be accepted in the CETP**. A set of parameters and their level of concentration has been prescribed and industrial units must comply to meet the preliminary treatment standards presented inTable 22 .
- Implement a quality control of pre-treatment for each industrial activity before its wastewater is sent to the CETP. This quality control will be in line with the Design Inlet Threshold for the CETP.
- Develop an operation plan to be implemented in case the quality control results in an exceedance of the Design Inlet Threshold.
- Each outfall location that discharges runoff into the central drain / subdrains must be **equipped with grates or nets** to arrest the debris, other solid entering the drain and the natural environment.
- **Implement a surface water quality monitoring program** to be carried out at the CETP discharge point and at the inlet of Togo Lake (corresponding to baseline point PESU-04).
- **All water** gathered from parking areas or areas with oily process operations **have to pass through an oily water separator** before being discharged in the stormwater network.
- **Development of an Emergency Response Plan/Procedure** to cover all scenarios for accidental spillage or other kind of accidents on site.

To residual impact of liquid discharges (including accidental situations) is considered as minor.

6.4.1.5.3. Water resource consumption

Impacts

Total water demand for the Project has been evaluated to be 6000 m^3/d, of which 700 m^3/d will be recycled (12%), thus resulting in a daily water demand of 5300 m^3/d. All the water supply will come from the Maastrichtian aquifer, apart from drinking water, although it depends on water quality results. Cleaning of the PV panels may use water although dry cleaning of the modules is recommended. The water consumption potentially needed for PV panels cleaning is considered negligible compared to the total industrial water consumption.

Taking into account a 65 m^3/h pumping rate for 16 hours per day, the 6 wells of the Project will provide 6240 m^3/d, thus meeting the daily water demand.

Water recycling constitutes an essential design measure to protect groundwater resources. If the water recycling rate commitment is not adhered to the designed 6 boreholes would however be sufficient to supply 6000 m^3/d.

Table 113 Water balance for the Project

Number of wells	Pumping rate (m3/d) per well	Potential Water flow m3/d per well	Total water production m3/d	Water Demand without recycling (m3/d)	Water Demand based on recycling of 12% (m3/d)
6	65	1040	6240	6000	5300

On PIA Phase II site no pumping test was conducted and there is no well reaching the Maastrichtian aquifer, however, PIA Phase 1 pumping test can be used as a reference considering that both phases will be sourcing water from the same aquifer. Futher testing will be required to assess aquifer capacity to supply water for the Project through operation phase.

Detailed hydrogeological data are not available nearby the site project. A comparison may be done with the average regional capacity of the aquifer (estimated as 13Mm^3/yr, of which 6,6Mm^3/yr is abstracted annually). Without the reuse of water, Project abstraction from the Maastrichtian aquifer should be around 1.87 Mm3/yr (corresponding to 29% of the estimated availableaquifer capacity). With water recycle, the abstraction sould be around 1.64 Mm3/yr (26%). In both cases, the Project would have a major impact on the regional capacity of the aquifer based on the data described above.

With regards to the large volume required by PIA during operations, there is a potential risk of a decrease in the piezometric levels of the upper aquifers (Paleocene aquifer and Continental Terminal aquifer, both used by villagers and the national water company and connected) if there is a connectivity with Maastrichtian aquifer (targeted by PIA and also exploited by the same national water company). Hence, a better understanding of hydrogeology is needed to verify Project impacts concluded in this ESIA. If no connection is identified between the Maastrichtian aquifer and the Paleocene aquifer, the Project water consumption impacts on the two upper aquifers would be low to insignificant.

A more detailed assessment of the impact of the Project operations on water resources is not feasible in the absence of further pumping tests in the Maastrichtian aquifer and more specific investigations allowing to know the aquifer dynamics, the volume available of the resources, its recharging capacity, its interannual variation (depending on the season), its current uses.

Based on available information and adopting a conservative approach, the intensity of impact on all three aquifers is rated as major.

Table 114 Impact of water resource consumption on groundwater availability during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

The impacts on groundwater resources can be further acerbated by climate change causing increased water scarcity and affecting all users in the region. It's however worth noting that water scarcity hazard level is currently rated as 'Very Low' among the climate hazards considered to be most important in the Project region (Table 35). The impact assessment is based on preliminary hydrogeological data and baseline.

If any change is observed regarding water availability (it may change with time depending on abstractions and external factors like climate change), the management of water use would have to be re-assessed by carrying out a proper hydrogeological study.

In this case, the relevance of such study would be critical as scarcity of the water resource may directly result in: (i) communities in the project zone suffering from the reduction of productivity of their activities related to agriculture, (ii) water stress, (iii) periods of drought, (iv) conflicts that may arise among communities to feed themselves as land productivity will decrease. Affecting the availability of the water resource will strongly impact households who will experience a drop in income.

Measures

A geological well reaching the Maastrichtian aquifer is necessary to understand the geology of the multi-layered aquifer (and most importantly thicknesses and facies of the reservoirs). We strongly advise to perform a pumping test in this well to assess the properties of the Maastrichtian aquifer within the Project area. Paleocene and Continental Terminal wells nearby the Maastrichtian well need to be monitored during the pumping test.

If the pumping test is conclusive regarding the local aquifer capacity and interconnections with other aquifers, we advise to realize a full cycle monitoring (1 year) of the Maastrichtian, Paleocene and Continental Terminal aquifer. After a year, once the data will be interpreted, it would be possible to target only some wells representative of the multi-layered aquifer to switch to (at least) a trimestral monitoring.

The measures to be implemented are:

- **Investigate the geology of the multi-layered aquifer** via a well reaching the Maastrichtian aquifer
- **Perform a pumping test in the Maastrichtian aquifer** while monitoring wells in Paleocene and Continental Terminal aquifers
- **Monitor water consumption from borewells** during the Project lifetime
- **Prefer dry cleaning of the PV modules** instead of wet cleaning.
- In a context of the water resource become scarcer, additional efforts to recycle water should be implemented by PIA by designing and implementing a system to recycle the treated water of the CSTP and allow to reuse it instead of discharge it to the environment.
- Weekly piezometric monitoring in a representative set of structures in the communities around PIA Phase 1 and PIA Phase 2 ;
- Monitoring of villagers' complaints about the lack of water resources ;

Unless unnecessary based on already issued governmental authorisations, a request submission to the Environment Ministry (ANGE or prefectural department of environment) must be made to **obtain an application for groundwater withdrawal**.

Without additional information, the residual impact is rated as major.

A major residual impact demands for compensation measures. The identification of such measures is the result of technical specific studies that will need to be carried out.

Compensation measures :

- **Carry out water stewardship/water neutrality studies** adopting internationally recognized standards (such as Alliance for Water Stewardship AWS standard) to identify, evaluate and quantify compensation measures (which may include increasing availability of water to the population, increasing water infiltration on the watershed scale, adapting the reuse rate of PIA users, …).

6.4.1.6. Impacts on landscape

Impacts

An industrial area is a new feature in an area initially mainly occupied by agricultural land, and without mitigation, will have some impact on the visual character and amenity of the area.

The location of the Project is a flat area despite the presence of several local variations. The spatial scope includes no viewpoints looking towards the PIA area.

Generally speaking, the PIA area will be designed to fit into the patterns of the landscape, and provide visual mitigation measures, where appropriate. The buildings located close to the main external roads can be architecturally designed. Nevertheless, the scale and nature of the Project is such that it is not possible to mitigate its visual impact entirely.

The most relevant impacts on landscape will be related to the industrial buildings that will be implanted on the PIA Phase 2 IZ area. This will significantly change the visual amenity of the area, from rural to anthropized. However, only a small number of houses are located in close proximity of the most impacted areas, corresponding to the industrial corridor and the south-eastern part of the IZ. These houses will no more benefit of a mainly rural landscape.

Finally, to mitigate their impact, each of these industries will have to assess the impacts on landscape resulting from its implantation in a dedicated ESIA.

Another impact that can affect the area is the buildings and roads lightening. Indeed, large lightening during the night will be observed in places initially lightly lightened.

Waste management is also a concern in terms of landscape, as poorly managed waste storage can lead to landscape degradation for local communities.

Owing to the vision of an environmentally sustainable industrial area, the choice has been taken to create approximately 11,71 ha of green areas. These green zones will be mainly developed along the N34 and will provide an opportunity to integrate nature with the industrial / commercial area.

The figure below illustrates the green areas projected.

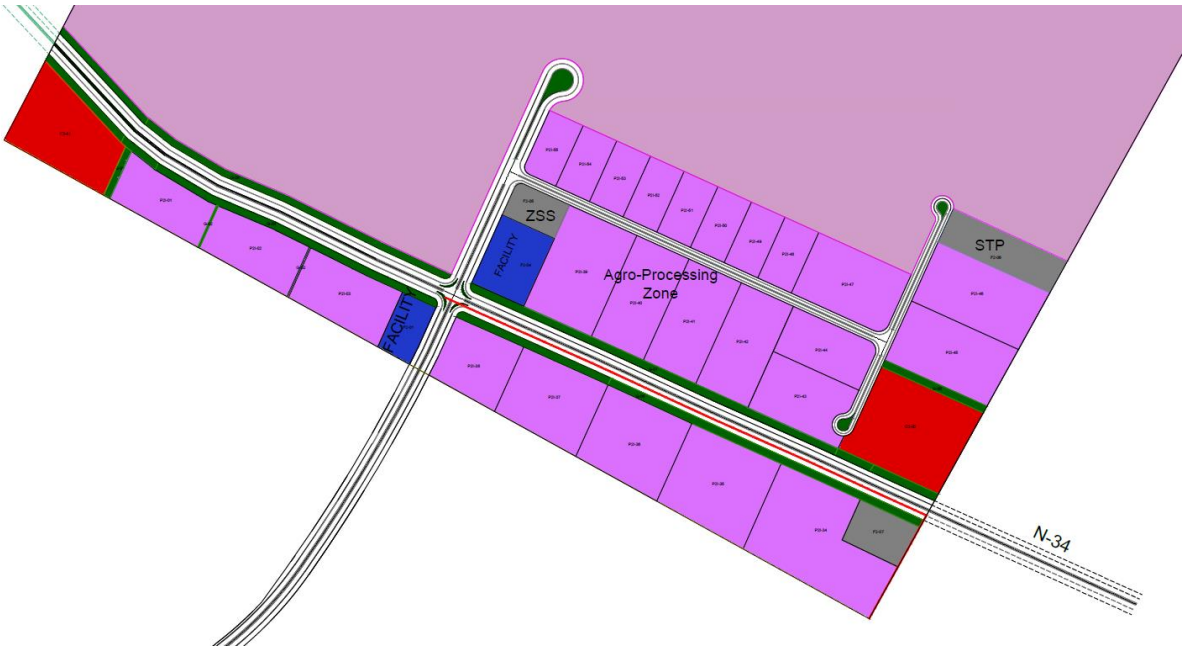


Figure 115 Green spaces

A large part of the PIA Phase 2 area will be occupied by the solar plant.

Ground-mounted PV systems cause a change in the natural setting due to their size, uniformity, design and materials used. Even if a solar park may appear aesthetic, it is nevertheless, by its technical aspect, an object foreign to the landscape, and which is therefore likely to harm the natural setting.

Overall, this type of installation is generally quite apparent in the landscape. When the modules are clearly visible from the observation point, the installation presents a greater luminosity and a color which differs in the natural setting, under the effect of the reflection of the light hence the impact of the project on the landscape.

Note that the risk of blinding reflections is non-existent. The face of the glass that protects the cells is treated with an anti-reflective film in order to improve the conversion efficiency of the photovoltaic power plant. There is therefore no visual disturbance by reflection for residents.

Contrary to a fear sometimes expressed, the risk of blinding reflections on photovoltaic panels is very low, if not zero.

The outer face of the glass that protects the cells is systematically treated with an anti-reflection coating in order to improve the conversion efficiency (the reflected light is "lost" from an energy point of view): about 5% of the incident light is reflected by the current modules.

Moreover, the inclination of the modules makes that the reflected light is directed more or less high in the sky according to the hour of the day and can thus be perceived by an observer only in a very dominant point, which is not possible in the zone of study because of the very flat topography of the zone. In addition, the tropical nature of Togo allows a low tilt of the panels (about 5°, they are positioned almost flat). The reflections are therefore mostly directed towards the sky.

With reference to the potential effects in proximity of airports, there are no regulations in Togo on this point, which is why we will rely on good practices in France. A technical information note from the Direction Générale de l'Aviation Civile (DGAC) has been produced, in which it is considered that (§2.2, p 5): "[...] Only projects for the installation of photovoltaic panels located less than 3 km from any point of an aerodrome runway and a control tower must be subject to a specific prior analysis. Thus, the competent authority of the civil aviation gives a favorable opinion to any project located at more than 3

km from any point of an aerodrome runway or a control tower as long as they respect the easements and the regulations applicable to them (see §1.2)".

The airport of Lomé is located more than 18 km from the future solar park and therefore unlikely to be disturbed by light reflections.

Thus, the risk of mirror effect is ephemeral and negligible because the reflected solar radiation is weak and the direction of the reflected rays is similar to that of the direct rays. One cannot speak of a mirror effect from a point of visibility included in the project area, but simply of the observation of a weak reverberation in very precise points and over short daily periods which will not disturb the local population. This impact can therefore have very little effect on the nearby areas.

In the case of the present installations, the solar plant is located away from urban centers within a pretty dense savannah. The relief is not very marked. Its presence can be seen as an element intruding on the natural landscape, and can thus generate a dominant effect, however largely attenuated by the absence of relief limiting the possibility of having direct points of view on the solar plant. No touristic areas exist in the surrounding of the PIA Phase 2 site. The overall aesthetic effect of a solar power plant is likely to be negative for some people, in particular where the planned structure approaches urban sites and where the absence of landscaped elements (trees, hedges) cannot regulate the infrastructures.

The height of the solar panels will be of approximately 5 m. Since the topography of the site is relatively flat, the panels shouldn't be particularly visible from the distance.

The intensity of the impact on landscape is rated as moderate.

Table 115 Ihe impact of the project on landscape during operational phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

Environmental, urban and landscape integration lie at the centre of the Project with the proposition to develop around 12 ha of green spaces with indigenous plants and trees and with concrete blocks barrier limiting the direct visual on industrial and logistic areas from the main roads. Trees and shrubs will be chosen in keeping with prevailing weather conditions and other such site characteristics (see section 6.3.2.3). The maintenance of green spaces will be essential to limit the visual impact.

It's important to ensure a proper integration of the solar park in the landscape. Native plants should be chosen to revegetate the area underneath and around the solar panels. Trees and other bushes should be planted on the perimeter of the solar plant to reduce the visual impact.

The proper mix of plants and trees should be identified by an expert in flora. The choice should take into account the local context as well as the proper functioning of the solar plant.

The following measures are expected to be implemented:

- **Obligation to fulfil a dedicated ESIA for each industry** establishing in the area. Impacts and measures related to noise emissions shall be studied and assessed appropriately,
- **Open green spaces maintenance operations** will begin after planting. Planting beds will be kept free of weed, grass and other undesired vegetation growth. In general, maintenance of all spaces under the PIA responsibilities has to be managed appropriately.

- Any **lightening requirements** should be designed to ensure light spill is directed into the site. Lighting at night shall be maintained at a minimum.
- **Revegetate the area underneath and around solar panels with native plants. Plant trees and bushes along the PV plant perimeter** to reduce the visual impact. The choice of appropriate plants and trees should be made by an expert in flora to adapt to the local context as well to the need of the solar plant (in terms of maintenance).
- The proper application of the waste management plan will ensure the maintain of the landscape conditions.

The residual impact intensity is considered to be minor.

6.4.1.7. Impacts resulting from solid waste production and management

Impacts

The assessment of impacts resulting from waste management traditionally focuses on two separate issues:

- Impact of collection, transport, manipulation, treatment and elimination of waste on the environment (related to the quality of soil, waters, air, etc) and the nuisances on surroundings communities, including aspects regarding the dumping site that will welcome PIA's green waste;
- Impact on national waste management infrastructure that is planned to be used by PIA for the needs of the project.

Impacts on communities health and safety are analysed in section 6.4.3.6.1. Impacts on waste management infrastructure are detailed in section 6.4.3.7.

Significant amounts of solid waste will be generated during the operation phase. The risks of water and soil pollution are high if this waste is not properly managed, with indirect impacts on groundwater, surface water, soil, air quality and development of disease vectors (mosquitoes, flies, rats) harmful to public health. For this reason, the assessment of the importance of impacts on different sensivitive components and resulting from waste production and management is grouped in this section.

Four categories of waste have been defined in section 6.3.1.7: domestic, green, inert and dangerous waste. Domestic and green waste (including soild waste from kitchens, agro-industries, leaf litter, green sweepings etc) are biodegradable. Inerts are not biodegradable and will include recyclable and non-recyclable waste (fiber scrap, paper, cardboard, packaging, plastics, tin, glass, metals, etc.).

Most of waste will be produced on a day to day basis by the industries implanted on the IZ. The estimated amount of waste produced is:

- Organic waste = 1500 Ton / year
- Non Hazardous waste = 2105 ton/ Year
- Hazardous waste = 280,39 ton / Year

However, the waste produced by the industries will have to be managed according to their own waste management plan, that shall be aligned with the Waste Management Plan developed by PIA, which will be imposed to all the industries that will rent a plot of the IZ.

As for the common utilities of the IZ, a minor source of waste will be the street sweepings, which will result in the collection of green waste, road traffic waste, behavioural waste and silt from open drainage. Hand carts are recommended for collection of streets sweeping waste from processing as well as non-processing areas.

A relevant part of hazardous waste produced from PIA is expected to be the sludge generated from effluent treatment plants (CETP). This waste is analysed in the following section.

The operation of a PV plant and the associated infrastructures produces very little waste, including hazardous waste:

- Electrical and electronic waste resulting from the maintenance of solar and electrical installations. This category of waste is mainly produced by the activity of the site when replacing worn or defective parts (inverters, batteries, etc.). For the impacts related to the storage of defective or broken modules, there is a risk of infiltration of liquid discharges containing heavy metals into the soil. If the panels are just defective, but not broken or cracked, environmental damage is considered non-existent.
- Other maintenance waste, in small quantities: waste oils in small quantities linked to the maintenance of motors and tracker gears, soiled rags and packaging, batteries, neon lights, aerosol;
- Ordinary industrial waste including in particular the packaging of maintenance parts: scrap metal, plastic and cardboard packaging, wooden pallets;

The amount of waste produced is included in the amount mentioned above.

The storage and transport of wastes during the PIA operation, if inappropriately managed, has a number of potential negative impacts through releases to air, soil and water. Impacts which could occur include:

- Insufficient disposal frequencies or inappropriate storage containers could result in odour concerns.
- Container used for hazardous substances and or fuels/oils not correctly disposed could contaminate both streams and groundwater (and indirectly lead to human health issues).
- Incorrect handling, separation and storage of operation waste resulting in soil and water contamination impacts.
- Runoff from waste storage areas that is not collected and has the potential to contaminate soil, stormwater, and groundwater.

Table 116 Impact of waste management on soil during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 117 Importance of the impact of waste management on hydrology during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 118 Importance of the impact of waste management on hydrogeology during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 119 Importance of the impact of waste management on air quality during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

Clear **waste management procedures** have to be established, implemented and communicated, both for PIA and its workers and the future industrials:

- Monitor the capacity of the vendors to manage the amount of waste produced and, if needed, identify further partnerships with local vendors for waste management to ensure all waste streams are correctly collected, handled, treated and disposed of.
- Implement best practices for the composting of biodegradable domestic waste to avoid the risk of attracting animals
- For hazardous waste:
  - In case of production of hazardous waste, an application must be submitted to the ANGE (usual national good practices).
  - Store in dedicated, secure areas. These areas will be sealed and equipped with retention basins to prevent any risk of leakage to the environment.
  - No waste or hazardous product storage facility will be located in an area subject to flooding or near a drinking water source.
  - Elaborate a complete list of hazardous waste produced, stored and collected as well as quantities. Conduct regular audits of waste segregation and collection practices.
  - Keep manifests or other records that document the amount of waste generated and its destination
  - Verify, via annual audits to be carried out by third party auditors, that all contractors handling, treating and disposing of hazardous waste are licensed by the relevant regulatory agency and follow good international industry practices
  - Ensure compliance with applicable local and international regulations among which any national commitment under r the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their disposal (http://www.basel.int/) and Rotterdam Convention on the prior Inform Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (http://www.pic.int/)

- Conduct regular visual inspection of all waste storage collection and storage areas for evidence of accidental releases and to verify that wastes are properly labeled and stored. Monitoring activities shall include
  - Inspection of vessels for leaks, drips or other indications of loss
  - Identification of cracks, corrosion, or damage to tanks, protective equipment, or floors
  - Verification of locks, emergency valves, and other safety devices for easy operation
  - Checking the operability of emergency systems (if any)
  - Documenting any changes to the storage facility, and any significant changes in the quantity of materials in storage

  Document the findings.
- Prepare and implement spill response and emergency plans to address their accidental release
- Avoid underground storage tanks
- All waste containers designated for off-site shipment should be secured and labeled with the contents and associated hazards, be properly loaded on the transport vehicles before leaving the site, and be accompanied by a shipping paper (i.e., manifest) that describes the load and its associated hazards

- Establish a pre-acceptance procedure with the landfill operator in Aképé. PIA must present certain elements to the operator, including
  - A description of the origin of the waste concerned
  - Volumes and types of waste
  - The results of the analysis of the waste concerned (analysis report)
- Verify, via annual audits to be carried out by third party auditors, that all contractors handling, treating and disposing of waste follow good international industry practices and have the capacities needed to handle, treat and dispose of the waste they are entitled to collect at PIA site.
- Develop and implement contractual specifications for future industrials including obligations for the proper collection, storage and disposal of waste in accordance with PIA Waste Management Plan.

By implementing these measures, the residual impact is considered to be negligible for soil, air quality and surface water and minor for groundwater.

6.4.1.8. Impacts resulting from sludge production and management

The reuse of sludge can lead to contamination of the soil by the pollutants it contains. The infiltration of these pollutant charges into the soil can then alter the quality of the groundwater. It is estimated that approximately 200 kg of sludge shall be produced per day for ultimate capacity of the treatment plant.

The sludge will be reused through one of the considered solution: disposal in ditches or dedicated trenches, landfarming, agricultural reuse, land reclamation and composting. For each option considered by PIA for the reuse of sludge, there is a specificity of treatment and associated threshold requirements and constraints.

For sanitary landfill, landfarming and land reclamation, it is necessary to carry out in-depth soil characterisation studies in order to know the physico-chemical parameters of the soil, which therefore boils down to characterising the geochemical background of the soils in the study area. Indeed, in order to avoid significant impacts on soil and groundwater quality, it is recommended that the characteristics of the sludge are similar to those of the soil where the sludge will be discharged.

In this sense, it is necessary to monitor the quality of the sewage sludge after the filter press.

Three parameters as a basis for determining sewage sludge quality:

- The presence of pollutants (arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc)
- The presence of pathogens (e.g., bacteria, viruses, parasites)
- The sewage sludge's attractiveness to vectors (e.g., rodents, flies, mosquitoes).

It appears then that the land reclamation option requires a lower quality of sludge as the soil quality would already be impaired. However, it is necessary to carry out a soil quality survey to ensure that the discharge of sludge will not contribute to further soil degradation.

On the other hand, there are greater constraints on the reuse of sludge for agricultural use. Since the crops on which the sludge is discharged are intended for human consumption, it is necessary that the quality of the sludge has low levels of pollutants and metals. Biosolids intended for application to agricultural land must not exceed maximum concentrations of pollutants, including heavy metals. The US EPA's Part 503 guidance document provides maximum allowable concentrations for ten heavy metals. In addition, an analysis of the soil on which the sludge will be spread should be carried out and then compared with the quality of the sludge produced by the PIA wastewater treatment.

The US EPA requirements for land application are presented in the table below.

Table 120 Pollutant limits (US – EPA, Land application of sewage sludge, A guide for land appliers on the requirements of the federal standards for the use or disposal of sewage sludge, 40 CFR Part 503, 1994)

Pollutant	Ceiling Concentration limits for all biosolids applied to land (mg/kg – dry weight basis)
Arsenic	75
Cadmium	85
Chromium	3,000
Copper	4,300
Lead	840
Mercury	57
Nickel	420
Selenium	100
Zinc	7,500

According to US EPA, ceiling concentrations apply to all land applied sewage sludge (bulk sewage sludge and sewage sludge sold or given away in a bag or other container). Ceiling concentrations establish the maximum concentration of each pollutant that sewage sludge can contain and still be land applied. Each sample of sewage sludge analyzed must meet the ceiling concentration limits. These limits are applied as maximum, never to be exceeded values, not as averages. Sewage sludge that does not meet these specified thresholds for any or all of the 10 regulated pollutants must be used of disposed of in some other way; it cannot be land applied (US-EPA, 1994).

Regarding composting, which appeas to be the selected option, a composting platform would be set up to store sludge, it should be located in non-flooded areas with a slope of less than 2%. Windrows in active phase would be covered in order to be protected from rainwater, especially during rainy season as to keep an optimal moisture ratio. A drainage system should be in place to direct the leachate to simple treatment facilities such as ponds or filters. Concrete and asphalt are commonly used to construct composting platforms but are relatively expensive. Other materials, such as a clay liner or a geotextile covered with gravel, can be used (Cornell Waste Management Institute, 2005). To ensure an efficient composting process, the regulation of temperature and time parameters for the composting of biosolids will be carried out according to US EPA recommendations (see 0).

Furthermore, it is expected that there will be an impact on the degradation of air quality through the emission of odours from the sludge treatment. These odours can affect the surroundings communities and workers, especially the workers in charge of turning the windrows.

Table 121 Impact of sludge management on soil during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 122 Impact of sludge management on hydrology during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 123 Impact of sludge management on hydrogeology during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 124 Impact of sludge management on air quality during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

- A dedicated Risk Assessment Study for sludge management shall be conducted in order to study and assess issues appropriately related to discharges and sludges management
- Respect WHO and US EPA (see section 2.5.6) recommendations on pathogen limits for reuse of sludges, notably concerning the monitoring of the sewage sludge quality after the filter press;
- If sludge is composted, the dry matter content should be between 40 and 45%. This corresponds to a water percentage, called "moisture ratio", of 55-60%. Composting is most efficient when the C:N ratio is in the range of 25 to 35:1. The appropriate bulking agent for the project may be green waste, leaves and scrub and pruning waste from the initial clearing of land for the project but also from the maintenance of green areas during the operation of the platform;
- Place the windrows under cover to protect them from rainwater, especially during rainy season, which can disturb the moisture content of the compost and prevent it from reaching its optimum level. In addition, it will probably be necessary to water the compost in the dry season to maintain an adequate moisture level;
- Set up a composting platform, located in non-flooded areas with a slope of less than 2%, use of impermeable liner, equipped with provided drain run-off from the drying area;
- Regarding the planned use of the compost, the process will have to respect recommendations of Part 503 of the US EPA regulation on temperature and time parameters for composting of biosolids;
- Control the C:N ratio (to be over 25) and ensure a correct aeration of the windrows (mechanical turning of windrows) to avoid emission of odours;
- Monitoring the quality of sludge with sampling, moisture content of the compost should be between 55 and 60%.

The residual impact intensity will be considered minor for all the above mentioned receptors.

6.4.2. Impacts on biological environment and mitigation

Impacts

During operation phase, no direct impact is expected on protected areas. The project area will be cleared during construction phase, and impacts have been evaluated in Section 6.3.2.

During operational phase, some fauna species that has been disturbed during the constrution works could come back on site and colonize the green spaces of the Project area, however these are negligible compared to the industrial zone. Small fauna species such as as *Cricetomys emini* Gambian rat, *Chameleo gracilis* Cameleon or *Hemidactylus brooki* Domestic gecko could be observed on site, especially during night-time when disturbance (traffic, noise, etc.) are weak. The same may be expected for avifauna, as

birds will be able to nest again, on ground or in trees of the new green areas. Poor waste management, and particularly organic waste, may provide an attractive habitat for little fauna and avifauna, including pests such as rats and vermine.

The faunistic richness may be negatively affected by the traffic related to the operation of the industrial zone and the risk of accidental collision leading to injury or death of animals. However, as fauna is likely to move during the night-time, where traffic is lower, the impact is judged as minor.

An indirect impact on natural environment could be observed downstream the Project area in the event of accidental situations such as the mismanagement of wastewater / stormwater reaching the natural environment via the discharge/oufall points. This applies to contamination of the aquatic life in Togo Lake. As a reminder, the natural environment will receive:

- All industrial treated effluent from the wastewater treatment plant (CSTP);
- All superficial runoff from rain and road washing (after an accidental event for example);
- Any other unauthorized discharges (accidental or not) from industrial plants, which may result in pollution issues.

While the discharges of the future industries cannot be assessed, accidents or mismanagement of the CETP or the drainage system may result in damages to the natural aquatic habitat, its flora and its fauna. To prevent these discharges to reach the Togo Lake and potentially affect its flora and fauna, measures have been defined in section 6.4.1.5 (including the need to carry out surface water quality monitoring at the inlet in Togo Lake corresponding to the baseline point PESU-04 as well as intervention plans in case of accidental situations).

The impact intensity on the biological environment (including aquatic flora and fauna) in case of accidental situations is then considered to be moderate.

Table 125 Impact of accidental situations on habitat and flora during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Table 126 Impact of traffic and accidental situations (including traffic) on fauna during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

The project footprint (and notably the land use for the solar park) will also result in an impact on the natural environment.

The impact of the construction of the solar plant on the floristic richness has been evaluated in section 6.3.2.2. The solar farm will offer the opportunity to restore, at least partially, the habitats lost for its construction by a proper revegetation. This will constitute a partial compensation for the lost habitat due tu land clearing.

The impact on large fauna will materialize in an inability to frequent the area. Indeed, the site fence will prevent large wildlife from accessing the project site. However, the data collected during the field mission shows that this large fauna already rarely visits the site.

As the shade of solar modules contributes to water retention in the earth, soil biodiversity will improve especially for rodents, some reptiles and several species of invertebrates. This new biodiversity may eventually attract a few species of birds that can benefit from a new trophic and may feed and even reproduce there.

The operation of the solar farm may cause injuries or fatalities of birds resulting from collision with panels or transmission lines or electrocution (as a result of a simultaneous contact with energized and grounded surfaces). Possible sources of attraction of birds to solar facilities include the following:

- The “lake effect”, where birds percieve reflective surface of solar panels as a body of water and try to land on them. This effect may result in injuries or death for birds and it puts waterbirds in particular at risk because some species can’t take off from the ground; they require a running start on the water’s surface. This risk is considered low as PV panels are not very reflective as covered with anti-reflective film;
- Glare from panels, unexpected fluctuations in lighting, increased illumination, and night lighting that could disorient birds in flight or attract them to solar facilities;
- Polarized light caused by PV panels and other lighting aberrations (as listed above) that could attract insects which then attract birds;
- Enhanced vegetation near panels that result from excess water runoff during cleaning activities and attracts prey species.

"Several studies have been conducted to assess behavioral disturbances of certain species due to photovoltaic installations. It is often argued that waterfowl or shorebirds may mistake solar modules for water surfaces due to reflections and attempt to land on them. Observations of a large-scale ground-mounted photovoltaic installation in the immediate vicinity of the Maine-Danube Canal and a large reservoir occupied almost year-round by waterfowl did not reveal such a risk of confusion (Source: Ministère du Développement durable, DGEC, Guide sur la prise en compte de l'environnement dans les installations photovoltaïques au sol: l'exemple allemand, January 2009. Available at www.developpement-durable.gouv.fr, under the heading "Energy and Climate").

In addition, the report states that "many birds such as mallard, goosander, grey heron, black-headed gull or cormorant were observed flying over the PV plant without showing any change in their flight direction (bypassing, attracting)".

In a 2010 study (Bönigk, 2010), it was possible to refute the hypothesis that birds mistake solar panels for water surfaces and get injured when trying to land on them, by studying the Lieberose and Schneeberger solar power plants in Germany. No negative effects were identified during monitoring programs conducted in 2006 by the Federal Agency for Nature Conservation.

However, there is a lack of knowledge about the effects of polarized light on aquatic insects, which are a food source for many birds. A study published in 2009 (Gábor Horváth, 2009) cites several examples of smooth, dark artificial surfaces - car bodies, asphalt roads, glass building facades, photovoltaic panels, or plastic films used for agricultural greenhouses - that polarize light and are therefore mistaken by insects for water surfaces. According to this study, such surfaces would disrupt the feeding, reproduction or orientation of several insect species. The impact on insects is therefore suspected, but further study is needed to confirm it.

Little is known about the potential impact of a PV plant on insects such as bees. There is insufficient experience feedback to conclude whether the negative impacts for insects are significant. This uncertainty does not rule out a residual impact on insects. However, research is underway to combine solar power plants with crops of flowering plants sown between rows of modules in order to attract pollinating insects and thereby increase the productivity of nearby agricultural crops (e.g. cotton, various crops. food crops, citrus fruits). The impact can therefore be globally positive for insects and the productivity of surrounding agricultural fields. It should be noted, for example, that the state of Minnesota (USA) has passed a law deciding the creation of more than 930 ha of biotopes for pollinating insects in existing solar power plants). Similar initiatives exist in several other states in the United States.

Table 127 Impact of the project footprint on fauna during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

- **Use grazing and not chemicals to retard re-growth of vegetation** both in the IZ green areas and the solar park
- **Ensure an effective waste selective sorting**, and an appropriate storage of organic waste in the compost trenches. These, as well as the waste transfer centers, must be appropriately fenced out to limit any access to small fauna (particularly rats and pests).
- Measures defined for the management of storm- and wastewater detailed at point 6.4.1.5 are also applicable to avoid or reduce impacts on the natural environment.

The residual impact is considered to be minor for both flora and fauna.

6.4.3. Impacts on the human environment and mitigation

Many of the impacts on the human environment during the operation phase of the project are similar to those occurring during the construction phase, but their intensity may decrease.

6.4.3.1. Impact on access to energy for the national community

The operation of the solar park will make it possible to provide energy not only for the PIA industrial zone but also for the Togolese population. Indeed, there is an estimated power excess of 220MW that is to be integrated into the national grid.

It is expected that the access to energy will expand and that more inhabitants will benefit from this. Access to energy can enable new people to access certain economic opportunities and more broadly it will improve living conditions. Indeed, access to energy can be used for lighting, health, access to modern technology for cooking or even communication. It can help activities such as agriculture and trade to become more productive. It can also improve access to education and recreation for communities.

Table 128 Impact of the project on access to energy for the national community during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE

NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

6.4.3.2. Impact on economic activities, livelihoods and local economy (employment)

The operation of the project will continue the dynamics of job creation and economic development in the Adétikopé area. Thus, as it was the case during the construction phase, the impact on employment will be positive. It is estimated that the project will generate 5,000 to 7,000 jobs during the operation phase.

The project is also likely to contribute to local economic development by using local service providers, for example in the field of restoration. Similarly, by purchasing from farmers in the area and provided that it is financially and technically appropriate, economic operators involved in the processing of agricultural products will be able to contribute to local economic development.

Additionnally, the ground beneath the solar panels may be used to graze animals or grow crops, thus mitigating the loss of agricultural land resulting in and resulting from the change in land use.

The impact in terms of employment and economic activity is positive, but also sensitive.

Table 129 Importance of the impact of the project on economic activities, livelihoods and local economy during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures:

A number of measures need to be undertaken to enhance these positive impacts. These include :

- Implementation of awareness campaigns involving local authorities on supply opportunities among local farmers and service providers;
- Development in the LRP, if relevant, of training allowing PAPs to improve the quality of their agricultural production in order to favour their inclusion in the supply chains of the operators operating within the project;
- Partnership with local training centres for training and recruitment of trainees;
- Creation of recruitment offices or connection between the project's economic operators and local recruitment offices if these are already in place, with priority given to people affected by the project with equal skills;
- Inclusion of local recruitment clauses in the PIA operational guidelines;
- Establishment of a complaints management mechanism and stakeholder engagement plan.
- Investigate the possibility to implement agrovoltaics (or agrophotovoltaics) strategies such as using the ground beneath the solar panels to graze animals or grow crops.

6.4.3.3. Impact on the social climate

Similar to the construction phase, the positive impacts of the project in terms of employment and economic spillover may be limited at the local level, and may lead to tensions between the local communities and the Promoter.

Indeed, as these jobs are mainly skilled and semi-skilled, local populations may not benefit from the job creation generated by the project. This situation is likely to create frustrations, protest movements and acts of vandalism.

If recruitment is not carried out in a transparent manner and in favour of people living near the site, with equal skills, this will lead to numerous social tensions.

This is a very sensitive issue for the population as it is their main expectation of the project. The intensity of the impact can be qualified as minor and its importance as moderate.

Table 130 Ihe impact of the project on the social climate during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures :

A number of measures need to be implemented in order to limit this negative impact. These include :

- Establishment of recruitment offices or connecting the project's economic operators with local recruitment offices if these are already in place, with priority given to people affected by the project with equal skills;
- Setting up a transparent procedure for the management and communication of tenders with local subcontractors via the commune and local communication media (radio, newspapers, notice board);
- Partnership with local training centres for training and recruitment of trainees;
- Implementation of training programmes for PAPs in the framework of the LRP for occupations related to the exploitation phase;
- Inclusion of local recruitment clauses in PIA's operational guidelines;
- Priority use of subcontractors based in the Adétikopé region if economically and technically reasonable;
- - Establishment of a complaints management mechanism and stakeholder engagement plan.

The residual impact after implementation of the mitigation measures is considered to be of minor importance.

6.4.3.4. Impact on women and vulnerable groups

Similarly to the construction phase, women and vulnerable people may not benefit from the economic and employment opportunities arising from the project. Traditional representations of the role of women and the limited social and economic capital of vulnerable people may limit their ability to take advantage of opportunities. In addition, they may also face discrimination in hiring and harassment in the workplace.

The influx of foreign male workers into the area may also increase violence against vulnerable people.

This impact is of moderate importance.

Table 131 Impact of the project on women and vulnerable groups during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures :

The attenuation measures presented at section 6.3.3.4 for construction phase may be applied to the operation phase. These measures are recalled here below:

- Compliance with the standards set by ILO conventions and national legislation concerning discrimination against women and people with disabilities;
- The implementation of positive discrimination measures favouring the employment of women and disabled people;
- Access to dedicated infrastructure (e.g. women's toilets and changing rooms) or adapted infrastructure (staircases with access ramps, etc.);
- The provision of Personal Protective Equipment (PPE) adapted for women;
- The provision of street lighting in selected areas to improve safety;
- The organisation of regular consultations with women and vulnerable people to monitor their socio-economic situation;
- The implementation of an employment management plan that promotes female employment, provides for the recruitment of women and ensures equal pay;
- The implementation of awareness campaigns on gender equality and the principle of non-discrimination;
- Ensuring strict control to avoid the employment of children under 14 years of age and ensuring that the tasks entrusted to children over 14 years of age do not endanger their physical integrity and health;
- The establishment of a community monitoring system for the protection of children;
- The establishment of a complaints and grievances management mechanism accessible to workers to monitor the number of cases of harassment or deviant behaviour against women or vulnerable persons;
- The inclusion of representatives of women and vulnerable people such as people with disabilities in the monitoring committee of the environmental and social management plan.

These measures should significantly limit these impacts. The residual impact is considered to be minor.

6.4.3.5. Impacts on health and safety of workers

Impacts

In the operational phase, workers will be employed directly by PIA or by the industries settled on site. Impacts on the health and safety of workers can take different forms:

- employees and customers may be exposed to sources of noise emissions such as technical equipment and transport machinery;
- operation activities may require the handling and use of hazardous products (used oil) and the production of waste and sludge. Poisoning or burns to the skin or eyes when handling these products may result if no precautions are taken;
- maintenance and repair activities requiring to work on machinery might cause pinches or sectioning of limbs;
- dust and atmospheric emissions emitted by technical equipment and transport machinery can affect the health of workers, as well as odour nuisance from sludge treatment;
- storage and handling of hazardous products, in particular hydrocarbons, causes risk of spills, fire, explosion and injury. Poisoning or burns to the skin or eyes when handling dangerous products such as solvents, hydrocarbons and other chemicals may result;
- heavy traffic on major roads (RN1 / RN34);
- traumatic accidents caused by unsafe working conditions (joint trauma due to the transport of heavy loads or manual work, etc.);
- illegal intrusion of individuals on the site;
- exposure of workers to STDs and HIV/Aids if they associate with sex workers outside the site.

Worker's rights might also not be respected by industrial operators with excess in worktime, unpaid overtime, no sick leaves, no contrat, wages below Togo standards, etc.

A dispensary, a police station and fire station on the PIA Phase 1 located 8 km west of the PIA Phase 2 site, will make it possible to contain these various risks to the health and safety of individuals.

Health and safety issues for the workers might as well be observed as a consequence of bad management of organic waste resulting in the presence of rats or pests.

The importance of the impact is therefore moderate.

Table 132 Impact on health and safety of workers during the operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

The measures to be implemented are:

- include clauses on Occupational hygiene, health and safety of workers in the PIA operating guidelines;
- monitor industrial operators' compliance with the PIA operating guidelines;
- make PPE available for workers and ensure their effective wearing;
- set up and implement an Occupational Hygiene, Health and Safety Plan;
- set up and implement a Waste Management Plan and a Hazardous Products Management Plan;

- set up and implement a Traffic and Road Safety Plan;
- recruit an HSE coordinator in charge of monitoring the correct application of the plans;
- manage the workforce and ensure working conditions in accordance with Togo's national regulations and the ILO conventions ratified by Togo;
- **Ensure an effective waste selective sorting**, and an appropriate storage of organic waste in the compost trenches. These, as well as the waste transfer centers, must be appropriately fenced out to limit any access to small fauna (particularly rats and pests);
- Regarding sludge, control the C:N ratio (to be over 25) and ensure a correct aeration of the windrows (mechanical turning of windrows) to avoid emission of odours.

After the implementation of corrective measures, the level of residual risk is considered to be minor.

6.4.3.6. Impact on health, safety and security of populations

6.4.3.6.1. Impact of waste, sludge and liquid discharge management

The operation of the Industrial Platform will generate waste and effluents. If these are not properly managed, they will inevitably affect the quality of life of the people living near the Phase II site.

Health and safety issues for the community might as well be observed as a consequence of bad management of organic waste resulting in the presence of rats or pests.

The environmental component is moderately sensitive and the intensity of the impact can be qualified as minor. It is therefore an impact of moderate importance.

Table 133 Impact of waste, sludge and liquid discharge management on the health and safety of the community during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures :

The following mitigation measures should be implemented to reduce this impact:

- Development and implementation of a Waste Management Plan including details concerning the storage and management of oils, hydrocarbons and other pollutants;
- Development and implementation of a wastewater and effluent management plan
- **Ensure an effective waste selective sorting**, and an appropriate storage of organic waste in the compost trenches. These, as well as the waste transfer centers, must be appropriately fenced out to limit any access to small fauna (particularly rats and pests).

The residual impact after application of the mitigation measures is considered to be minor.

6.4.3.6.2. Impact of traffic

The main transport-related impact concerns accidents on the National Road 34 (RN34), which crosses the project area and serves the localities of Gnatikopé, Hagblévou, and Akadjamé. These communities are therefore likely to face an increasing number of vehicles serving the activities of the new industrial zone.

A significant traffic is also expected on the newly constructed road connecting Phase 1 to Phase 2.

This impact is of moderate importance.

Table 134 Impact of traffic on health and safety of the community during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

- **Carry out a traffic study** to properly evaluate the volume of traffic induced by the industrial zone and consequently assess the impacts on the road infrastructure, air and noise emissions and identify potential improvements required for the transportation system (traffic signals, intersections, safety for all users).
- Development and implementation of a traffic management plan that takes into account the use of the RN34 road by the population, notably the off-peak and peak periods of use;
- **Limit the vehicles speed** to 30 km/h in all inhabited areas, and, if possible, pave road sections experiencing highest traffic load;
- The organisation of informative campaigns in the villages located in the immediate vicinity of the site concerning road safety measures.
- Development of specific segments for pedestrians and motorcyclists on accident-prone sections or in the vicinity of infrastructures or places of residence;
- Use of road sign signage.

Residual impacts are considered to be minor.

6.4.3.6.3. Impact of water resource consumption

The water requirements for the operation of the site have been estimated at 5300 m^3 per day (including reuse).

The intensive use of water for the operation of the site may lead to difficulties in accessing water for the different users (among which adjacent villages), which may be a source of conflict. Indeed, the socio-economic baseline study shows that households have difficulties in accessing water, particularly in January, February and March.

Further studies will be required to more accurately assess the impact of water consumption during the operation phase. The impacts are therefore considered to be major for the time being.

Table 135 Impact of water resource consumption on health and safety of the community during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures :

A series of measures are needed to ensure that communities have adequate access to water, such as:

- Regular monitoring of the satisfaction of access and quality of water at the sources used by the villagers
- Regular monitoring of water flow and quality in the villages through pumping tests;
- If necessary, the construction of additional drinking fountains to ensure satisfactory access to water for villagers.

Residual impacts are considered to be major.

A moderate residual impact demands for compensation measures. The identification of such measures is the result of technical specific studies that will need to be carried out.

Compensation measures :

- Refer to measures defined in section 6.4.1.5.3.

6.4.3.6.4. Impact of air and noise emissions

With regard to noise pollution, the traffic of trucks and other heavy vehicles may cause discomfort to residents of adjacent communities.

With regard to air quality, dust generation will remain limited, but the companies operating on the site will emit gases and particles during the processing of the products. These emissions may result in odour nuisance for the local population.

Table 136 Impact of air emissions on health and safety of the workers and the community during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

The importance of the impact of the construction phase on human health due to noise emissions is rated as moderate.

Table 137 Impact of noise on health and safety of the workers and the community during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures :

Measures developed during the construction phase will reduce noise and air quality impacts during the operation phase. These measures include preventing the maintenance of noisy equipment and vehicles outside working hours, limiting truck traffic to 30 km/h in residential areas, and using recent low-emission vehicles and equipment that meets noise standards. In addition, air quality can be maintained by:

- Including clauses on air quality and noise pollution in the PIA operational guidelines;
- Developing a monitoring of industrial operators' compliance with the PIA operational guidelines.

Residual impacts are considered minor.

6.4.3.6.5. Additional impacts on the health, safety and security of the community

During the operation phase, access to the site will be limited by controls at the gates. There will therefore be limited impacts of the site's activities on the local population.

The establishment of an industrial platform will have a visual impact on the landscape which may be perceived negatively by the population and degrade the aesthetic value of their environment. This impact is not certain as it is subjective. The population may also perceive it as a sign of development and modernity.

Accidental situations (spillage, technologican accidents or other situations resulting in an industrial accident) may directly affect the health and safety of the community.

This impact is considered moderate as the site is close to residential areas.

Table 138 Impact of accidental situations on health and safety of the workers and the community during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measure :

In addition to the measures developed in previous sections, the following measures should limit the risks to the safety of the population:

- Development of an industrial risk prevention and management plan;
- Development of an awareness campaign for the villages concerned on the behaviour to adopt in case of industrial accident

The residual impact is considered to be minor.

6.4.3.7. Impact on the waste management infrastructure

The assessment of the impact on waste management infrastructure, and in particular the Aképé landfill, is not possible due to the lack of information on its capacity to receive the significant amount of waste generated by the industries implanted on PIA Phase 2.

Therefore, and adopting a precautionary approach, the impact intensity is then rated as major.

For further details refer to sections 6.4.1.7 and 6.4.3.6.1.

Table 139 Impact of solid waste management on the waste management infrastructure during operation phase

Nature of the impact	Effect of the impact	Sensitivity level of the component	Level of impact intensity	Importance of the impact
POSITIVE	DIRECT	NEGLIGIBLE	NEGLIGIBLE	NEGLIGIBLE
NEGATIVE	INDIRECT	MINOR	MINOR	MINOR
		MODERATE	MODERATE	MODERATE
		MAJOR	MAJOR	MAJOR

Measures

The same measures described in sections 6.4.1.7 and 6.4.3.6.1 apply for this topic.

Additional mitigation measures:

- Carry out a Waste Management Infrastructure Analysis to assess the actual and global capacity of the existing regional/national waste management infrastructure to manage, on the long term, the amount of waste produced by PIA operations (including hazardous and non hazardous waste).
- Investigate the technical and financial feasibility to build an additional waste management facility (or extend an existing one) specifically intended to the disposal of PIA operations waste;

The residual impact intensity is considered to be minor (importance is moderate).

Compensation measures:

- Implement the possibility for neighbouring communities to have access to PIA waste management infrastructure (collection and disposal)

6.4.4. Impacts and measures synthesis for the operation phase

Table 140 Impacts and measures synthesis for the operation phase

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Impact importance	Mitigation measure	Residual impact
Climate and climate-change related risks	Atmospheric emissions Traffic	- Greenhouse gas emissions from traffic and site operations (mostly powered by the solar park)	Minor	- Obligation to fulfil a dedicated ESIA for each industry establishing in the area. Impacts and measures related to atmospheric emissions shall be studied and assessed appropriately. - Routine maintenance checks will be undertaken regarding electric substations and emergency generators. Especially for the equipment using SF6 gas that has to be done properly and periodically in accordance to the specification and operation manuals. - As there is no available alternative to ban SF6, the judicious use of SF6 with careful closed-loop handling and full recycling upon equipment retirement have to be privileged. - Refer to measures identified for solid waste management that may affect air emissions - To face the potential increase in the risk of flooding, the stormwater network (including basin and surface cover with increased permability) needs to be properly designed. The measures described for an effective management of stormwater are of application for reducing the increasingly risk of flooding. - Limit to a minimum the vegetation removal and revegetate the area of the solar park may also help reduce runoff and increase infiltration, thus mitigating the flood risk downstream. - It is relevant to use light colored paints or materials on the walls of the buildings on the site and plantations along the walls to decrease the phenomenon of heat islands on the site.	Minor
	Water resource consumption	- Significant water consumption adding pressure to the water resource	Major	- Refer to measures identified for the impacts on hydrogeology	Major
	Installation of power plant	- Contribution to the the fight against climate change with the use of renewable energies	POSITIVE		

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Impact importance	Mitigation measure	Residual impact
		- Improve access to energy for national population			
Geology, topography and soil	Liquid discharges	- Discharge of hazardous liquids from the electrical substation - Stagnant water in drains, - Use of chemical products for the maintenance of green spaces - Soil erosion from rainwater collected on solar panels	Minor	- Obligation to fulfil a dedicated ESIA for each industry establishing in the area. Impacts and measures related to discharges shall be studied and assessed appropriately. - Use of pesticides shall be prohibited. Mechanical method for green spaces maintenance shall be privileged. - Revegetation of the surface underneath and around solar panels by planting or sowing native floral species compatible with the solar power plant to limit soil erosion. - Carry out monthly soil monitoring to ensure that treated effluents using for watering plants it is not accumulating contaminats (mainly Heavy metals, total hydrocarbon); - In all areas where rainwater is likely to be loaded with pollutants, closed drainage systems are to be installed and connected to the CETP for further treatment. Polluting and large scale industry will be required to carry out analysis of stormwater discharges at their outlets connected into the PIA common drainage network	Negligible
	Solid waste management	- Disturbance in runoff management from waste storage areas causing erosion, - Contamination of soil by the waste leachate infiltrating in the ground in case of waste mismanagement or accidental situations	Moderate	- In case of production of hazardous waste, an application must be submitted to the ANGE (usual national good practices). - Store in dedicated, secure areas. These areas will be sealed and equipped with retention basins to prevent any risk of leakage to the environment. - No waste or hazardous product storage facility will be located in an area subject to flooding or near a drinking water source. - Monitor the capacity of the vendors to manage the amount of waste produced and, if needed, identify further partnerships with local vendors for waste management to ensure all waste streams are correctly collected, handled, treated and disposed of. - Implement best practices for the composting of biodegradable domestic waste to avoid the risk of attracting animals - Hazardous waste will be listed and stores appropriately, records will be held and monitoring will be carried out through third parties audits and internal visual inspection	Negligible

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Impact importance	Mitigation measure	Residual impact
				- Prepare and implement spill response and emergency plans to address their accidental release - Establish a pre-acceptance procedure with the landfill operator in Aképé. PIA must present certain elements to the operator, including o A description of the origin of the waste concerned o Volumes and types of waste o The results of the analysis of the waste concerned (analysis report) - Verify, via annual audits to be carried out by third party auditors, that all contractors handling, treating and disposing of waste follow good international industry practices and have the capacities needed to handle, treat and dispose of the waste they are entitled to collect at PIA site. - Develop and implement contractual specifications for future industrials including obligations for the proper collection, storage and disposal of waste in accordance with PIA Waste Management Plan	
	Sludge management	- Contamination of soil by the waste leachate infiltrating in the ground in case of sludge mismanagement or accidental situations - Risk of soil contamination by sludge reuse (for example in case of agricultural reuse)	Moderate	- A dedicated Risk Assessment Study for sludge management shall be conducted in order to study and assess issues appropriately related to discharges and sludges management - Respect WHO and US EPA (see section 2.5.6) recommendations on pathogen limits for reuse of sludges, notably concerning the monitoring of the sewage sludge quality after the filter press; - If sludge is composted, the dry matter content should be between 40 and 45%. This corresponds to a water percentage, called "moisture ratio", of 55-60%. Composting is most efficient when the C:N ratio is in the range of 25 to 35:1. The appropriate bulking agent for the project may be green waste, leaves and scrub and pruning waste from the initial clearing of land for the project but also from the maintenance of green areas during the operation of the platform; - Place the windrows under cover to protect them from rainwater, especially during rainy season, which can disturb the moisture content of the compost and prevent it from reaching its optimum level. In addition, it will probably be necessary to water the compost in the dry season to maintain an adequate moisture level;	

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Impact importance	Mitigation measure	Residual impact
				- Set up a composting platform, located in non-flooded areas with a slope of less than 2%, use of impermeable liner, equipped with provided drain run-off from the drying area; - Regarding the planned use of the compost, the process will have to respect recommendations of Part 503 of the US EPA regulation on temperature and time parameters for composting of biosolids; - Control the C:N ratio (to be over 25) and ensure a correct aeration of the windrows (mechanical turning of windrows) to avoid emission of odours; - Monitoring the quality of sludge with sampling, moisture content of the compost should be between 55 and 60%.	
	Accidental situations	- Mismanagement of discharges from the wastewater treatment plant (accidental situation), - Poor management of washing water following a product spill on the road, after a truck/vehicle accident for example.	Moderate	- For accidental situations measures, refer to groundwater section below in this table	Minor
Air quality	Atmospheric emissions Traffic	- Atmospheric emissions (including odors) from the operation of the CETP and traffic	Minor	- Obligation to fulfil a dedicated ESIA for each industry establishing in the area. Impacts and measures related to atmospheric emissions shall be studied and assessed appropriately. - Monitor atmospheric emissions of fixed sources for common infrastructure and CETP to ensure they comply with General EHS Guidelines: environmental (IFC, 2007) for air emissions and ambient air quality (Table 7). - Identify an optimal location for CETP maximising the distance with sensitive receptors (housing) to reduce the risk of odors related nuisances. - Implement a monitoring and grievance mechanism for odors produced by the CETP or any other common infrastructure managed by PIA. - Carry out a traffic study to properly evaluate the volume of traffic induced by the industrial zone and identify potential improvements required for the transportation system.	Minor

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Impact importance	Mitigation measure	Residual impact
	Solid waste management	- Odors from insufficient disposal frequencies or inappropriate storage containers	Minor	- For solid waste management measures, refer to soil section, above in this table	Negligible
	Sludge management	- Odors from insufficient disposal frequencies or inappropriate storage containers - Odors resulting from sludge treatment (composting)	Moderate	- For sludge management measures, refer to soil section, above in this table	Minor
Noise	IZ operations Traffic	- Noise generation from traffic and PIA common utilities operation (CSTP, electrical substation, if any)	Minor	- Speed limit in line with the road's classification, - Acoustically isolate the electrical substation - and measures related to noise emissions shall be studied and assessed appropriately. - Carry out a CETP noise emissions assessment to evaluate the noise emissions of the CETP and identify the measures that may be integrated at the design stage to effectively reduce noise emissions (choice of low-emissions equipments, design of noise screens, …). - Identify an optimal location for CETP maximising the distance with sensitive receptors (housing) to reduce the risk of noise related nuisances. - Implement a monitoring and grievance mechanism for noises produced by the CETP or any other common infrastructure managed by PIA	Negligible
Hydrology	Project footprint	- Overflow, water logging or soil erosion resulting from drains clogging or mismanagement of the drainage network	Negligible	- Monitor any malfunctions of the stormwater drainage system that may result in soil erosion, overflow or other physical effect. - Implement a maintenance plan aimed at assuring the proper functioning of the runoff drainage system, including cleaning of any critical point that may get clogged (in particular after intense rainfall events)	Negligible
	Liquid discharges Accidental situations	- Degradation of surface water quality -	Moderate	- Adequately designed CETP to meet established Project Standards for discharges into the natural environment. - Design and integrate in the conceptual scheme of the CETP an emergency retention basin to collect untreated wastewater in case of accidental situations.	Negligible

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Impact importance	Mitigation measure	Residual impact
				- Respect delimited effluent requirements to be accepted in the CETP. A set of parameters and their level of concentration has been prescribed and industrial units must comply to meet the preliminary treatment standards. - Implement a quality control of pre-treatment for each industrial activity before its wastewater is sent to the CSTP. This quality control will be in line with the Design Inlet Threshold for the CSTP. - Develop an operation plan to be implemented in case the quality control results in an exceedance of the Design Inlet Threshold. - Implement a surface water quality monitoring program to be carried out at the CETP discharge point and at the inlet of Togo Lake (corresponding to baseline point PESU-04). - Each outfall location that discharges runoff into the central drain / subdrains must be equipped with grates or nets to arrest the debris, other solid entering the drain and the natural environment. - All water gathered from parking areas or areas with oily process operations have to pass through an oily water separator before being discharged in the stormwater network. - Development of an Emergency Response Plan/Procedure to cover all scenarios for accidental spillage or other kind of accidents on site	
	Solid waste management	- Surface water quality contamination by the waste leachate reaching surface waters	Moderate	- For solid waste management measures, refer to soil section, above in this table	Negligible
	Sludge management	- Surface water quality contamination by leachate resulting from sludge treatment (composting)	Moderate	- For sludge management measures, refer to soil section, above in this table	Minor
Hydrogeology	Water resource consumption	- Additional pressure on the groudwater resource availability	Major	- Investigate the geology of the multi-layered aquifer via the excavation of a geological well reaching the Maastrichtian aquifer - Perform a pumping test in the Maastrichtian aquifer while monitoring wells in Paleocene and Continental Terminal aquifers - Monitor water consumption from borewells during the lifetime of PIA Phase 2 project, including all activities	Major

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Impact importance	Mitigation measure	Residual impact
				- Prefer dry cleaning of the PV modules instead of cleaning them using water. - In a context of the water resource become scarcer, additional efforts to recycle water should be implemented by PIA by designing and implementing a system to recycle the treated water of the CSTP and allow to reuse it instead of discharge it to the environment. - Weekly piezometric monitoring in a representative set of structures in the communities around PIA Phase 1 and PIA Phase 2 ; - Monitoring of villagers' complaints about the lack of water resources - Compensation measure: Carry out water stewardship/water neutrality studies adopting internationally recognized standards (such as WAS standard) to identify, evaluate and quantify compensation measures (which may include increasing availability of water to the population, increasing water infiltration on the watershed scale, adapting the reuse rate of PIA users, …).	
	Liquid discharges Solid waste management	- Groundwater quality contamination by the waste leachate infiltrating through the ground	Moderate	- For solid waste management measures, refer to soil section, above in this table	Minor
	Sludge management	- Groundwater quality contamination by leachate resulting from sludge treatment (composting)	Major	- For sludge management measures, refer to soil section, above in this table	Minor
Landscape	Project footprint	- Loss of existing visual amenity - Modification of existing visual amenity as a result of the installation of lightening systems	Moderate	- Obligation to fulfil a dedicated ESIA for each industry establishing in the area. Impacts and measures related to noise emissions shall be studied and assessed appropriately, - Open green spaces maintenance operations will begin after planting. Planting beds will be kept free of weed, grass and other undesired vegetation growth. In general, maintenance of all spaces under the PIA responsibilities has to be managed appropriately. - Any lightening requirements should be designed to ensure light spill is directed into the site. Lighting at night shall be maintained at a minimum. - Revegetate the area underneath and around solar panels with native plants. Plant trees and bushes along the PV plant perimeter to reduce the	Minor

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Impact importance	Mitigation measure	Residual impact
				visual impact. The choice of appropriate plants and trees should be made by an expert in flora to adapt to the local context as well to the need of the solar plant (in terms of maintenance). - The proper application of the waste management plan will ensure the maintain of the landscape conditions.	
Habitat and floristic richness	Accidental situations	- Loss of habitat or floristic richness due to the mismanagement of wastewater / stormwater reaching the natural environment via the discharge/outfall points	Moderate	- Refer to measures defined for the management of storm- and wastewater	Minor
Faunistic richness	Accidental situations Traffic	- Death or injury of animals due to accidental collision with vehicles - Loss of fauna due to the mismanagement of wastewater / stormwater reaching the natural environment via the discharge/outfall points	Moderate	- Refer to measures defined for the management of storm- and wastewater	Minor
	Project footprint	- Loss of transit corridors for large wildlife due to site fencing - Death or injury of birds due tocollision with panels or transmission lines or electrocution	Minor	- Use grazing and not chemicals to retard re-growth of vegetation both in the IZ green areas and the solar park - Ensure an effective waste selective sorting, and an appropriate storage of organic waste in the compost trenches. These, as well as the waste transfer centers, must be appropriately fenced out to limit any access to small fauna (particularly rats and pests)	Minor
Access to energy	Project footprint (solar park)	- Expansion of the access to energy to national population resulting in a broader access to economic opportunities and improvement of living condition	Positive	-	
Economic activities, livelihood, employment	Job creation	- Creation of 5000 to 7000 jobs by the PIA project	Positive	- Implementation of awareness campaigns involving local authorities on supply opportunities among local farmers and service providers; - Development in the LRP, if relevant, of training allowing PAPs to improve the quality of their agricultural production in order to favour their inclusion in the supply chains of the operators operating within the project;	

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Impact importance	Mitigation measure	Residual impact
				- Partnership with local training centres for training and recruitment of trainees; - Creation of recruitment offices or connection between the project's economic operators and local recruitment offices if these are already in place, with priority given to people affected by the project with equal skills; - Inclusion of local recruitment clauses in the PIA operational guidelines; - Establishment of a complaints management mechanism and stakeholder engagement plan - Investigate the possibility to implement agrovoltaics (or agrophotovoltaics) strategies such as using the ground beneath the solar panels to graze animals or grow crops.	
Social climate	Recruitment of workers and contractors	- Appearance of social tensions following the recruitment of staff from outside the area or the use of external service providers; - Acts of vandalism and damage.	Moderate	- Establishment of recruitment offices or the establishment of connections between the project's economic operators and local recruitment offices if these are already in place, with priority given to people affected by the project with equal skills; - Setting up a transparent procedure for the management and communication of tenders with local subcontractors via the commune and local communication media (radio, newspapers, notice board); - Partnership with local training centres for training and recruitment of trainees; - Implementation of training programmes for PAPs in the framework of the LRP for occupations related to the exploitation phase; - Inclusion of local recruitment clauses in PIA's operational guidelines; - Priority use of subcontractors based in the Adétikopé region if economically and technically reasonable; - Establishment of a complaints management mechanism and stakeholder engagement plan	Minor
Women and vulnerable people	Employment	- Discrimination in employment; - Harassment on and off site; - Increase in gender-based violence or violence against vulnerable people.	Moderate	- Compliance with the standards set by ILO conventions and national legislation concerning discrimination against women and people with disabilities; - Positive discrimination measures favouring the employment of women and disabled people;	Minor

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Impact importance	Mitigation measure	Residual impact
				- Dedicated infrastructure (e.g. women's toilets and changing rooms) or adapted infrastructure (stairs with ramps, etc.); - Provision of adapted PPE for women; - Street lighting in selected areas to improve safety; - Regular consultations with women and vulnerable people to monitor their socio-economic situation; - Establishment of an employment management plan that promotes female employment, provides for the recruitment of women and equal pay; - Awareness campaigns on gender equality and the principle of non-discrimination; - Strict control to avoid the employment of children under 14 and to ensure that the tasks entrusted to children over 14 do not endanger their physical integrity and health; - Establishment of a community monitoring system for the protection of children; - Mechanism for managing complaints and grievances accessible to workers to monitor the number of cases of harassment or deviant behaviour against women or vulnerable persons; - Inclusion of representatives of women and vulnerable people such as people with disabilities in the monitoring committee of the environmental and social management plan.	
Health, safety and security of workers and the community	Operation activities	- Exposure of site workers to accidents and diseases caused by various factors (HSE risks, noise, traffic, illegal intrusions on site, mismanagement of waste) - Lack of respect of workers' labour rights - Nuisances caused by air emissions (including dust and odors) and noise affecting the populations living in the	Moderate	- include clauses on Occupational hygiene, health and safety of workers in the PIA operating guidelines; - monitor industrial operators' compliance with the PIA operating guidelines; - make PPE available for workers and ensure their effective wearing; - set up and implement an Occupational Hygiene, Health and Safety Plan; - set up and implement a Waste Management Plan and a Hazardous Products Management Plan; - set up and implement a Traffic and Road Safety Plan; - Avoiding the maintenance of vehicles outside working hours;	Minor

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Impact importance	Mitigation measure	Residual impact
		close proximity of the construction site - -		- Use of equipment that meets noise standards; - recruit an HSE coordinator in charge of monitoring the correct application of the plans; - manage the workforce and ensure working conditions in accordance with Togo's national regulations and the ILO conventions ratified by Togo; - Ensure an effective waste selective sorting, and an appropriate storage of organic waste in the compost trenches. These, as well as the waste transfer centers, must be appropriately fenced out to limit any access to small fauna (particularly rats and pests); - Regarding sludge, control the C:N ratio (to be over 25) and ensure a correct aeration of the windrows (mechanical turning of windrows) to avoid emission of odours.	
	Solid waste production Sludge production Liquid discharges	- Degradation of the living environment of local residents in case of porr management of solid waste, sludge or liquid discharges -	Major	- Implementation of a Waste Management Plan; - Development and implementation of a wastewater and effluent management plan - Development and implementation of a Storage and Management Plan for oils, hydrocarbons and other pollutants; - For solid waste and sludge management measures, refer to soil section, above in this table	Minor
	Traffic	- Increased traffic, deterioration of roads and increase in road accidents. - Nuisances related to air emissions and noise due to traffic, affecting the populations living in the close proximity of the construction site	Major	- Carry out a traffic study to properly evaluate the volume of traffic induced by the industrial zone and identify potential improvements required for the transportation system. - Development and implementation of a traffic management plan that takes into account the use of the RN34 road by the population, notably the off-peak and peak periods of use; - Limit the vehicles speed to 30 km/h in all inhabited areas, and, if possible, pave road sections experiencing highest traffic load; - The organisation of informative campaigns in the villages located in the immediate vicinity of the site concerning road safety measures. - Development of specific segments for pedestrians and motorcyclists on accident-prone sections or in the vicinity of infrastructures or places of residence;	Minor

Sensitive component	Impact factor	Description of the potential impact / impactful activity	Impact importance	Mitigation measure	Residual impact
				- Use of road sign signage.	
	Water resource consumption	- Decreased access to water	Major	- Regular monitoring of satisfaction with access and quality of water at sources used by villagers - Regular monitoring of water flow and quality in the villages through pumping tests; - If necessary, construction of additional drinking fountains - Compensation measures :Refer to measures defined in section 6.4.1.5.3.	Major
	Atmospheric emissions	- Nuisances related to air emissions affecting the populations living in the close proximity of the construction site	Moderate	- Use of low emission recent vehicles; - Inserting air quality and noise pollution clauses in PIA's operational guidelines; - Monitoring of operators' compliance with PIA's operational guidelines.	Minor
	Accidental situations	- Industrial accidents	Moderate	- Development of an industrial risk prevention and management plan; - Development of an awareness campaign for the villages concerned on the behaviour to adopt in case of industrial accident	Minor
Waste management infrastructure	Solid waste management	- Increased pressure on the already weak existing waste management infrastructure	Major	- Carry out a Waste Management Infrastructure Analysis to assess the actual and global capacity of the existing regional/national waste management infrastructure to manage, on the long term, the amount of waste produced by PIA operations (including hazardous and non hazardous waste). - Investigate the technical and financial feasibility to build an additional waste management facility (or extend an existing one) specifically intended to the disposal of PIA operations waste; - Compensation measures: Implement the possibility for neighbouring communities to have access to PIA waste management infrastructure (collection and disposal)	Moderate

6.5. Impacts and measures during decommissioning phase

This phase involves the end of operation of some or all the shared utilities and common infrastructure of the IZ (electric system, water supply system and wastewater treatment plant, etc.) as well as the various industries that will lease a plot to PIA.

The main activities involved include the dismantlement of building components, specifically for reuse, repurposing, recycling and waste management. Deconstruction is followed by demolition of the remaining buildings, the decontamination of the site, the management of waste material and the clearing of the site coherently with the future identified purpose it will recover.

Impacts

The direct impacts of the deconstruction site will be either:

- The same as those of the construction site (noise, movement of machinery with the risks that this implies on the road, soil and underground water, waste);
- Or lower than those of the construction site (access roads already in place, waste management system furtherly developed).

- For impacts of the construction phase, refer to section 6.3.

Recycling linked to dismantling will take place in several years; this problem is anticipated from the project phase by selecting easily recyclable technologies. As the industries that will be implanted are not know yet, an assessment of their deconstruction is not feasible.

As for the solar plant and power transmission line, the materials adopted are largely recyclable:

- photovoltaic modules are made up of more than 85% of glass, aluminum and crystalline silicon cell, all easily recyclable materials;
- the support structures for the modules and anchoring piles are in steel, an easily recyclable material;
- electrical equipment is mainly composed of copper, glass, aluminum, etc. and fully recyclable.

Note that with dismantling taking place at least in 20 years, new techniques and technologies may be available thus allowing to optimize the recycling of modules.

Measures

The works of the deconstruction/dismantling phase will use the same techniques and the same means as the construction phase. Therefore, the environmental protection measures taken will be, for the most part, the same as during the construction phase. They will consist above all in ensuring soil protection (erosion, pollution and runoff) and in ensuring adequate waste management. The paths will have already been created and / or improved.

Finally, PIA should ask the industries that will rent a plont of PIA Phase 2 IZ to comply with sustainable construction principles thus allowing a proper and efficient deconstruction at the end of life. ESIA of each industries should also take into account the deconstruction phase.

6.6. Impacts on the ecosystem services

6.6.1. Ecosystem services assessment

The table on the following pages assesses ecosystem services present in the study area and identify priority ones.

In the table, the column “Presence of the service” gives information on the effective presence of the service in the study area, while the column “Use of the service” details the use made of the service.

For type I services, whenever columns “Impact of the project on the service”; “Consequences for the communities”; “Management or influence on the service by the project”; bear the mention YES, then the service is regarded as priority type I.

For type II services, whenever columns “Dependency of the project on the service” and “Management or influence on the service by the project” bear the mention YES, then the service is regarded as priority type II.

Table 141 Ecosystem services assessement (ESA)

Type of service	Presence of the service	Use of the service	Impact of the project on the service	Consequences for the communities	Dependency of the project on the service	The project has an influence over the management of the service	Priority of the service and type of priority
PROVISIONING							
Farmland	Yes	Cultivation of cereals, tubers, fruit trees and vegetable crops	Yes	Yes	No	Yes	Priority type 1
Pasture land	Yes	Grazing of transhumant and sedentary oxen	Yes	Yes	No	Yes	Priority type 1
Halieutic resources	No	No	No	No	No	No	No
Sand and gravels	Yes	Sand and gravel quarries	Yes	No	No	Yes	No
Aquaculture	No	No	No	No	No	No	No
Wild food: hunting and gathering	Yes	Practiced in a limited way	Yes	No	No	Yes	No
Biochemical products, natural medicine and pharmaceutical products	Yes	Medicinal plants used by resident populations for the treatment of diseases and for sale in local markets	Yes	Yes	No	Yes	Priority type 1
Wood and wood fibers (teak, eucalyptus, palm tree leaves, raffia)	No	No	No	No	No	No	No
Other fibers	No	No	No	No	No	No	No
Fuel	Yes	Some limited firewood collection	Yes	Yes	No	Yes	Priority type 1
Fresh water	Yes	Fishing	Yes	Yes	No	Yes	Priority type 1

Type of service	Presence of the service	Use of the service	Impact of the project on the service	Consequences for the communities	Dependency of the project on the service	The project has an influence over the management of the service	Priority of the service and type of priority
Genetic resources	No	No	No	No	No	No	No
Groundwater	Yes	Yes	Yes	Yes	No	Yes	Priority type 1
CULTURAL							
Sacred sites	Yes	Yes	Yes	Yes	No	Yes	Priority type 1
Religious areas	Yes	Yes	Yes	Yes	No	Yes	Priority type 1
Recreational, tourism or leisure areas	No	No	No	No	No	No	No
REGULATION							
Regulation of air quality	No	No	No	No	No	No	No
Regulation of global climate Regulation of regional/local climate	No	No	No	No	No	No	No
Regulation of water	No	No	No	No	No	No	No
Regulation of erosion	No	No	No	No	No	No	No
Water purification and waste treatment	No	No	No	No	No	No	No
Disease regulation	No	No	No	No	No	No	No
Pest regulation	No	No	No	No	No	No	No
Pollination	Yes	Swarms of bees and other pollinating insects	Yes	No	No	Yes	No

Type of service	Presence of the service	Use of the service	Impact of the project on the service	Consequences for the communities	Dependency of the project on the service	The project has an influence over the management of the service	Priority of the service and type of priority
Natural catastrophes regulation	Yes	Yes Indirect use. Large agricultural/fallow area favouring water infiltration in the soil	Yes Soil sealing reducing water infiltration	Yes Risk of increased frequency and/or intensity of flooding events	No	Yes	Priority type 1
SUPPORT							
Capture and recycling of nutrients	No	No	No	No	No	No	No
Primary production	No	No	No	No	No	No	No
Connexions for genetic exchanges	No	No	No	No	No	No	No

6.6.2. Mitigation measures

The analysis reveals that there are in the study area several ecosystem services of priority 1 which are:

- **Provisioning services**: farmland, pasture land, natural medicine, fuel (firewood collection), fresh water.
- **Cultural services**: sacred and religious sites
- **Regulating services**: natural catastrophes regulation (flood regulation).

With regard to impacts on provisioning services:

- Impacts on farmland, pasture land and natural medicine are mostly related to change in land use as well as land clearing. These impacts are mainly analysed in section 6.2.3.2. , fuel (firewood collection),
- Impacts on fresh water (and specifically the Togo Lake) are related to the effluents of the Project finally reaching the Lake after being released in the environment. These impacts are mostly linked to accidental situations or mismanagement of the CETP, even if chronicle effects due to the accumulation over time of substances coming from the industrial zone may as well appear. These impacts are analysed in section 6.4.2.
- **Cultural services**: sacred and religious sites

The impacts on cultural services, and in particular the relocation of an existing church, have been descrived in section 6.2.3.3.

Impacts on regulating services, and in particular the effects on floods have been analysed in sections 6.3.1.1 and 6.4.1.1.

A set of measures already proposed in the sections6.2, 6.3 and 6.4 (physical, biological and human environments for preparation, construction and operation phase) help to avoid, reduce and compensate for the impacts on provisioning, cultural and regulating ecosystem services impacted. The measures planned for social aspects also respond to these challenges. No need for additional measures is identified in this section.

6.7. Project impact matrix

The interrelation between the sources of impact and the environmental components likely to be affected by PIA Phase 2 project is presented in the following matrix, offering a synthetic view of the project impacts by displaying impact factors in columns and sensible components (physical, natural and human environment) in rows.

Table 142 Project impact matrix

NO IMPACT		POSITIVE IMPACT	
NEGLIGIBLE	MINOR	MODERATE	MAJOR

Se = sensitivity of the environment
Imp = Importance = Se x I
I= Intensity of the impact
Negatif = 1 to 4
Positif= P

		PREPARATION	CONSTRUCTION							OPERATION								
		Project land acquisition	Civil works, including land clearing	Traffic	Solid waste production	Green waste production	Liquid discharges production	Employment (spontaneous migration)	Resources consumption (energy, water)	Project footprint / Easement of IZ	Atmospheric emission	Solid waste production	Sludge production	Liquid discharges production	Resources consumption (energy, water)	Traffic	Employment	Accidental situation (spillage, technological accidents, etc.)
Physical environment	Climate and climate change related risks																	
	Geology, topography and soils																	
	Air quality																	
	Noise																	
	Hydrology (surface water quality and availability)																	
	Hydrogeology (groundwater quality and availability																	
	Landscape																	
Natural environment	Habitat and flora																	
	Fauna																	
Human environment	Demographic balance and migrations																	
	Women and gender issues																	
	Vulnerable groups																	
	Land tenure and land use																	
	Economic activities, livelihoods and local economy (employment)																	
	Social climate																	
	Housing and settlements																	
	Health and Safety of workers and communities																	
	Cultural Heritage																	
	Archaeological heritage																	
	Waste management Infrustructure																	

6.8. Residual impact matrix

The interrelation between the sources of impact and the environmental components likely to be affected by PIA Project, after implementation of mitigation measures is presented in the table below.

Table 143 Residual impact matrix

NO IMPACT	POSITIVE IMPACT
NEGLIGIBLE / MINOR	MODERATE / MAJOR

Se = sensitivity of the environment
Imp = Importance = Se x I
I= Intensity of the impact
Negatif = 1 to 4
Positif= P

		PREPARATION	CONSTRUCTION							OPERATION								
		Project land acquisition	Civil works, including land clearing	Traffic	Solid waste production	Green waste production	Liquid discharges production	Employment (spontaneous migration)	Resources consumption (energy, water)	Project footprint / Easement of IZ	Atmospheric emission	Solid waste production	Sludge production	Liquid discharges production	Resources consumption (energy, water)	Traffic	Employment	Accidental situation (spillage, technological accidents, etc.)
Physical environment	Climate and climate change related risks																	
	Geology, topography and soils																	
	Air quality																	
	Noise																	
	Hydrology (surface water quality and availability)																	
	Hydrogeology (groundwater quality and availability																	
	Landscape																	
Natural environment	Habitat and flora																	
	Fauna																	
Environnement humain	Demographic balance and migrations																	
	Women and gender issues																	
	Vulnerable groups																	
	Land tenure and land use																	
	Economic activities, livelihoods and local economy (employment)																	
	Social climate																	
	Housing and settlements																	
	Health and Safety of workers and communities																	
	Cultural Heritage																	
	Archaeological heritage																	
	Waste management Infrustructure																	

6.9. Rapid cumulative impact assessement

6.9.1. Introduction

Cumulative impacts are an important issue to be considered for the Project. Cumulative impacts are those effects that may result from the combination of past, present or future actions of existing or planned activities. While a single activity may itself result in an insignificant impact, it may, when combined with other impacts (significant or insignificant) in the same geographical area and occurring at the same time, result in a cumulative impact that is significant.

It is important that during the process of identifying environmental and social impacts and risks, the project developer: (a) recognize that the project may contribute to cumulative impacts on Valued Environmental and Social Component (VEC) condition (or "receptors and resources") on which other existing or future developments may also have detrimental effects, and; (b) avoid and/or minimize these impacts to the greatest extent possible. Furthermore, developments may be at risk because of an increase in cumulative effects over ecosystem services they may depend on.

This Cumulative Impact Assessment (CIA) has been performed, as per international guidelines and best practices. The objectives of the CIA are as follows:

- To determine if the combined impacts of the Project, other projects and activities, and natural environmental and social drivers may put the sustainability of a VEC at risk (i.e. exceed a threshold for VEC condition which is an unacceptable outcome); and
- To determine what management measures could be implemented to prevent an unacceptable VEC condition; this may include additional mitigation of the Project being assessed, additional mitigation of other existing or predictable future projects, or other regional management strategies that could maintain VEC condition within acceptable limits.

The overall aim of the CIA is to avoid/minimize any of the identified cumulative impacts.

6.9.2. Methodology

The methodology used in this report is based on the IFC guidebook *Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets* (2013). It follows the main steps of the approach presented in this guide, namely:

1. Determine spatial and temporal boundaries of the analysis
2. Identify valued environmental and social components (CEVs)
3. Identify all the projects that might affect CEVs
4. Determine the baseline status of CEVs
5. Assess cumulative impacts and their importance for each CEVs
6. Develop and implement strategies, plans and procedures to manage cumulative impacts

In line with the Handbook's proposed approach, a Rapid Cumulative Impact Assessment (RCIA) approach is considered to be appropriate for the Project as it considers the challenges to conducting a CIA in an emerging market, which apply in this case, namely:

- Lack of baseline data related to the other project developments;
- Uncertainties associated with anticipated developments; and
- Limited and emergent, strategic regional, sectoral, or integrated resource planning schemes.
- In line with IFC PS 1 guidance notes (GN41) that the assessment will be "*commensurate with the incremental contribution, source, extent, and severity of cumulative impacts anticipated*",

this assessment attempts to focus only on the potentially significant cumulative impacts, and where the Project's contribution to the cumulative impact is considered to be significant. In line guidance provided in Section 2 and 3 of the IFC Handbook, potential mitigation measures are designed to focus on cooperation and information-sharing, in recognition of the limited control and direct influence/ decision-making ability of this private sector sponsor.

The rapid cumulative impact assessment involves a combination of desk-based research and engagement with stakeholders. The identification and management of cumulative impacts are limited to those effects generally recognized as important on the basis of scientific concerns and/ or concerns of affected communities.

6.9.3. Spatial and temporal boundaries

The spatial boundaries are set at the level of 3 municipalities: Dalavé, Kpogamé and Agoe-Nyive 6, which encompass several existing industrial and residential infrastructures and will see the development of additional projects of the same nature.

The temporal boundary is a five-year period for any new projects to be developed in this municipality.

6.9.4. Projects analysed

In the surrounding of PIA site, several industrial developments and companies can be identified as either present or planned in the foreseeabe future. These are not considered exhaustive however:

- Société Nationale des Phosphates du Togo (SNPT): the communities of Kpomé Agomé, Akadjamé, Dzogblakopé, have expressed their concern about the loss of land as a result of the projects developed in the area, in particular following the exploitation of a phosphate deposit that extends from Avéta to Dagbati. By its nature, the extraction and exploitation of ore is an activity with a significant land impact, which will be exacerbated by the development of PIA. In addition, truck traffic and other heavy machinery will further impact on road quality and traffic.
- Diamond Cement Togo (DCT): The cement plant is located approximately 2km northwest of the Project area. The construction and development of this facility has already required the occupation of land owned by villagers. These impacts were mentioned during the consultations in Agbadovinou. In addition, emissions from the project have caused odour and respiratory problems for the inhabitants.
- PIA Phase 1: The first phase of the PIA project will generate impacts similar to those identified and assessed in this study. The impacts will concern in particular the consumption of water resources, waste generation, effluent discharges, employment, influx of workers, impacts on women and vulnerable people, population health and safety, land pressure, and cultural heritage.
- Former sand quarries in the canton of Dalavé.
- Project for the construction of a care centre for people with COVID 19 in the canton of Dalavé.
- ZAAP project (Zone Agricole Aménagée pour le Pâturage - Agricultural Zone Developed for Pasture).
- DO-PHARMA production plant (Dzogblakopé). DO-PHARMA is a pharmaceutical company with modern equipments adopting the most advanced international standards.
- Industrial activites that use ground water resource and may generate air emission (SNB, VOLTIC, TDE, etc.).

6.9.5. Valued environmental and social components

In the physical, natural and human environment surrounding the project area, the following VECs have been identified as particularly sensitive, vulnerable or valuable that warrants their are considered in the cumulative impact assessment.

Table 144 Valued environmental and social components

Environment	Valued environmental and social components
Physical	– Air quality – Hydrology – Hydrogeology – Geology, topography and soils – Landscape
Natural	– Habitats and flora – Fauna
Human	– Land pressure – Loss of residential structures and associated infrastructure – Job creation and economic opportunities – Influx of workers – Impacts on women and vulnerable people – Safety of the population – Community Health – Cultural heritage – Ecosystem services – Waste Management Infrustructure

6.9.6. Cumulative impact assessment

The table below presents a summary of the cumulative impacts stemming from the implementation of the 9 projects in the same spatio-temporal framework. It encompasses the construction and exploitation phase of PIA.
The presented ratings are predicted residual impacts.

Table 145 Cumulative impact assessment

	Physical environment				Natural environment		Human environment							
Composante / Projet	Air quality and noise	Hydrology and hydrogeology	Geology, topography and soils	Landscape	Habitat and flora	Fauna	Ecosystem services	Loss of residential structure	Employment	Spontaneous migration (workers influx)	Women and vulnerable groups	Health and safety of the community (without air and noise emission)	Healt and safety of the community -Air and noise emissions	Cultural heritage
PIA – Phase 2 & Industrial Corridor	Mo	Im	Mo	Mo	Lo	Lo	Mo	Mo	Po	Im	Im	Mo	Lo	Lo
PIA – Phase 1	Mo	Im	Mo	Mo	Lo	Lo	Mo	Mo	Po	Im	Im	Mo	Lo	N
SNPT	Mo	Mo	Im	Mo	Lo	Lo	Lo	Lo	Po	N	N	Mo	Lo	N
DTC	Im	Mo	Mo	Lo	Lo	Lo	Lo	Lo	Po	N	N	Lo	Mo	N
Former sand quarries	N	Lo	Mo	Lo	Lo	Lo	Lo	Lo	N	N	N	N	N	N
COVID 19 care center	N	N	N	N	N	N	N	Lo	Po	Lo	Lo	Lo	Lo	Lo
ZAAP	N	Lo	Lo	N	Po	Po	Po	N	Po	Lo	Po	N	N	N
DO-PHARMA	Lo	Mo	Lo	N	N	N	N	N	N	Lo	N	N	N	N
Industrial ground water users	N	Im	N	N	N	N	N	N	N	N	N	N	N	N
Number of impacting projects	5	8	7	6	5	5	5	6	6	5	4	5	5	2
Interaction type	Add	Syn	Syn	Add	Add	Add	Add	Add	Syn	Syn	Syn	Syn	Add	Add
Potentially significant	**Yes**	**Yes**	**Yes**	**Yes**	No	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No
Additional Mitigation	N	**Y**	**Y**	N	N	N	N	N	N	N	N	Y	N	N

Impact: Positive: **Po**; No impact: N; Low: **Lo**; Moderate: **Mo**; Potentially significant: **Im;**
Interaction: addition: **Add;** Synergy: **Syn;** Opposition: **Ant**[18]
Additional mitigation requirement: Yes: Y; No: N

The potentially most significant cumulative impacts caused by the Project concern the following:

- **Groundwater resource quality and availability**. PIA Phase 1 and Phase 2 are identified as the two projects with the most important impact on the exploitation of the water resource.

  Other industrial activites has been identified as ground water users like SNB, VOLTIC, TDE. In order to analyse cumulative impacts on the ground water resource, an information request has been submitted to the water ministry concerning the already authorized amount of groundwater abstraction. To date, the author did not receive any response to these requests.

[18] Addition addition refers to a summation effect of impacts, without the simultaneity of the projects bringing any additional effect.
Synergy refers to an effect of multiplying the magnitude of the impacts due to the simultaneity of the projects, which then have greater impacts than the simple sum of the impacts.
Opposition refers to the situation in which the effects of project impacts run counter to each other and may partially cancel each other out.

Both PIA Phases, although independent, are located 8km from each other and will use the same Maastrichtian aquifer as the main water supply.

The water demand for PIA Phase 1 is estimated to be 8650 m^3 per day (without planned water re-use) and 3250 m^3 per day (with planned re-use). Based on 6 days working week, 312 working days per year, the yearly water consumption would be 2,67 and 1,01 Mm^3/yr, respectively.

The water demand of PIA Phase 2 and Industrial Corridor is estimated to be 6000 m^3 per day (1.87 Mm^3/yr). The implementation of a system for reusing water would allow to reduce the consumption to 5300 m3/day (1.65 Mm^3/yr).

The combined effect on the water resource is presented in the table here below.

Table 146 Combined effect of PIA Phase 1 and 2 on the aquifers' capacity (source : Agbewornu, 2018 and PIA, 2022)

Aquifer	Capacity (Mm3/yr)	Total groundwater abstracted by current users (Mm3/yr)	Total of water abstracted by PIA Phases I and II without reuse (Mm3/yr)	Total groundwater demand for PIA Phases I and II with reuse (Mm3/yr)
Continental Terminal	12	16,6	-	-
Palaeocene	ND	9	-	-
Maastrichtian	13	6,6	4,55 (71% of the available aquifer capacity)	2,66 (41% of the available aquifer capacity)

As shown on the table here above, the total amount of groundwater needed by the PIA Phases I and II would increase significantly the abstraction from the Maastrichtian aquifer. While the planned reuse of water will help reduce the stress on groundwater resources, more efforts need to be made.

Even if the total groundwater withdrawn from the Maastrichtian aquifer is below its full capacity, uncertainties remain as the aquifer's capacity and water consumptions by current users were evaluated in 2018. Furthermore, the connectivity of the Maastrichtian aquifer with the shallower Continental Terminal and Palaeocene aquifers, which are predominantly used by the communities and industries, has not been studied. If such connectivity exists, this can result in potentially significant indirect cumulative impact on already overexploited and deficient groundwater resources. These effects may furtherly be aggravated by climate change.

The cumulative impact on groundwater quality is strictly related to how each project manages its waste water. We can assume PIA Phase 1 and Phase 2 will be the largest contributors in terms of waste water production. However, being equipped with CETPs, the quality of the treated water released to the environment is expected to be good. Accidental situations or mismanagements may however affect the quality of surface- and groundwater.

- **Soil**. PIA Phase 2 projects will convert 925 ha of agricultural and natural land, a significant part of which will be sealed. The rainwater that currently infiltrates in soil will be accumulated on the surface leading in the increase of the runoff volume. If these volumes are not managed or mismanaged, problems related to flooding or water stagnation could be observed, and trigger other negative impacts, like impacts on human health or water pollution. The volume of water runoff and infiltrated water and in general the hydraulic scheme of the area must be studied at the projects scale in order to properly define scaled measures for the runoff management. We can add that other industries in the area will or already have impact on soil sealing. The issue of managing volume of runoff water need to be treated at the scale of watershed. Lack of data about the runoff water management of each industriy doesn't allow today to have a clear view of the global cumulative impact of soil sealing.

- **Landscape** : Due to their size, PIA Phase 1 and PIA Phase 2 will constitute the largest contributors to the change in local landscape, when compared to other projects. Even if the different projects' impacts will cumulate, the lack of relevant viewpoints (relatively flat topography) will consistently limit the significance of the global impact, that will mainly affect local visual amenity.
- **Air quality:** Due to the future activites on PIA site, a significant increase of the traffic in the area is expected. This traffic will cross traffic from other industries mainly on the main road of the sector (N1). The cumulative increase of air emissions is considered to be moderate (as justified in section 6.4.1.3).
- **Surface water (hydrology):** Depending on whether they are present in the same catchment area or not, the various activities in the area can have a significant cumulative effect on surface water discharges. These can in fact be accumulated at the level of the flow axes of the same catchment area and at the level of the outlet of this catchment area. PIA Phase 1 and PIA Phase 2 are assumed to be the biggest contributors in terms of surface water releases. Based on preliminary analysis, their waters end in the Togo Lake: in the south-west, at a distance of approx. 30 km from PIA Phase 1 outlets and in the north, at 15 km from PIA Phase 2 outlets. The impacts will then finally cumulate. No information is available at a large scale in order to assess a global surface water impact.
- **Human environment:** The analysis shows that land pressure, the influx of workers, health and safety of the population are the main cumulative impacts associated with the development of the Adétikopé economic zone. On the one hand, the development of the Adétikopé Industrial Platform within the peri-urban area located 25 km from Lomé, increases land and natural ressources pressure, thereby limiting the economic activity of the populations of the surrounding villages, which is essentially based on agriculture and livestock. During the consultations, the populations systematically expressed their concern about the availability of land. This pressure will increase as other projects are developed in the area. In addition, the influx of workers will lead to an increase in demography and population density, which will put pressure on social infrastructure such as health services, waste management and access to water and mainly ground water ressource.The operations of PIA Phase 1 and PIA Phase 2 will significantly add pressure on the existing waste management infrastructure, whose capacity and efficacy are questioned. A detailed Waste Management Infrastructure Analysis will need to be carried out to assess the actual and global capacity of the existing regional/national waste management infrastructure to manage, on the long term, the amount of waste produced by PIA operations (including hazardous and non hazardous waste). PIA may investigate the technical and financial feasibility to build an additional waste management facility (or extend an existing one) specifically intended to the disposal of its waste. Such mitigation measures will eventually reduce the pressure on the existing infrastructure.
- Finally, the development of economic activity (PIA and other activites in the area) in the area will certainly lead to an increase in road traffic, water consumption, waste production,….

6.9.7. Additional Mitigation

To mitigate significant cumulative impacts the following strategies and measures are considered necessary:

- **With regard to the groundwater resources availability**, the main recommendation concerns the realisation of pumping tests. This has already been formulated in section 6.4.1.5.3. It is here extended to PIA Phase 1. Hence, we recommend to conduct at least 2 geological reconnaissance drilling reaching the Maastrichtian aquifer, one for PIA Phase 1 and the other for PIA Phase 2, to assess precisely the thicknesses and properties of the aquifers. Futher

realization of 2 pumping tests in the Maastrichtian aquifer (one per each phase) will be needed to monitor water levels PIA Phase I and PIA phase II, and at the same time in other existing (non-PIA) wells associated with the Continental Terminal and Palaeocene aquifers. Finally, water stewardship/water neutrality studies adopting internationally recognized standards (such as WAS standard) will have to be carried out to identify, evaluate and quantify additional mitigation/compensation measures (which may include increasing availability of water to the population, increasing water infiltration on the watershed scale, adapting the reuse rate of PIA users, …).

- **As far as the influx of workers is concerned,** these issues are difficult to manage by the private operators operating in the area. The control of flows and the upgrading of the impacted infrastructures depend essentially on the public authorities. The implementation of transparent recruitment procedures favouring local residents would make it possible to limit the opportunistic influx of workers.
- **As far as land pressure is concerned,** this is once again an issue that is beyond the scope of private operators. The local authorities will have to ensure strategic planning that leaves enough space for the agricultural activity of the villagers, or will have to stimulate the implementation of activities to support the populations towards dynamic and valued sectors of activity (creation of training centres, development of technical sectors).
- **In terms of health and safety,** impacts concerning air emissions, traffic and noise may be managed by the implementation of national ESIAs and monitoring the emissions of each facility. The identified mitigation measures will help reducing risks related to the significant increase in traffic. Additionally, private operators can coordinate in order to set up awareness campaigns on road safety in the villages whose inhabitants often use the RN34.

7. Analysis of the risks of accidents

7.1. Hazard analysis

7.1.1. Hazards related to the external environment

These dangers are related to neighboring external installations and risks of natural origin (earthquake, storm, lightning, flood, etc.). Steps must be taken to ensure that the effects of accidents originating from outside the unit do not reach the unit's installations.

The PIA Phase 2 area is subject to low to moderate risk of flooding because of the difficulty of infiltrating meteoric water which can fall in large quantities on poorly permeable soil, risk amplified by the natural presence of a flood-risk zone in the eastern part of the site area. Infrastructures could be damaged by stagnant water. The project will include the construction of a system to collect and channel runoff due to stormwater.

Despite these measures, the risk of flooding is considered as a potential source of danger.

The risk of lightning also exists. An electric shock can trigger a fire that is detrimental to the installations.

Regarding the seismic risk, as Togo is subject to very low seismic risk, this is not taken into account.

7.1.2. Hazard related to technological environment

PIA and its infrastructures (CSTP and substations) are expected to be located close to industrial activities. Nevertheless, as the industrial activities are unkonwon, no danger potential can be therefore retained.

7.1.3. Hazard related to human environment

PIA and its infrastructures (CSTP and substations) will be surrounded by a wall/fence delimiting access to the infrastructrures and will be guarded by a security team. Maintenance/operational technicians will also be permanently present. Malicious act is not identified as a potential source of danger.

7.1.4. Hazards related to equipment and operations

In this part, the various processes implemented within the framework of the Project are analyzed to determine what are the potential dangers associated with the various equipment and operations. The potential dangers of operations and equipment are determined from the dangerousness of the products used and the operating conditions and possible drifts.

Table 147 Hazard related to operations

Equipment / operation		Identified risk	Means of control
Operation		Start of fire (lightning, overheating of connection cable, short circuit, installation fault, heat, bad storage, etc.)	Choice of quality material Staff training Compliance with strict standards Security systems Maintenance Fire fighting means
Maintenance		Start of fire (work by hot spot, bad handling, etc)	Staff training Fire permit Monitoring after works Fire fighting means
		Spill of product	Staff training Limited product quantity
Machine room	Transformer	Start of fire (short circuit, aging, lightning, etc.)	Electrical equipment to standards Regular maintenance Authorized personnel Automatic shutdown system Fire fighting means
		Oil spill	Watertight and retention room
	Technical area	Inflammable liquid spill	Watertight and retention room Presence of extinguishers in the room
Access road		None	Access control at the entrance of the PIA site
Electric cables		Start of fire (short circuit, aging, lightning, etc.)	Electric cables to standards Buried cables materialized for prior identification in the event of excavation work
Electric line		Fall of electric pole on third parties or installations	Installation of posts outside risk areas Construction according to current standards

7.1.5. Hazard related to products used

The purpose of identifying potential hazards is to identify the hazards associated with products (substances or preparations). This involves qualifying the risks (flammability, toxicity, etc.) presented by the products or substances present or likely to be present on site in significant quantities.

Waste transfer stations:

Product	Storage	Identified risk	Dangers
Dangerous waste	Transfer stations	Waste incompatibility	Explosion Fire Release of flammable, toxic or asphyxiating gases

Wastewater treatment plant

The operation and the products used on the treatment plant are not likely to generate significant risks.

Substations

Product	Storage	Identified risk	Dangers
Oil	In the machine room (transformateur)	Oil leak High flash point, no fire hazard	Pollution
Diesel	In the machine room	Leaking liquid cans and source of ignition	Incendie
SF6	High-voltage equipment	Degradation of air quality	/

7.2. Measures proposed

The proposed measures can be summarized as follows:

- **prevention**: measures taken to limit the risk of nuisance from a disaster, its possible spread and its consequences on the normal operation of the installations;
- **forecast**: measures taken to deal, if necessary, with any disaster with a view to limiting the damage and facilitating the action of the emergency services;
- **intervention**: measures taken with a view to effectively implementing the means of combating the disaster, regulating traffic and the correct evacuation of victims through the existence of an organization for disaster management.

7.2.1.1. Substations

The electrical and electromechanical installations will be constructed according to national/supplier standards and maintained in good condition. They must be checked periodically by a competent technician followed by CEET (Togolese Electric Power Company) agents and the control reports made available to the emergency services.

Substation must have a suitable and sufficient fleet of extinguishers according to the standards, located in appropriate place and safety instructions well applied by the staff. The measures to be followed in the first instance in the event of a fire will be established and communicated.

7.2.1.2. Wastewater treatment plants

The effluents coming from the unit must meet the most stringent threshold values between national and IFC standards for discharge into the natural environment.

7.2.2. Forecast

7.2.2.1. Firefighting measures

Regarding firefighting, it will be necessary to set up:

- a water network consisting of a reserve of water under a certain pressure supplied by a high-capacity booster pump or motor pump;

- firefighting equipment (gas extinguisher, etc.);
- an alarm system;
- fire instructions posted at the site entrance and in risk areas;
- a traffic plan: all arrangements must be made to indicate the direction of traffic for persons and vehicles on the site.

Traffic signs and gates to control entrances and exits will greatly help to regulate traffic in order to avoid accidents on the site.

7.2.2.2. Intervention

The implementation of the listed measures will ensure that the facilities are equipped with adequate means of protection. The provisions in the area of intervention are described below.

7.2.2.2.1. Staff training

The unit's staff will be trained in disaster prevention and the use of fire-fighting equipment, and will undergo periodic simulation exercises. In addition, the site will house a fire fighting station.

7.2.2.2.2. Site emergency response plan

The purpose of the emergency plan is to identify the risks linked to the construction and operation of PIA and to organize the adequate material and human resources to fight against fire, explosion and pollution.

Also, certain events, such as those presented below in a non-exhaustive manner, would trigger the emergency plan:

- serious bodily injury;
- fire or explosion;
- events threatening the natural or biological environment.

During the implementation of the Project, the application of the emergency plan will be ensured by a designated responsible person. The latter must be qualified in terms of security and, during the various meetings that will be organized, the intervention personnel will be informed of the keeping of the plan in question in order to be able to manage an emergency situation.

The site emergency response plan should cover, in line with ARISE ESMS manual, the following aspects:

- Applicable legislation requirements and reference and contact details of local government agencies;
- Identification of emergency situations that may occur;
- Individuals that may be impacted (including communities if any);
- Roles and responsibilities;
- Emergency response Standard Operating Procedures (SOP);
- The provision of equipment and resources and designation ofresponsibilities for emergency preparedness and response;
- Communication procedures, including that with potentially affected communities and local government agencies;
- Periodic training in order to ensure effective response to possible emergency situations;

- Periodic emergency drills, involving Affected Communities and in order to ensure preparedness to possible emergency situations;
- Business continuity and contingency.

This site emergency response plan must be developed in collaboration with the other industrials and communicated to neighboring communities and appropriate stakeholders.

The services of the ANPC should be solicited and put through with the fire station on site. A dedicated communication must be established between the ANPC and PIA.

8. Public consultation and participation

Where affected communities are exposed to the risks and negative impacts of a project, it is important to ensure that a consultation process allows affected communities to express their views freely on the project's risks, impacts and mitigation measures, and that the client considers these views and formulates a response (NP1 §30).

Disclosure or dissemination of information is the provision of information about the project to affected communities and other stakeholders. This information should be provided in the appropriate language(s) (NP1 §29 NO99).

According to the IFC Performance Standard 1 on Environmental and Social Risk and Impact Assessment and Management, stakeholder engagement is the basis for a strong, constructive and responsive relationship that is essential for good management of the environmental and social impacts of a project. For example, disclosure of relevant project information helps affected communities and other stakeholders to understand the risks, impacts and opportunities arising from the project. Effective stakeholder consultation can improve the environmental and social sustainability of the project, its acceptance, and contribute significantly to the successful design and implementation of the project.

The consultations and public participation were opportunities to interact with the previously identified stakeholders to present the project in its various aspects, to discuss their perception of the potential impacts and risks of the project, their fears, expectations and recommendations to the promoters of the Adetikopé Industrial Platform (PIA) to take mitigation measures to reduce the said impacts and risks.

Stakeholder participation can be defined as the involvement of individuals and/or groups of individuals or legal entities, positively or negatively affected by a development project, programme, plan or policy subject to a decision-making process.

Although the ESIA is an appropriate time to carry out preliminary stakeholder consultation, public participation should take place throughout the life of the project and should be planned in advance in order to maximise the positive impacts of such a strategy.

In order to establish such planning, a Stakeholder Engagement Plan (SEP) is usually implemented at the same time as the ESIA. The SEP for the Phase II project is presented in Annex II of the ESIA.

8.1. Objectives of public consultation

The purpose of public consultation and participation is to ensure that the people and groups directly affected by the project, often referred to as stakeholders, receive accurate, clear and transparent information about the project. It is also an opportunity to collect the expectations and grievances of the affected populations in order to provide input to the ESIA process and to propose impact and risk mitigation measures that take into account the expectations and needs expressed by those consulted.

Public opinion plays an important role in the process of assessing the impacts on the environment and on the populations affected by the project. It is distinct from the public hearing procedure, which is a regulatory procedure for the environmental authorities to ensure that there are no major objections to the Project and that the views of stakeholders have been taken into account in the impact assessment.

Public consultation, ultimately, makes it possible to establish the appropriation and effective participation of the populations concerned in the Project in all its phases, and thus to put in place the mechanisms that guarantee their social support, among others, by the Project.

8.2. Consultation process

In order to meet all the stakeholders directly concerned by PIA Phase 2, a participatory approach combining individual interviews and public consultation meetings was deployed.

This approach made it possible to meet with three main types of stakeholders: administrative authorities, traditional authorities and the populations benefiting from and/or affected by the project.

It is in this context that several meetings and interviews were held with local communities and project stakeholders from 15 to 30 September 2021.

8.2.1. Individual consultations

Individual interviews were conducted with 18 stakeholders, as shown in the table below. These stakeholders were interviewed either because they were essential to the project's operation or because they might have an interest in the project or be affected by it.

Table 148 List of individual stakeholders interviewed

	Municipality/Village	Organisation	Institution or person met	Meeting date
1	Agoe	Agoe Nyivé Prefecture	Prefect's Secretary General	15/09/2021
2	Tsévié	Zio Prefecture	Prefect of Zio and Secretary General	15/09/2021
3	Tsévié	Zio 1 municipality	Secretary general	15/09/2021
4	Lomé	Regional/Prefectural Department of Social Action	Prefectural Director of the Ministry of Social Action	29/09/2021
5	Lomé	Ad hoc commitee	Member of the Ad Hoc Committee	29/09/2021
6	Kpomé	Traditional chieftaincy	Kpomé canton chief	18/09/2021
7	Dalavé	Traditional chieftaincy	Dalavé canton chief	18/09/2021
8	Hagblévou	Traditional chieftaincy	Hagblévou and Gnatikopé village chief	21/09/2021
9	Tokpanou	Traditional chieftaincy	Tokpanou village chief	22/09/2021
10	Agbadovinou	Traditional chieftaincy	Agbadovinou village chief	24/09/2021
11	Vondjogbékopé	Traditional chieftaincy	Vondjogbékopé village chief	23/09/2021
12	Akadjamé	Traditional chieftaincy	Akadjamé village chief	20/09/2021
13	Djogblakopé	Traditional chieftaincy	Djogblakopé village chief	23/09/2021
14	Kpomé Agomé	Traditional chieftaincy	Kpomé Agomé village chief	22/09/2021
15	Fiogblé	Traditional chieftaincy	Fiogblé village chief	24/09/2021
16	Lomé	National Environmental Management Agency ANGE	Studies Officer (ESIA, Audit and Monitoring of ESMP implementation)	30/09/2021

	Municipality/Village	Organisation	Institution or person met	Meeting date
17	Lomé	Expropriation Committee COMEX	Member of the Executive Committee In charge of receiving and registering files	30/09/2021
18	Tsévié	Civil society organisation in Zio (NGO)	Executive Director of the NGO EQUINAT	26/09/2021

8.2.2. Public consultation meetings

Public information meetings were held in the 10 villages and hamlets surrounding the project site. The table below shows the public consultations held:

Table 149 List of public information meetings held

Village	Date	Duration of meeting	Number of participants	Men	Women
Hagblévou and Gnatikopé	21/09/2021	2h 30min	67	33	34
Akadjamé	20/09/2021	2h 15min	50	46	04
Tokpanou	22/09/2021	2h 03 min	40	30	10
Agbadovinou	24/09/2021	2h30 min	21	10	11
Vondjogbékopé	22/09/2021	2h 05 min	09	08	01
Djogblakopé et Afloacondji	23/09/2021	2h 10min	14	10	04
Fiogblé	24/09/2021	2h 16 min	14	09	05
Kpomé Agomé	22/09/2021	1h 05 min	41	36	05

A few images from the consultations are shown below.

Each meeting followed this agenda:

- Presentation of the project and the main positive or negative impacts identified and discussion on the corrective measures to be proposed.

Potential positive impacts include: job creation and poverty reduction, increased production and economic growth, reduction of the isolation of the area, creation of an economic growth zone, etc.

However, this project will also have negative impacts: loss of agricultural land, loss of means of subsistence, risk of conflicts and grievances, risk of depravation of morals, risk of gender-based violence, risk of discrimination, risk of violence against children, risk of loss of material and/or immaterial goods, etc., pressure on water and energy resources, degradation of biodiversity, etc.

- Presentation of the environmental and social assessment procedure.

In accordance with Article 38 of the Framework Law on the Environment in Togo and in line with Decree N°2017-040/PR setting out the ESIA procedures, the promoter of the PIA project must carry out an ESIA as part of the implementation of this project in order to obtain the environmental and social compliance certificate authorising it to carry out its project in compliance with the regulations in force. Emphasis was placed on the need and interest of conducting this procedure with the involvement of stakeholders in accordance with the principle of participation in the execution of development projects. This impact assessment is therefore a prerequisite for evaluating the environmental and social repercussions of the project on the lives of the populations affected and those living near the site, with a view to recommending corrective and mitigating measures.

- Question and answer sessions and collection of people's preoccupations, complaints and expectations

It should be noted that the health context led the team to take protective measures (barrier measures) to prevent the spread of the pandemic to COVID-19 during the meetings. These included the installation of a hand-washing facility with soap, the provision and wearing of nosecovers by all participants, the provision and use of hydroalcoholic gelique.

Figure 116 COVID 19 protection device

8.2.3. Summary of the concerns and wishes expressed

The main issues raised by the participants were:

- Physical and economic displacement:

  The issue of people being affected by physical and/or economic displacement has been addressed.

  The loss of agricultural land (physical displacement) raises concerns about restoring the livelihoods of people affected by the project.

  Fears and concerns were raised about the RAP process: some participants pointed out that they were not involved in the process of identifying PAPs and compensating them, others stated that they had not been compensated (to be verified), and still others found the amount of compensation insufficient.

- **Community health and safety:** People expressed concerns about a number of potential impacts on their health and safety. These include the risk of accidents on the site and on roads/tracks in the area, the harmful effect of industrial gases, noise pollution (machine noise), degradation of air quality (dust), the production of effluents and waste, etc.
- **Tesocial tensions:** risk of loss of cultural values, habits and customs of the area.
- **Employment** : The need to take into account the local workforce and the priority of recruiting this workforce, pointing out that the SNPT, which has been in place since 1963, has made commitments in terms of local employment that have not been kept, leaving the youth of Akadjamé, for example, very dubious about the promise of local employment, but at the same time very concerned about this aspect. Some went so far as to say that if young people are not recruited by PIA when they no longer have cultivable land, they could interfere with the running of project activities.
- **Environment and Biodiversity:** Concerns have been raised in relation to the cutting down of trees and destruction of vegetation cover on the Phase 2 site and its potential contribution to climate change.
- **ESIA:** People are concerned about the respect of commitments made in the impact assessment by the promoters. Some people have stated that once the environmental certificate of conformity has been issued, the developer no longer keeps the commitments made. The example of SNPT came up several times, putting the population in a state of anger and doubt about the good faith of PIA. This state of mind is reflected in the following proverb: "When a snake has bitten you, you should be afraid of the earthworm".
- **Contribution to local development:** The populations have formulated requests for contribution to local development. These include:
  - Rehabilitation of village roads and tracks;
  - Construction of well-equipped health centres
  - Construction of markets;
  - Water supply;
  - Construction of a leisure centre.

For each meeting, transcripts were prepared and signed by the local authorities, as well as attendance lists signed by the participants. These are presented at the Annexe III.

8.2.4. Inclusion in the ESIA

The following measures were included in the ESIA in response to the wishes and expectations expressed by local people:

- Development of a LRP for the populations affected by the Project;
- Various measures to reduce the nuisance created by the future industrial zone;
- Local recruitment programme;
- Environmental protection measures;
- Proposal for the development of a Local Development Plan to support infrastructure development in the villages.

8.3. ESIA disclosure consultation process

ESIA disclosure consultations will be conducted after the ESIA report has been approved by the client.

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ANNEXES

Annexe I Terms of reference for the ESIA « Plate-forme industrielle d'Adetikope »

Annexe II Stakeholder Engagement Plan (SEP)

Annexe III Transcripts and attendance lists of public consultations – preliminary consultations

Annexe IV Protected fauna and flora in Togo

Annexe V Analysis and measurement report (air, soil and water)

Annexe VI PIA Title of ownership

Annexe VII Site topographic map

Annexe VIII Flora species identified on site

Especes	Familles	TB	TP	Statut IUCN
Abelmoschus esculentus (L.) Moench	Malvaceae	np	I	NE
Abutilon mauritianum (Jacq.) Medic.	Malvaceae			NE
Acacia auriculiformis A. Cunn. ex Benth.	Leguminosae-Mimosoideae	mp	I	LC
Acanthospermum hispidum DC.	Asteraceae	Th	GC-SZ	NE
Achyranthes aspera L. var. aspera	Amaranthaceae	Th	GC-SZ	NE
Adansonia digitata L.	Bombacaceae	m_P	SZ	NE
Ageratum conyzoides L.	Asteraceae	Th	GC-SZ	LC
Albizia adianthifolia (Schumach.) W.F. Wright	Leguminosae-Mimosoideae	m_P	GC	LC
Alternanthera pungens Kunth	Amaranthaceae	Ch	GC-SZ	NA
Amaranthus spinosus L.	Amaranthaceae	Th	GC-SZ	NE
Ampelocissus grantii (Baker) Planch.	Vitaceae	Lmp	GC	NE
Andropogon africanus Franch.	Poaceae	H	SZ	NE
Antiaris africana Engl.	Moraceae	m_P	GC-SZ	NE
Arachis hypogaea L.	Malvaceae			NE
Aspilia africana (Pers.) Adams	Asteraceae	np	SZ	NE
Azadirachta indica A.Juss.	Meliaceae	mp	I	LC
Azadirachta indica A.Juss.	Meliace+G2:G25ae	mp	I	NE
Bidens pilosa L.	Asteraceae	Th	GC-SZ	NE
Boerhavia diffusa L.	Nyctaginaceae	np	GC	NE
Brachiaria deflexa (Schumach.) C.E.Hubb. ex Robyns	Poaceae	Th	SZ	NE
Brachiaria jubata (Fig. & De Not.) Stapf	Poaceae	Th	SZ	NE
Brachiaria lata (Schumach.) C.E.Hubb.	Poaceae	Th	SZ	NT
Cajanus cajan (L.) Millsp.	Leguminosae-Papilionoideae	np	I	NE
Calopogonium mucunoides Desv.	Leguminosae-Papilionoideae	Lmp	GC	NE
Calotropis procera (Aiton) W.T.Aiton	Asclepiadaceae	np	SZ	DD
Carica papaya L.	Caryophyllaceae	mp	I	LC
Ceiba pentandra (L.) Gaertn.	Bombacaceae	M P	GC-SZ	NE
Celosia argentea L. var. argentea	Amaranthaceae	Th	GC-SZ	NE
Chloris barbata Sw.	Poaceae	Th	GC	NE
Chromolaena odorata (L.) R.M.King	Asteraceae	np	GC	NE
Citrullus colocynthis (L.) Sehrad.	Cucurbitaceae	Lnp	I	LC
Commelina benghalensis L.	Commelinaceae	Ch	GC-SZ	LC
Commelina erecta L. ssp. erecta	Commelinaceae	Ch	GC-SZ	NE
Commelina forskalaei Vahl	Commelinaceae	Ch	GC-SZ	NE
Corchorus olitorius L.	Tiliaceae	Th	GC-SZ	NE
Corchorus tridens L.	Tiliaceae	Th	GC-SZ	NE
Crotalaria retusa L.	Leguminosae-Papilionoideae	np	GC-SZ	NE
Croton hirtus L'Her.	Euphorbiaceae	Th	GC-SZ	NE
Croton lobatus L.	Euphorbiaceae	Th	GC-SZ	NE
Cucumis melo L. subsp. agrestis (Naudin) Pangalo	Cucurbitaceae	Lnp	GC-SZ	NE

Especes	Familles	TB	TP	Statut IUCN
Cucumis melo L. subsp. melo	Cucurbitaceae	Lnp	I	LC
Cyperus alopecuroides Rottb.	Cyperaceae	Gr	I	LC
Cyperus iria L.	Cyperaceae	H	GC-SZ	LC
Cyperus reduncus Hochst. ex Boeck.	Cyperaceae	H	SZ	LC
Cyperus rotundus L.	Cyperaceae	H	GC-SZ	NE
Dactyloctenium aegyptium (L.) Willd.	Poaceae	H	GC-SZ	NE
Desmodium gangeticum (L.) DC. var. gangeticum	Leguminosae	np	GC-SZ	NE
Desmodium gangeticum (L.) nc. var. gangeticum	Leguminosae	Th	GC-SZ	NE
Desmodium tortuosum (Sw.) DC.	Leguminosae	np	GC-SZ	NE
Desmodium velutinum (Willd.) DC.	Leguminosae	Th	GC-SZ	LC
Dichrostachys cinerea (L.) Wight & Am.	Leguminosae-Mimosoideae	mp	GC-SZ	NE
Digitaria horizontalis Willd. ar. porrhanta (Steud.) Henr. ex Hubb. & Vaughan	Poaceae	H	GC-SZ	NE
Digitaria leptorhachis (Pilger) Stapf	Poaceae	H	GC-SZ	NE
Diodia sarmentosa Sw.	Rubiaceae	Lnp	GC-SZ	LC
Dioscorea togoensis Knuth	Dioscoreaceae	G	GC-SZ	LC
Echinochloa colona (L.) Link	Poaceae	Th	GC-SZ	LC
Elaeis guineensis Jacq.	Arecaceae	m_P	GC	LC
Eleusine indica (L.) Gaertn.	Poaceae	Th	GC-SZ	NE
Eleutheranthera ruderalis (Sw.) Sch.Bip.	Asteraceae	Th	GC	NE
Emilia coccinea (Sims) G.Don	Asteraceae	Th	GC	NE
Emilia lisowskiana C.Jeffrey	Asteraceae	Th	GC	NE
Enydra radicans (Willd.) Lack	Compositae	Hyd	GC-SZ	NE
Eragrostis amabilis (L.) Wight & Arn. ex Nees	Poaceae	Th	GC-SZ	NE
Eragrostis ciliaris (L.) R.Br.	Poaceae	Th	GC-SZ	NE
Eragrostis tremula (Lam.) Steud.	Poaceae	Th	GC-SZ	NT
Eucalyptus camaldulensis Dehn.	Myrtaceae	m_P	I	NE
Euphorbia heterophylla L.	Euphorbiaceae	Th	GC-SZ	NE
Euphorbia hirta L.	Euphorbiaceae	Th	GC-SZ	NE
Euphorbia hyssopifolia L.	Euphorbiaceae	Th	GC-SZ	LC
Ficus benjamina L.	Moraceae	mp	I	LC
Ficus mucuso Ficalho	Moraceae	mp	GC-SZ	LC
Flueggea virosa (Roxb. ex Willd.) Voigt	Euphorbiaceae	np	GC-SZ	NE
Gomphrena celosioides Mart.	Amaranthaceae	Ch	GC-SZ	NE
Heteropogon contortus (L.) P.Beauv.	Poaceae	H	GC-SZ	NE
Hibiscus sabdariffa L.	Malvaceae			DD
Hygrophila laevis (Nees) Lindau	Acanthaceae	np	SZ	NE
Hyptis suaveolens (L.) Poit.	Lamiaceae	np	GC-SZ	LC
Imperata cylindrica (L.) P.Beauv.	Poaceae	Gr	GC-SZ	NE
Indigofera hirsuta L. var. hirsuta	Leguminosae-Papilionoideae	np	GC-SZ	NE
Indigofera tinctoria L. var. tinctoria	Leguminosae-Papilionoideae	np	GC-SZ	LC
Ipomoea aquatica Forssk.	Convolvulaceae	Hyd	GC-SZ	DD
Ipomoea batatas (L.) Lam.	Convolvulaceae	Lnp	I	NE

Especes	Familles	TB	TP	Statut IUCN
Ipomoea eriocarpa R.Br.	Convolvulaceae	Th	SZ	NE
Ipomoea obscura (L.) Ker-Gawl.	Convolvulaceae	Th	GC-SZ	LC
Kyllinga bulbosa P.Beauv.	Cyperaceae	Gr	SZ	NE
Launaea taraxacifolia (Willd.) Amin ex C.Jeffrey	Asteraceae	Th	GC-SZ	LC
Leersia hexandra Sw.	Poaceae	Hyd	GC-SZ	NE
Leptadenia hastata (Pers.) Decne.	Asclepiadaceae	Lmp	GC-SZ	CD
Leucaena leucocephala (Lam.) DC Wit	Leguminosae-Mimosoideae	mp	I	LC
Lonchocarpus sericeus (Poir.) Kunth	Leguminosae-Papilionoideae	Lmp	GC-SZ	NE
Ludwigia decurrens Walt.	Onagraceae	Hyd	GC-SZ	NE
Ludwigia erecta (L.) Hara	Onagraceae	Th	GC-SZ	LC
Ludwigia hyssopifolia (G.Don) Exell	Onagraceae	Th	GC-SZ	LC
Ludwigia octovalvis (Jacq.) Raven ssp. brevisepala (Brenan) Raven	Onagraceae	np	GC-SZ	VU
Mallotus oppositifolius (Geisel.) Müll.Arg. var. oppositifolius	Euphorbiaceae	np	GC-SZ	DD
Manihot esculenta Crantz	Euphorbiaceae	np	I	NE
Mariscus cylindrystachyus Steud.	Cyperaceae	H	GC	NE
Melinis repens (Willd.) Zizka ssp.	Poaceae	H	GC	NT
Milicia excelsa (Welw.) C.C.Berg	Moraceae	m_P	GC-SZ	NE
Mimosa invisa Mart. var. invisa	Leguminosae-Mimosoideae	np	GC-SZ	NE
Mollugo nudicaulis Lam.	Molluginaceae	Th	GC-SZ	NE
Momordica charantia L.	Cucurbitaceae	Lmp	GC-SZ	NE
Morinda lucida Benth.	Rubiaceae	mp	GC-SZ	LC
Mucuna pruriens (L.) DC. var. pruriens	Leguminosae-Papilionoideae	Lmp	GC-SZ	NE
Musa paradisiaca L.	Musaceae	H	I	LC
Oldenlandia corymbosa L.	Rubiaceae	Th	GC-SZ	NE
Panicum maximum Jacq.	Poaceae	H	GC	LC
Paspalum scrobiculatum L.	Poaceae	H	GC-SZ	NE
Paullinia pinnata L.	Poaceae	Lmp	GC-SZ	
Paullinia pinnata L.	Sapindaceae	Lmp	GC-SZ	LC
Pennisetum macrourum Trin.	Poaceae	Th	GC-SZ	NE
Pentodon pentandrus (Schumach. & Thonn.) Vatke var. pentandrus	Rubiaceae	Ch	GC-SZ	LC
Pergularia daemia (Forssk.) Chiov.	Asclepiadaceae	Lnp	GC-SZ	NE
Persicaria senegalensis (Meisn.) Sojak	Portulacaceae	np	GC-SZ	LC
Phyllanthus amarus Schumach. & Thonn.	Euphorbiaceae	Th	GC	LC
Physalis angulata L.	Solanaceae	Th	GC-SZ	LC
Pistia stratiotes L.	Araceae	Hyd	GC-SZ	LC
Pithecellobium dulce (Roxb.) Benth.	Leguminosae-Mimosoideae	mp	I	NE
Portulaca oleracea L.	Portulacaceae	Ch	GC-SZ	LC
Pupalia lappacea (L.) Juss.	Anacardiaceae	np	GC-SZ	NE
Rauvolfia vomitoria Afzel.	Apocynaceae	mp	GC-SZ	NE
Rottboellia cochinchinensis (Lour.) W.D.Clayton	Poaceae	Th	GC-SZ	NE

Especes	Familles	TB	TP	Statut IUCN
Rourea coccinea (Thonn. ex Schumach.) Benth.	Connaraceae	Lnp	GC	NE
Saccharum officinarum L.	Poaceae	np	I	NE
Sarcocephalus latifolius (Sm.) E.A.Bruce	Rubiaceae	mp	GC-SZ	NE
Schrankia leptocarpa DC.	Leguminosae-Mimosoideae	np	GC-SZ	NE
Scoparia dulcis L.	Scrophulariaceae	Th	GC-SZ	NE
Senna hirsuta (L.) H.S.Irwin & Barneby	Leguminosae-Caesalpinioideae	np	GC-SZ	NE
Senna occidentalis (L.) Link	Leguminosae-Caesalpinioideae	np	GC-SZ	NE
Senna tora (L.) Roxb.	Leguminosae-Caesalpinioideae	np	GC-SZ	NE
Sida acuta Burm.f. ssp. acuta	Malvaceae			NE
Sida acuta Burm.f. ssp. carpinifolia (L. f.) Borss.Waalk.)	Malvaceae			NA
Solanum macrocarpon L.	Solanaceae	np	GC-SZ	NE
Solanum melongena L.	Solanaceae	np	I	NE
Sorghum arundinaceum (Willd.) Stapf	Poaceae	H	GC-SZ	LC
Spermacoce radiata (De.) Hiem	Rubiaceae	Th	GC-SZ	NE
Sphenoclea zeylanica Gaertn.	Sphenocleaceae	Hyd	GC-SZ	LC
Spigelia anthelmia L.	Loganiaceae	Th	GC-SZ	NE
Spirodela polyrhiza (L.) Schleiden	Lemnaceae	Hyd	GC-SZ	NE
Sporobolus pyramidalis P.Beauv.	Poaceae	H	GC-SZ	NE
Synedrella nodiflora (L.) Gaertn.	Asteraceae	Th	GC-SZ	LC
Talinum triangulare (Jacq.) Willd.	Primulaceae	np	GC	LC
Tephrosia villosa (L.) Pers. ssp.ehrenbergiana (Schweinf.) Brummitt	Leguminosae-Papilionoideae	np	GC-SZ	LC
Terminalia catappa L.	Combretaceae	mp	I	NE
Terminalia mantaly H.Perrier	Combretaceae	mp	I	LC
Trianthema portulacastrum L.	Amaranthaceae	Ch	GC-SZ	NE
Tribulus terrestris L.	Zygophyllaceae	H	GC-SZ	NE
Tridax procumbens L.	Asteraceae	Ch	GC-SZ	LC
Triumfetta rhomboidea Jacq.	Tiliaceae	np	GC-SZ	NE
Typha domingensis Pers.	Typhaceae	Hyd	GC-SZ	NE
Urena lobata L.	Malvaceae			LC
Vernonia cinerea (L.) Less.	Asteraceae	np	GC-SZ	LC
Vernonia colorata (Willd.) Drake	Asteraceae	np	GC-SZ	NE
Vigna angularis var. nipponensis (Ohwi) Ohwi & H.Ohashi	Leguminosae-Papilionoideae	Lmp	GC-SZ	NE
Vigna angustifolia (Schum. & Thonn.) Hook.f.	Leguminosae-Papilionoideae	Lmp	GC-SZ	NE
Waltheria indica L.	Sterculiaceae	np	GC-SZ	LC
Xenostegia tridentata (L.) Austin & Staples ssp. angustifolia (Jacq.) Lejoly & Lisowski	Convolvulaceae	Lmp	GC	Statut IUCN
Zea mays L.	Poaceae	Th	I	NE

Annexe IX **Content of a Resettlement action plan according to World Bank Performance Standard No. 5**

1. *Description of the project*

General description of the project and identification of the project area

2. *Potential effects*

Identification :

(a) the components or activities of the project that create displacement, explaining why the land retained is to be acquired and used during the life of the project;

(b) the area of impact of these components or activities;

(c) the scope and scale of land acquisitions and the effects of such acquisitions on physical works and other capital assets;

(d) any restrictions imposed by the project on the use of, and access to, land or other natural resources;

(e) alternatives to the project design that are considered to avoid or minimize displacement and the reasons why they have been rejected; and

(f) mechanisms put in place to minimize travel, to the extent possible, during project implementation.

3. *Objectives*

The main objectives of the resettlement program

4. *Census and socio-economic baseline studies*

The findings of a household census to identify and enumerate affected persons and, with the participation of affected persons, to conduct topographical surveys, survey works and other capital assets that may be affected by the project. The census also performs other essential functions:

(a) To identify the characteristics of displaced households, including a description of household structure and the organization of production and work; and to collect baseline data on the livelihoods (including, where appropriate, levels of production and income generated by formal and informal economic activities) and standards of living (including health status) of the displaced population;

(b) Gather information on vulnerable groups or persons for whom special arrangements are likely to be needed;

(c) Identify infrastructure, services or public or collective goods likely to be affected;

(d) Establish a basis for the design and budgeting of the resettlement program;

(e) Establish a basis for excluding persons who are ineligible for compensation and resettlement assistance at the same time as an eligibility deadline is set;

(f) Establish baseline conditions for monitoring and evaluation purposes.

5. *Legal framework*

The results of an analysis of the legal framework, covering:

(a) The extent of the power to expropriate and impose restrictions on land use and the nature of the related compensation, including both the valuation methodology and the time limits for payment;

(b) Applicable legal and administrative procedures, including a description of the means of redress available to displaced persons during legal proceedings and the normal timeframe for such proceedings, as well as any complaint management mechanisms available and applicable under the project;

(c) Laws and regulations concerning the agencies responsible for the implementation of resettlement activities;

(d) Disparities, if any, between local laws and practices regarding expropriation, imposition of land use restrictions and establishment of resettlement measures and the provisions of NES No. 5, as well as mechanisms to address such disparities.

6. *Institutional framework*

(a) Identification of agencies responsible for resettlement activities and NGOs/CSOs likely to play a role in the implementation of the project; including providing assistance to displaced persons;

(b) An assessment of the institutional capacities of these agencies and NGOs/CSOs;

(c) Any proposed measures to strengthen the institutional capacities of agencies and NGOs/CSOs responsible for implementing resettlement activities.

7. *Admissibility*

Definition of displaced persons and criteria for determining their eligibility for compensation and other resettlement assistance, including relevant deadlines.

8. *Assessment of losses and compensations*

The method that should be used to assess losses in order to determine their replacement cost; and a description of the types and levels of compensation proposed for land, natural resources and other assets under local law and the additional measures deemed necessary to achieve replacement cost in each case.

9. *Community Involvement*

Involvement of displaced persons (including host communities, where applicable)

(a) A description of the strategy for consultation and participation of displaced persons in the design and implementation of resettlement activities;

(b) A summary of the views expressed and how these views were taken into account in the preparation of the resettlement plan;

(c) An examination of the resettlement options proposed and the choices made by the IDPs among the options submitted to them;

(d) Institutionalized mechanisms through which displaced persons can convey their concerns to project officials throughout the planning and implementation phases, and measures to ensure that vulnerable groups such as indigenous peoples, ethnic minorities, landless peasants and women are adequately represented.

10. *Schedule for implementation*

An implementation schedule providing the anticipated displacement dates, and an estimate of the start and completion dates of all activities in the relocation plan. This schedule should indicate how the relocation activities are linked to the implementation of the overall project.

11. Cost and budget

Tables presenting cost estimates by line item for all resettlement activities, including adjustments for inflation, population growth and other contingencies; the timing of expenditures; sources of funding; and arrangements for the timely availability of funds and for the funding of resettlement, where applicable, to areas outside the jurisdiction of implementing agencies.

12. *Complaint management mechanism*

The plan describes affordable and accessible procedures for third-party dispute resolution arising from the displacement or resettlement of affected populations; these complaint management mechanisms should take into account the availability of judicial remedies and community and traditional dispute resolution mechanisms.

13. *Monitoring and assessment*

Devices for the monitoring of displacement and resettlement activities by the executing agency, completed by independent controls deemed appropriate by the Bank, to ensure complete and objective information; performance monitoring indicators to measure inputs, outputs and outcomes associated with resettlement activities; participation of the displaced in the monitoring process; evaluation of results within a reasonable period of time after completion of all resettlement activities; using the results of monitoring of resettlement activities to guide further implementation of the project.

14. *Provisions for adaptive management*

The plan should include provisions to adapt the implementation of resettlement activities to unforeseen changes in project conditions, or unexpected difficulties to achieve satisfactory resettlement results.

In case of physical displacement:

1. *Transitional aid*

The plan describes the assistance that will be provided for the relocation of families and their assets (or business equipment and stocks). It also describes any additional assistance required for households that choose to receive cash compensation and to seek alternative accommodation on their own, including the construction of a new home.

Where the sites planned for relocation (for housing or business) cannot yet be occupied at the time of the physical move, the plan shall establish a transitional allowance sufficient to cover temporary rental and other associated costs until such sites are ready.

2. *Site selection, preparation and resettlement*

Where sites for the relocation are to be prepared, the relocation plan shall describe the other relocation sites being considered and the rationale for the selection of the sites selected, including the following elements:

(a) The institutional and technical arrangements in place to identify and prepare resettlement sites, whether rural or urban, whose combination of productive potential, locational advantages and other characteristics is better or at least comparable to the advantages of former sites; together with an estimate of the time required to acquire and dispose of the land and related resources;

(b) The identification and examination of opportunities to improve local living conditions by making additional investments (or establishing mechanisms for sharing the benefits derived from the project) in infrastructure, equipment or services;

(c) All necessary measures to prevent land speculation or the influx of ineligible persons to the selected sites;

(d) Procedures for physical resettlement under the project, including time frames for site preparation and divestment;

(e) The legal modalities for regularization of ownership and transfer of title to resettled persons, including security of tenure for persons who did not have full rights to the land or structures concerned.

3. *Housing, infrastructure and social services*

Plans aimed at providing (or financing the provision to the local community) of housing, infrastructure (e.g. water supply, feeder roads, etc.) and social services (e.g. schools, health centers, etc.); plans to maintain or provide a comparable level of services to the host population; any site development, civil engineering works and architectural plans for such facilities.

4. *Protection and management of the environment*

A description of the boundaries of the proposed relocation sites; and an assessment of the environmental impact of the proposed relocation and measures to mitigate and manage that impact (coordinated as much as possible with the environmental assessment of the main investment occasioning the relocation).

5. Consultation on the terms and conditions of the relocation

The plan describes methods for consulting the physically displaced on their preferences among the resettlement options available to them, including, where appropriate, choices relating to forms of compensation and transitional assistance, the resettlement of single families or pre-existing communities or related groups, the maintenance of group organization patterns, and the relocation of or access to cultural property (e.g. places of worship, pilgrimage centers and cemeteries).

6. *Integration into host communities*

Measures to mitigate the impact of planned resettlement sites on host communities, including:

(a) Consultations with host communities and local authorities;

(b) Arrangements for the prompt payment of any payments due to the hosts for land or other property ceded for the benefit of the proposed resettlement sites;

(c) Provisions for identifying and resolving conflicts that may arise between resettled persons and host communities; and

(d) Any measures necessary to strengthen services (e.g. education, water, health and production services) in host communities to meet the increased demand for such services or to bring them to a level at least comparable to the services available in the planned relocation sites.

In case of economic displacement:

1. *A direct replacement of land*

For people who make a living from farming, the relocation plan offers the option of receiving replacement land of equivalent productive value or demonstrates that sufficient land of equivalent value is not available. Where replacement land is available, the plan describes how and when it will be allocated to the displaced persons.

26. *Loss of access to land or to resources*

For persons whose livelihoods are affected by the loss of land, use of resources or access to land or resources, including communally owned resources, the resettlement plan shall describe the means of obtaining alternative or replacement resources, or otherwise provide support for alternative livelihoods.

2. *Alternative livelihood support*

For all other categories of economically displaced persons, the resettlement plan shall describe possible ways of obtaining employment or setting up a business, including through the provision of appropriate additional assistance, such as vocational training, credit, licences or permits, or specialized equipment.

Where necessary, the livelihood plan shall provide special assistance to women, minorities or vulnerable groups who may find it more difficult than others to pursue alternative livelihoods.

3. *Analysis of economic development opportunities*

The resettlement plan identifies and assesses all opportunities for the promotion of improved livelihoods as a result of the resettlement process. These may include, for example, preferential employment arrangements within the project, support for the development of specialized products or markets, the establishment of trade areas and preferential trade agreements, or other measures. Where appropriate, the plan should also identify the possibility of allocating financial resources to communities, or directly to displaced persons, through the establishment of benefit-sharing mechanisms for the benefits derived from the project.

4. *Transitional assistance*

The resettlement plan provides transitional assistance to those whose livelihoods will be disturbed. This may include payments to compensate for the loss of crops and natural resources, loss of income suffered by businesses or employees affected by the relocation of businesses. The plan provides for this transitional support to continue throughout the transition period.

Annexe X Transcripts and attendance lists of public consultations – consultations of restitution

To be conducted

Annexe XI Photographs from site visit for the dumping site (March 2022, JAT Consulting

D1 - EAST

D1 - NORTH

D1 - SOUTH

D1 - WEST

D2 - EAST

D2 - NORTH

D2 - SOUTH

D2- WEST

D5 - EAST

D5 - NORTH

D5- SOUTH

D5 - WEST

D6 - EAST

D6 - NORTH

D6- SOUTH

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D44 - NORTH

D44 - SOUTH

D44 - WEST

D45 - EAST

D45 - NORTH

D45 - SOUTH

D45 - WEST

D46 - EAST

D46- NORTH

D46 - SOUTH

D46 - WEST

Station	Longitude	Latitude	Habitat
D05	1,337778	6,381993	Plantations
D06	1,3365985	6,3825483	field/fallow
D07	1,3361334	6,383107	Fallow Wetland
D36	1,3353687	6,3837973	field/fallow
D42	1,3302172	6,384471	Wetland Wooded savannah
D12	1,3290637	6,3833439	Constructed area
D46	1,3283581	6,381768	Plantations Field/fallow
D14	1,3274744	6,3817886	Plantations Field
D45	1,3274776	6,3808817	Plantations Field
D44	1,3283307	6,3799652	Shrubby savannah
D15	1,3282194	6,3787343	Plantations
D24	1,3286463	6,3765733	Field fallow
D25	1,3303202	6,3761013	Constructed area
D27	1,3302362	6,3775068	Fields/fallow
D28	1,331052	6,37818	Fields
D31	1,3310319	6,3803789	Plantations

D41	1,3323752	6,380562	Plantations
D42-1	1,334218	6,3816295	Fallow
D39	1,3355754	6,3818458	Fields
D05	1,3377773	6,3819477	Fallow
D35	1,3338962	6,3835835	Wetland
D38	1,3328302	6,3845437	Fiels/fallow
D37	1,33374	6,385422	Wetland Wooded savannah
DO1	1,3323353	6,3866455	Wetland
D02	1,3310611	6,385731	Wetland
D40	1,336466	6,38091	Fallow
D42	1,3302172	6,384471	Wetland / Wooded savanah

Annexe XII Data collected on the boreholes around the PIA site

N°	Code GPS	Date	Lieu-dit (PIA Adétikope/Dalave-kpome)	Coordonnées X (DD)	Coordonnées Y (DD)	Type d'ouvrage (forage, puit, puit foré, piezo)	Type d'équipement (PVC, PEHD, INOX)	Aquifère capté	Niveau statique ou dynamique (m/sol)	Profondeur totale (m)	Débit d'exploitation (m3/h)	Connexion au réseau AEP (oui/non)	Préférence (résau AEP/privé)	Utilisation	Qualité
1	025	17/08/2021	PIA Adetikope	1,218433	6,331721	Puit		Nappe superficielle	7	10		NON	AEP	Ménage	Turbide
2	026	17/08/2021	PIA Adetikope	1,219753	6,331075	Forage	PVC	Continental terminal	22	47	1,68	NON	Privé	Tous usages	Limpide
3	027	17/08/2021	PIA Adetikope	1,223822	6,330174	Puit		Nappe superficielle	15	20		NON	AEP	Tous usages	Turbide par moment
4	028	17/08/2021	PIA Adetikope	1,230139	6,331066	Puit		Nappe superficielle	3,7	8		NON	Privé	Tous usages	Limpide
5	029	17/08/2021	PIA Adetikope	1,2319	6,329993	Forage	PVC	Continental terminal	21	38		NON	Privé	Tous usages	Turbide par moment
6	030	17/08/2021	PIA Adetikope	1,235037	6,330057	Puit		Continental terminal	19	30	1,86	NON	Privé	Industriel	Limpide
7	031	17/08/2021	PIA Adetikope	1,233781	6,336782	Forage	PVC	Continental terminal	23,5	40	2,1	NON	Privé	Tous usages	Limpide
8	032	17/08/2021	PIA Adetikope	1,237661	6,336819	Puit		Nappe superficielle	2,5	6,5		NON	AEP	Tous usages	Turbide par moment
9	033	17/08/2021	PIA Adetikope	1,236939	6,334985	Forage	PVC	Continental terminal		54	1,33	NON	Privé	Tous usages	Limpide
10	034	17/08/2021	PIA Adetikope	1,240662	6,342249	Forage	PVC	Continental terminal	21	35	2	NON	Privé	Tous usages	Limpide
11	035	17/08/2021	PIA Adetikope	1,243673	6,342459	Forage	PVC	Continental terminal	22,6	40	4	NON	Privé	Tous usages	Limpide
12	036	17/08/2021	PIA Adetikope	1,244803	6,346316	Puit		Nappe superficielle	4,5	6		NON	AEP	Tous usages	Turbide
13	037	17/08/2021	PIA Adetikope	1,241359	6,345618	Puit		Nappe superficielle	10,5	13		NON	AEP	Tous usages	Turbide
14	038	18/08/2021	PIA Adetikope	1,236853	6,35182	Forage	PVC	EO_Paléocène	50	75	1,33	NON	Privé	Tous usages	Turbide par moment
15	039	18/08/2021	PIA Adetikope	1,231058	6,356439	Puit		Nappe superficielle	8	10		NON	AEP	Tous usages	Limpide
16	040	18/08/2021	PIA Adetikope	1,230033	6,357318	Forage	PVC	EO_Paléocène	41	81	2,1	NON	Privé	Tous usages	Certifiée
17	041	18/08/2021	PIA Adetikope	1,228414	6,356641	Forage	PVC	Continental terminal		54	1,5	NON	Privé	Tous usages	Turbide par moment
18	042	18/08/2021	PIA Adetikope	1,22481	6,351628	Puit		Nappe superficielle	4,8	8		NON	AEP	Ménage	Turbide
19	043	18/08/2021	PIA Adetikope	1,220834	6,346561	Forage	PVC	Continental terminal		52	0,66	NON	Privé	Tous usages	Turbide par moment
20	044	18/08/2021	PIA Adetikope	1,224499	6,345393	Forage	PVC	EO_Paléocène	56	80	0,93	NON	Privé	Tous usages	Turbide par moment
21	045	18/08/2021	PIA Adetikope	1,227193	6,345894	Puit foré		Nappe superficielle	15,3	16		NON	AEP	Tous usages	Turbide par moment
22	046	18/08/2021	PIA Adetikope	1,221644	6,343607	Puit		Nappe superficielle	15	15,5		NON	AEP	Tous usages	Turbide par moment
23	047	18/08/2021	PIA Adetikope	1,216263	6,342981	Puit foré		Nappe superficielle	12	15		NON	AEP	Tous usages	Turbide par moment
24	048	18/08/2021	PIA Adetikope	1,214589	6,344389	Forage	PVC	EO_Paléocène	51		5	NON	Privé	Tous usages	Limpide
25	049	18/08/2021	PIA Adetikope	1,21704	6,340652	Puit foré	PVC	Nappe superficielle	15	22		NON	Privé	Tous usages	Limpide
26	050	18/08/2021	PIA Adetikope	1,216973	6,338981	Forage	PVC	EO_Paléocène	43	72	3	NON	Privé	Tous usages	Turbide par moment
27	051	18/08/2021	PIA Adetikope	1,219423	6,337887	Puit foré	PVC	Nappe superficielle	13,33	15	3	NON	Privé	Tous usages	Limpide
28	052	18/08/2021	PIA Adetikope	1,223839	6,331312	Forage	PVC	Continental terminal	33,2	51	1,4	NON	Privé	Tous usages	Turbide par moment
29	053	18/08/2021	PIA Adetikope	1,22718	6,334452	Puit		Nappe superficielle	15	17		NON	Privé	Tous usages	Limpide
30	054	19/08/2021	PIA Adetikope	1,228804	6,334034	Forage	PVC	Continental terminal	28,9	45	1,33	NON	Privé	Tous usages	Limpide
31	055	19/08/2021	PIA Adetikope	1,228875	6,334007	Puit		Nappe superficielle	10,53	15,5		NON	Privé	Tous usages	Turbide par moment
32	056	19/08/2021	PIA Adetikope	1,232113	6,338376	Puit		Nappe superficielle	1	3,5		NON	Privé	Tous usages	Limpide
33	057	19/08/2021	PIA Adetikope	1,231765	6,341163	Forage	PVC	Continental terminal	28	41	0,7	NON	Privé	Tous usages	Limpide
34	058	19/08/2021	PIA Adetikope	1,235376	6,331653	Puit foré	PVC	Nappe superficielle	10,5	15	2	NON	Privé	Tous usages	Limpide
35	059	19/08/2021	PIA Adetikope	1,22701	6,327672	Forage	PVC	Continental terminal	38,22	53	1	NON	Privé	Tous usages	Turbide par moment
36	060	19/08/2021	PIA Adetikope	1,224093	6,32615	Forage	PVC	Continental terminal	34,6	55	1,68	NON	AEP	Ménage+Cuisine	Turbide par moment
37	061	19/08/2021	PIA Adetikope	1,22063	6,327399	Forage	PVC	Continental terminal	16,2	35	2	NON	Privé	Tous usages	Limpide
38	062	19/08/2021	PIA Adetikope	1,221054	6,340471	Forage	PVC	EO_Paléocène	43	75	2,4	NON	AEP	Tous usages	Turbide par moment
39	063	19/08/2021	PIA Adetikope	1,230182	6,35179	Forage	PVC	EO_Paléocène	45	73	1,68	NON	Privé	Tous usages	Limpide
40	064	19/08/2021	PIA Adetikope	1,21126	6,342879	Forage	PVC	EO_Paléocène	38	60	2,4	NON	AEP	Tous usages	Limpide
41	065	19/08/2021	PIA Adetikope	1,209507	6,339199	Forage	PVC	EO_Paléocène	25	55	1,4	NON	AEP	Tous usages	Limpide
42	066	19/08/2021	PIA Adetikope	1,215259	6,33599	Forage	PVC	EO_Paléocène	47	66	1,5	NON	Privé	Tous usages	Turbide par moment
43	067	19/08/2021	PIA Adetikope	1,215745	6,327445	Forage	PVC	Continental terminal	21	30	2	NON	AEP	Tous usages	Limpide
44	068	21/08/2021	AGBADOVINOU	1,2859	6,362985	Forage	PVC	PALEOCENE	45,72	150	1	NON	Privé	Tous usages	Limpide
45	069	21/08/2021	DIAMOND CEMENT	1,287943	6,350172	Forage	PVC	PALEOCENE				NON	Privé	Industriel	Limpide
46	070	21/08/2021	HAGBLEVOU	1,299517	6,336642	Forage	PVC	Continental terminal	26,7	43	0,66	NON	AEP	Ménage	Turbide par moment
47	071	21/08/2021	HAGBLEVOU	1,299235	6,329073	Forage public	PVC	PALEOCENE	38	196		NON	AEP	Tous usages	Limpide
48	072	21/08/2021	GAWLUIWLUI KOPE	1,303589	6,324778	Forage	PVC	Continental terminal	28	47	2	NON	AEP	Tous usages	Limpide
49	073	21/08/2021	KPOME AKADJAME	1,334846	6,328871	Forage public	PVC	EO_Paléocène	44	105	2,1	NON	AEP	Tous usages	Turbide par moment
50	074	21/08/2021	EPP KPOME AGOME	1,341752	6,334234	Piézomètre	PVC	PALEOCENE	33,3	146		NON		aucun (ouvrage de suivi)	Certifiée
51	075	21/08/2021	EPP TCHAGOME	1,305912	6,359205	Forage public	PVC	PALEOCENE	32	138	2	PEA	AEP	Tous usages	Limpide

Annexe XIII Design principles frthe stormwater network

Design basis of the stormwater network

A preliminary stormwater network design is outlined below.

Rainfall and runoff

Considering the historical meteorological conditions, 20 mm /hr intensity of rainfall will be considered for the design of the storm water drainage network. The design will be based on the analysis of rainfall pattern and its distribution with respect to time in and around the Project area. The critical parameters that would be considered with respect to the rainfall include frequency distribution, depth and duration.

Frequency Analysis

The rainfall return period that will be used to design the drains will depend on the use of the area that needs to be drained. The amount of rainfall corresponding to the selected return period will be determined based on a frequency analysis.

Commercial and industrial areas have to be subjected to less frequent flooding. The recommended design frequencies for use in simple design methods as suggested in BSEN752-2008 as tabulated below.

Table 1 Design storm frequency

Location	Design Storm Frequency	
	Return Period (1 in "n" years)	Probability of exceeding in any 1 year
Rural Areas	1 in 1	100%
Residential Areas	1 in 2	50%
City centers /Industrial/ Commercial areas	1 in 5	20%
Underground railway / underpass	1 in 10	10%

The suggested runoff coefficient for various land use types is as follows:

Table 2 Runoff coefficient for various land use types

Type of Land use	C value
Roads	0.7 to 0.95
Greens and undeveloped areas	0.1 to 0.3
Residential plots	0.3 to 0.7
Commercial plots	0.7 to 0.95
Industrial plots	0.5 to 0.95
Roofs	0.75 to 0.9

Computation of flow

The most common method used in determination of storm water run-off is the "Rational" method. The rational formula is expressed by the following equation.

$$Q=10xCxIxA$$

Where

- Q is runoff in cum/hr

- C is co-efficient of runoff
- I is intensity in mm/hr
- A is area of the drainage basin in hectares

Determination of Capacity of Drain :

Several empirical formulae can be used for computing flows in open channels. Among them, it is recommended the use of Manning's formula for design under open channel flow conditions.

Manning's Equation, $V=[(1/n)]x[R^{2/3}xS^{1/2}]$

For open channel (rectangularsection)

$$Q=AxV;$$

Where,

- Q=discharge in m3/sec;
- S=slope of hydraulic gradient;
- R=hydraulic radius in m;
- R=A/P
- V=velocity in m/sec;
- n=Manning's coefficient of roughness;
- A=Wetted area in Sqm;
- P=Wetted perimeter in m

Proposed section of Drain:

The right of way of the roads has a provision of utility corridor on both sides. The utility corridor accommodates various services like water supply, Sewerage, Telephonelines, electrical lines and storm water drains. About 1.5 m wide corridor is provided on both sides of the road to construct a storm water drain. The section of the drains could be a combination of rectangular channels and underground RCC pipelines with inspection chambers.

Free Board

The free board is the vertical distance from the water surface of designed flow condition to the top of the channel. The importance of this factor depends on the consequence of over flow of the channel bank. Freeboard should be sufficient to prevent waves, superelevation changes, or fluctuations in water surface from over flowing the sides. The concept design shall ensure provision of at least 0.1m free board for drains depth up to 0.5 m and 0.15 m for deeper drains.

Longitudinal Bed Slope

Longitudinal bed slopes of drains would be fixed considering the natural slope of the area and drops would be provided to meet the permissible velocity criteria in case of steep slopes. For the Project, since the pre-castdrains are being used, the drain longitudinal slopes shall follow road vertical profiles.

Velocity

The permissible velocities shall varies between 0.6 m/s to 3.0m/s. The self-cleaning velocities are required prevent siltationin the drains and higher velocities above 3.0m/s needs to restricted to avoid erosion. Velocities in the drains or channels shall be determined using Manning'sequation. Higher velocities for smaller lengths are acceptable.

Vegetated Swales

In all the road hierarchy types, within the RoW section, there is a proposal to introduce an unlined drain or vegetated swale on both sides within the utility corridor. The width of the utility corridor on each side of the RoW is adequate to carry a 1.5 m wide swale to collect the runoff generated from the corridor and infiltrate thereafter within the premises. This is an effort to introduce a water sensitive urban design concept with an objective to minimize the discharges into the main conveyance system and further to improve the ground water resources. For details, a drawing showing the typical road cross sections can be seen.

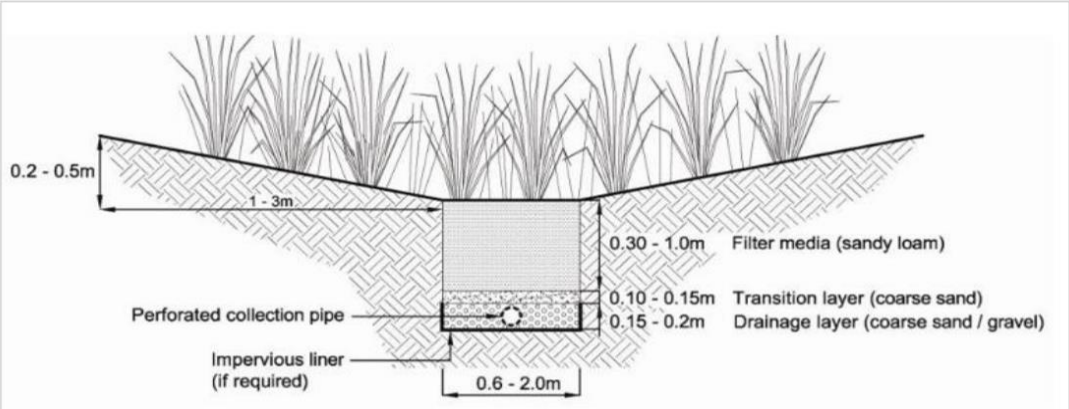

Figure 117 Exemple of vegetated swale with collection pipe and filter media

Annexe XIV **Sludge management**

Sludge Management

Sludge treatment

The primary objective of the sludge treatment is to ensure that the treated material can be safely reused or disposed in the environment. Solid sludge fraction for recovery is generally referred to as "biosolids".

Sludge is typically separated into liquid effluent and a sludge residue, followed by separate treatment of each fraction. This results in the reduction of oxygen demand, suspended solids, nutrient and pathogen concentrations in the liquid fraction.

The next step after the separation is dehydration of the solid fraction, as it needs to be dried further before being treated as solid material. Pre-treatment may also include other operations, such as the removal of gravel, oil and grease, and stabilisation of fresh sludge to reduce odour and make it easier to treat. Where sludge comes from septic tanks serving establishments that produce large quantities of oil and grease, a separate reception tank with a baffle and an upward outlet should be provided. The baffle catches the oil and grease, which can then be removed from the surface. The remaining tank contents can then be returned to the main treatment line, preferably by gravity or possibly by the suction pump of a tanker.

Further specialized treatment can be still required to ensure that the sludge is suitable for recycling and does not present a risk to health and the environment. In that sense, the treatment requirements depend on the intended end use.

Sludge can be reused in several ways, including landfarming, agricultural or landscaping reuse through composting methods.

For sludge treatment PIA will install the following equipment:

- Air compressor ;
- Filter presses machine ;
- Filter press feed pump.

PIA also plans to compost the sludge. MBR technology deployed at the CETP is capable of removing suspended solids and pathogenic micro-organisms from domestic effluents and is efficient in producing lesser quantity of sludge compared to other technologies.

The options for sludge application will be explored as part of the overall waste management strategy by PIA. The most commonly applied alternatives that can be effectively adopted include:

- Sanitary landfill: disposal of the sludges with compaction and soil covering, after which they are sealed;
- Landfarming: sludges are transported to a specific landfarming site, mixed into the soil surface and periodically turned over (tilled) to aerate the mixture. These land farming activities cultivate and enhance microbial degradation of hazardous compounds;
- Agricultural application: use of the sludge on agricultural soils, in association with the development of crops;
- Land reclamation: disposal of sludge in areas that have been drastically altered, such as mining areas, where the soil does not offer conditions for development due to lack of organic matter and nutrients;
- Landscaping purposes : composted sludges used for landscaping.

For each option considered by PIA for sludge application and disposal, there is a specificity of treatment and associated threshold requirements and constraints.

For sanitary landfill, landfarming and land reclamation, it is necessary to carry out in-depth soil characterization studies in order to know the physico-chemical parameters of the soil, which therefore boils down to characterizing the geochemical background of the soils in the study area. Indeed, in order to avoid significant impacts on soil and groundwater quality, it is recommended that the characteristics of the sludge are similar to those of the soil where the sludge will be discharged.

In this sense, it is necessary to monitor the quality of the sewage sludge after the filter press.

Three parameters as a basis for determining sewage sludge quality:

- The presence of pollutants (arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc)
- The presence of pathogens (e.g., bacteria, viruses, parasites)
- The sewage sludge's attractiveness to vectors (e.g., rodents, flies, mosquitoes).

Land reclamation requires large space and only applies to organic contaminants as the process relies on biodegradation. The process being largely uncontrolled, the time until complete degradation may be long. Liners are also necessary to intercept leaching contaminants and prevent groundwater pollution. A risk based assessment is necessary whereby receptors are well understood and to ensure that the discharge of sludge would not contribute to further soil degradation.

On the other hand, there are greater constraints on the application of sludge on agricultural land. Since the crops are intended for human consumption, it is necessary that the quality of the sludge has low levels of pollutants and metals. Biosolids intended for application to agricultural land must not exceed maximum concentrations of pollutants, including heavy metals. The US EPA's Part 503 guidance document provides maximum allowable concentrations for ten heavy metals. In addition, an analysis of the soil on which the sludge will be spread should be carried out and then compared with the quality of the sludge produced by the PIA wastewater treatment.

The US EPA requirements for land application are presented in the table below.

Table 1 Pollutant limits (US – EPA, Land application of sewage sludge, A guide for land appliers on the requirements of the federal standards for the use or disposal of sewage sludge, 40 CFR Part 503, 1994)

Pollutant	Ceiling Concentration limits for all biosolids applied to land (mg/kg – dry weight basis)
Arsenic	75
Cadmium	85
Chromium	3,000
Copper	4,300
Lead	840
Mercury	57
Nickel	420

Selenium	100
Zinc	7,500

According to US EPA, ceiling concentrations apply to all land applied sewage sludge (bulk sewage sludge and sewage sludge sold or given away in a bag or other container). Ceiling concentrations establish the maximum concentration of each pollutant that sewage sludge can contain and still be land applied. Each sample of sewage sludge analyzed must meet the ceiling concentration limits. These limits are applied as maximum, never to be exceeded values, not as averages. Sewage sludge that does not meet these specified thresholds for any or all of the 10 regulated pollutants must be used of disposed of in some other way; it cannot be land applied (US-EPA, 1994).

Composting sludge

Composting uses aerobic decomposition to break down organic materials under controlled conditions and produce stabilised products that do not emit odours. Pathogens in the composting material are inactivated by maintaining the temperature in a thermophilic range (between 40 and 70°C) for a sufficient period of time.

Composting should include an active phase, during which the compost is regularly turned, followed by a passive phase, during which the compost is left to rest. The inclusion of a passive composting phase improves the reduction of pathogen concentration to an acceptable level in mature compost.

For best results, the dry matter content should be between 40 and 45%. This corresponds to a water percentage, called "moisture ratio", of 55-60%. Composting is most efficient when the C:N ratio is in the range of 25 to 35:1 (WEF, 2010)

In order to achieve the required temperature levels, the water level and carbon to nitrogen (C:N) ratio of the composting material must be kept within fairly narrow limits and there must be sufficient air pockets to provide the oxygen required for aerobic microbial activity. To meet these conditions, sewage sludge is most often co-composted with a suitable bulking agent with a high carbon content and low water content. The addition of a bulking agent increases the number of free spaces and thus facilitates aeration. Materials commonly used as fillers include solid waste, agricultural waste and sawdust. The volume of bulking agent required is typically 2-5 times that of the sludge, with the ratio varies depending on the C:N ratio, the moisture level of the sludge and the bulking agent.

The following table shows the types of bulking agent that should be used to achieve an optimum moisture level and an optimum C:N ratio. The studies revealed significant variations from some of the values given there. Whatever the reason, this difference confirms the importance of determining the density of the materials to be used as bulking agents under the intended conditions of use.

Table 2 Examples of standard moisture levels, C:N ratios and density in selected bulking agents (Kevin Tayler, 2018)

Bulking agent	Moisture level (%)	C:N ratio	Density of bulking agent (kg m^3)
Paper/magazines	4 to 6	150 to 500:1	100 to 500
Green waste	80 (variable)	10 to 15:1	470 to 600
Cut grass	60 to 80	12 to 25:1	240 to 480

Corn straw	9	30 to 60:1	50
Rice husk	8 to 10	110:1	90 to 110
Bagasse	9	170:1	100 to 2022
Leaves	10 to 50	30 to 80:1	90 to 400
Brushwood and pruning waste	40 to 50	200 to 500:1	150 to 300
Wood chips and sawdust	5 to 20	100 to 500:1	180 to 360

Source : CalRecovery Inc. (1993) ; Hirre5l et al. (non-daté) ; Michigan Recycling Coalition (2015) ; Danish et al. (2015) ; NIIR (non dated) ; Hobson et al. (2016) ; Thoreson et al. (2014).

The appropriate bulking agent for the Project may be green waste, leaves and scrub and pruning waste from the initial clearing of land for the Project but also from the maintenance of green areas during the operation of the platform. Indeed, in the medium and long term, a source of green waste will need to be identified to provide the adequate bulking agent. This may be done in synergy with agro-processing industries that will be implanted on the industrial zone or other actors to be identified.

IFC guidelines for Water and Sanitation (IFC, 2007) recommend that lime sludges should be disposed by land application if allowed, limiting application rates to about 20 dry metric tons per hectare (9 dry tons per acre) to minimize the potential for mobilization of metals into plant tissue and groundwater.

Windrow composting

The most appropriate composting technique to use would be windrow composting. The material to be composted is laid out in long piles, usually triangular or trapezoidal in cross-section, 1.25 to 2.5 m high with a width to height ratio of about 2:1. The piles should be large enough to retain heat and ensure thermophilic conditions, but porous enough to allow oxygen to permeate deeply.

Windrows should be turned at regular intervals to maintain porosity and allow oxygen to penetrate the windrow core. Thus, the size of the pile will be influenced by whether manual or mechanical means are used to turn the pile.

It is necessary to place the windrows under cover to protect them from rainwater, especially during rainy season, which can disturb the moisture content of the compost and prevent it from reaching its optimum level. In addition, it will probably be necessary to water the compost in the dry season to maintain an adequate moisture level.

The sides of the cover structure should be open to allow cross-ventilation. Given the high cost of covering, it is advisable to cover the active composting area and leave the passive composting area exposed to the weather.

Characteristics and location of the composting platform

A composting platform should be set up to avoid the potential negative impacts of windrow storage on soil, surface water and groundwater. Therefore, to reduce the risk of surface water pollution, sludge should be stored in non-flooded areas with a slope of less than 2%. It is recommended that the location of storage sites is determined by the depth of the water table, which should be at least 3 to 4 m in all seasons.

Given the static level of the groundwater in the Project area, 40 m for the BM2 FFA borehole but of the order of a few metres for some of the structures around the site (used by the people living near the Project), it is recommended that an impermeable liner be used to store the sludge, except in areas where the soil is particularly impermeable, such as clay. Concrete and asphalt are commonly used to construct composting platforms but are relatively expensive. Other materials, such as a clay liner or a geotextile covered with gravel, can be used (Cornell Waste Management Institute, 2005). A drainage system should be in place to direct the leachate to simple treatment facilities such as ponds or filters.

Berms should be provided to drain run-off from the drying area and arrangements should be made to collect and safely dispose of any contaminated water that percolates from the drying sludge.

It will be necessary to provide sufficient space to accommodate the storage of windrows, both active phase piles and maturing compost, and the storage of bulking agents. Storage areas should be under cover and located on a waterproof platform.

Monitoring

The following table shows the US EPA (Part 503) temperature and time requirements for Class A and Class B biosolids.

Table Part 503 of the US EPA regulation on temperature and time parameters for composting of biosolids

Class	Requirement
Class A (unrestricted use)	Windrow composting: the temperature must be > 55°C for a minimum of 15 days and the windrows must be turned at least 5 times
Class B (restricted use)	The temperature must be > 40°C for a minimum of 5 days and > 55°C for at least 4 hours over the 5 days period

Once the composting process is operational, the temperature of the sludge should be monitored regularly to ensure that the conditions necessary for pathogen inactivation are met. It can be done by taking samples at various points in the compost pile during the composting process.

The best results are obtained when the moisture content of the compost is between 55 and 60%. To keep the moisture content within this range, operators must be able to assess it. Simple manual methods can be used to qualitatively assess the moisture content of compost. For example, the compost should have the texture of a "wrung out" sponge, i.e. squeezing a handful of compost should produce a trickle of water.

Manual turning of windrows is labour intensive and mechanical equipment in the form of tractor loaders is essential in large installation. Moreover, when the C:N ratio is less than 25, the temperature does not increase sufficiently to allow inactivation of the pathogens and ammonia gas is likely to be formed which produces an odour. It is then necessary to improve treatment methods to eliminate these nuisances.

In conclusion for composting sludge the viability of composting depends on the availability of several elements:

- Land ;
- Labour or mechanical equipment for the necessary operations, especially turning the windrows;

- A reliable and inexpensive source of carbon-rich waste for use as a bulking agent;
- Operational capacity and management systems to monitor the process.

Annexe XV Solar park design principles

Main principles

'Photovoltaic (PV)' refers to the direct conversion of sunlight into electrical energy. A solar PV plant aims at producing electricity from the electromagnetic energy created by solar radiation and exporting it into the grid network. Before reaching the grid network, electricity can be stored via batteries. The more intense is the solar light, the greater the amount of electricity produced.

PV finds application in varying fields such as Off-grid domestic, Off-grid non-domestic, grid-connected distributed PV and grid-connected centralised PV. The proposed 260MW is a utility-scale grid-interactive PV plant.

The main components of a solar PV plant include:

- Solar PV modules. These convert solar radiation directly into electricity through the photovoltaic effect which requires no moving parts and is a silent and clean process. The photovoltaic effect results in electron movement when photons from the light hit the semi-conductor. The output from a solar PV cell is direct current (DC) electricity. A PV power plant contains many cells connected together in modules and many modules connected together in strings to produce the required DC power output.
- Module Mounting Systems: These allow PV modules to be securely attached to the ground at a fixed tilt angle, or on sun-tracking frames which orient sun.
- Inverters: These are required to convert the DC electricity to alternating current (AC) for connection to the utility grid. Many modules in series strings and parallel strings are connected to the inverters.
- Step-Up Transformers: The output from inverters generally requires a further step-up in voltage to reach the AC grid voltage level. The step-up transformer takes the output from the inverters to the required grid voltage (for example 11kV, 22kV, 33kV, 66kV, 132kV etc. depending on the level of power evacuation).
- The Grid Connection Interface: This is where the electricity is exported into the grid network. A switchyard with required switchgear, control and protection of the PV plant may be required for grid interfacing besides energy meters. The substation and metering points are often external to the PV power plant boundary and are typically located on the grid operator's property.

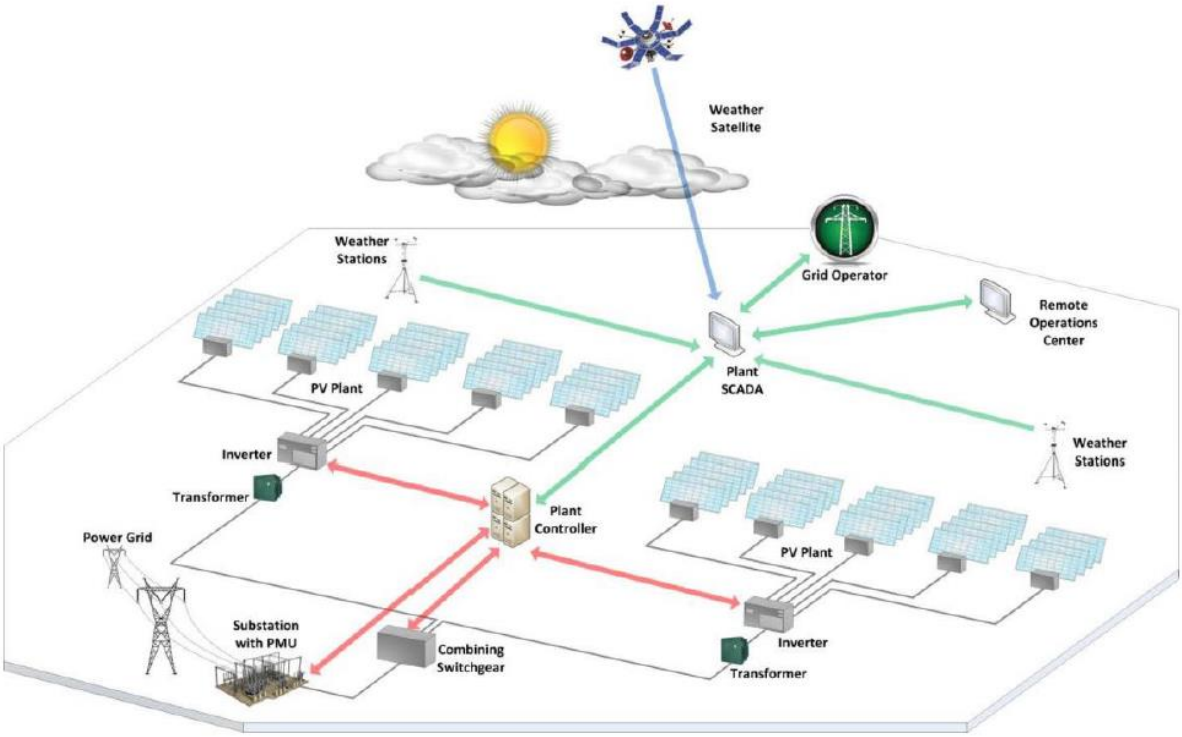

Figure 1 Overview of a type of solar PV power plant to be installed at PIA Phase 2 site (Source : https://www.nrel.gov/docs/fy16osti/65368.pdf)

PV modules selection

A PV cell is the principal building block of a solar PV plant. Basically, a semi-conductor, PV cells convert sunlight into useful Direct Current (DC) electrical energy. PV cells are small in size and capable of generating only a few Watts (W) of energy. However, PV plants are highly modular (i.e.) modules can be combined together to generate power ranging from a few watts (W) to tens of megawatts (MW).

Due to the electrical properties of PV cells, their manufacturing is restricted to a handful of raw materials. Presently, the most common materials in use are Silicon (in crystalline and amorphous form), Micro-crystalline (also referred to as micro-morph), Cadmium Telluride (CdTe) and Copper Indium (Gallium) Selenide (CIS/CIGS). Each material has its unique characteristics which impact PV module performance, manufacturing process and cost.

PV cells may be based on either wafer (manufactured by cutting wafers from a solid ingot block of material) or “thin-film” material (which is deposited onto low-cost substrates).

PV cells can further be characterised according to the long-range structure of the semiconductor material used: “mono-crystalline”, “multi-crystalline” (also known as “poly-crystalline”) or less ordered “amorphous” material.

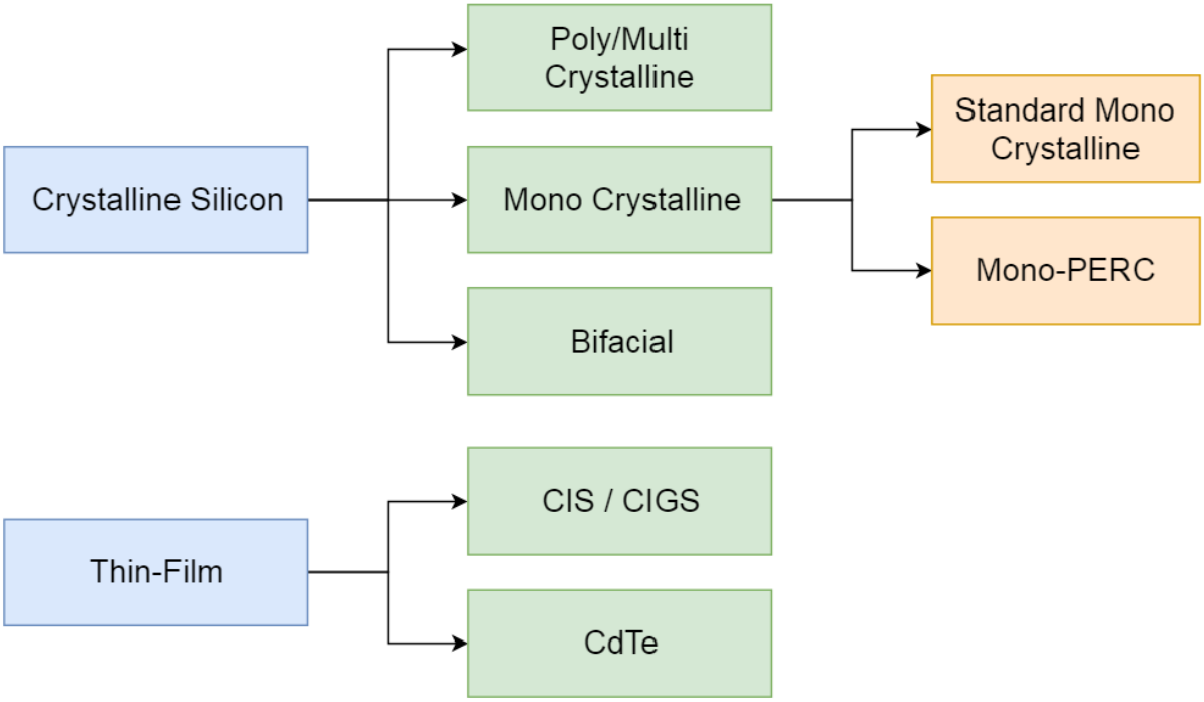

Figure 2 Overview of PV technology classes

Crystalline Silicon PV modules :

Crystalline silicon modules consist of PV cells (typically 6 × 6 inches) connected together and encapsulated between a transparent front (usually glass), and a backing material (usually plastic or glass). Crystalline silicon is further distributed in mono-crystalline and multi-crystalline technology.

Mono-crystalline wafers are sliced from a large single crystal ingot in a relatively expensive process.

PERC technology modules incorporate a passivated film on the rear side of the cell and use chemicals to create tiny pockets in the film that absorb more light and higher internal reflectivity. This helps PERC cells to offer higher efficiency as compared to standard cells. PERC cells also perform better under low light conditions and high temperature.

Cheaper, multi-crystalline wafers may be made by a variety of techniques. One of the technologies involves the carefully controlled casting of molten poly-silicon, which is then sliced into wafers. These can be much larger than mono-crystalline wafers. Multi-crystalline cells produced in this way are currently cheaper and the end product is generally of similar efficiency as mono-crystalline technology

This type of cell is made up of thin plates of silicon, a very abundant chemical element, which is extracted in particular from sand or quartz, which must be of very high purity. Silicon is obtained from a single crystal or from several crystals: these are referred to as monocrystalline or multi-crystalline cells. Crystalline silicon cells perform well (14 to 21% [Ministry of Ecological and Inclusive Transition]) and represent around 90% of the current market.

Figure3 Mono-crystalline wafer

Figure 4 Multi-crystalline wafer

Figure 5 Bifacial modules

Conventional PV modules are mono-facial; that is the electrical power output is the function of the direct and diffuse radiation captured on the front side of the module only. Bifacial PV modules can utilise light from both sides thereby increasing energy yield.

Thin Film PV Modules :

Thin film cells are made by depositing one or more semiconductor and photosensitive layers on a support of glass, plastic, steel, etc. This technology makes it possible to reduce the cost of manufacture, but its yield is lower than the crystalline technology (from 5 to 15% [Ministry of ecological and solidarity transition]). The most common thin-film cells are made of amorphous silicon, composed of silicon sprayed onto a flexible material.

Crystalline wafers provide high-efficiency solar cells but are relatively expensive to manufacture. In comparison, thin-film cells are typically the cheaper alternative; layers of material are deposited on a low-cost backing such as glass in an automated manufacturing process.

Thin Film technology PV modules are categorised depending on the material used as amorphous silicon (a-Si), Cadmium Telluride (CdTe), Copper Indium Selenide (CIS), Copper Indium Gallium Selenide (CIGS) and Tandem (µc:a-Si) technologies. Even though a-Si technology has been in production longer than other thin-film technologies, the solar industry trend has shown that CdTe technology is better suited for the African climate.

Figure 6 Amorphous silicon (left), CdTe (middle), CIGS (right)

Conclusion on Solar PV Technology Selection

SgurrEnergy has performed a detailed analysis to select the best-suited Solar PV technology for Project site conditions. Both crystalline and CdTe solar PV technology are considered to be commercially established. Both these technologies have their own pros and cons and have been performing well globally. For CdTe solar PV technology, limited module manufacturers are a key bottle neck for ensuring supplies.

Further, recent trend suggests a shift from polycrystalline module to Mono PERC modules in the market. Hence with an aim to reduce the life time risk lower cost to benefit ratio and specific yield, SgurrEnergy has selected Mono PERC and Bifacial PV module technologies for the Project.

Inverter selection

There are two broad classes of inverters: string inverters and central inverters.

String inverter concept uses multiple inverters for multiple strings of modules. String inverters are being used as they can cover a very wide power range. Additionally, they allow all strings to be independent of each other.

The main advantages of string inverter are that (1) they can be serviced and replaced by non-specialist personnel, (2) it is practical to keep spare string inverters on site, which makes it easy to handle unforeseen circumstances, as in the case of an inverter failure. In comparison, the failure of a large central inverter with a long lead time for repair can lead to significant yield loss before it can be replaced.

Central inverters are usually three-phase and can include grid frequency transformers. There is no electrical connection between the input and output voltages, which is a conditionality that is sometimes required by national electrical safety regulations.

Maintenance may be effectuated by qualified personnel only.

Figure 7 Central inverters (left) and string inverters (right)

Conclusion on Inverter Selection

For large PV plants using central inverters is generally the most optimum solution than using multi-string inverters. Central inverters allow high reliability and simplicity of installation as compared to string inverters.

Disadvantages of central inverter include increased mismatch losses and absence of maximum power point tracking for each string. This is an issue where arrays have multiple tilt and orientation angles and arrays that suffer from shading or for arrays using different module types.

For the Project concept and energy yield analysis, SgurrEnergy opted for Sungrow central inverters for the proposed site in consultation with the Developer.

Solar PV Mounting System

PV modules are installed on mounting structures to keep them oriented in right direction with a tilt that is optimised to have maximum irradiation and to provide structural support to the PV modules.

Mounting systems may be either fixed or tracking type. Fixed type mounting systems being simple in design and installation, is generally favourable for developing a utility scale Solar PV plant; however, given the aggressive competition, the focus is completely shifted to maximising energy generation using trackers. Trackers are module mounting system that follows the sun trajectory resulting in a

higher irradiation on collector plane. With multiple tracker topologies available in the industry; the most commercially established tracker remains Horizontal Single Axis Trackers (HSAT).

For further technology evaluation SgurrEnergy has shortlisted fixed and Horizontal Single Axis Trackers (HSAT).

Fixed mounting system

Fixed mounting systems keep the rows of modules at a fixed tilt angle (the angle of the PV modules from the horizontal plane) and facing a fixed angle of orientation (the angle of the PV modules relative to south). Following tilt pitch optimisation, the tilt angle and orientation has been selected in order to maximise the total annual incident irradiation and total annual energy yield.

In addition to traditional south-facing module mounting structure, East – West orientation has also been evaluated for the Project site.

Figure 8 Fixed mounting system

Tracking systems :

Mobile structures, otherwise known as "trackers", are equipped with a motor allowing them to follow the course of the sun to optimize their exposure and therefore their performance. They require greater investment and maintenance for higher productivity. Trackers can be mono-axial (east-west orientation) or bi-axial (east-west and north-south orientation possible).

SgurrEnergy has investigated the application of one specific typology of trackers, namely the Horizontal Single Axis Tracking (HSAT).

When considering the use of tracking systems, there are additional aspects to take into account. Tracking systems may allow a maximization of energy yield bu they are more expensive (procurement and installation), ask for more land area and higher maintenance.

Figure 9 Horizontal single axis tracking

Both options have been evaluated by SgurrEnergy when carrying out the technical evaluation of selected configurations.

The support structures of the modules need to be implanted in the ground. There are several anchoring options, the most appropriate of which is generally selected on the basis of geotechnical studies carried out prior to the installation of the park. Classically, the following anchors are found:

- driven / screwed piles: the piles, generally made of galvanized steel, are driven with a threshing machine between 80 and 150 cm into the ground;
- concrete beams or studs: if the soil does not allow the installation of piles, due to its instability for example, the structure can be built on concrete foundations cast in place or delivered "ready to use";
- concrete foundation: concrete poured into the earth will accommodate the structure.

Figure 10 Driven piles

Figure 11 Screwed piles

Figure 12 Concrete foundation