Arinna Solar Power Environmental & Social Impact Assessment

NEW AND RENEWABLE ENERGY AUTHORITY (NREA)

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Introduction

1.1 Project Background

The Egyptian New & Renewable Energy Authority (NREA), is planning to establish a PV power plant park (approximately 1740 MW of AC) in Benban near Kom Ombo in Aswan Governorate. The project has been tendered to investors and service providers to build and operate PV plants ranging from 20 to 50 MW of AC. About 40 investors have been assigned land plot under the Feed-in Tariff Scheme (FIT). NREA will construct the required transmission lines and substation to accommodate the generated electricity from all PV plans and connect to the national electricity grid.

Arinna Solar Power SAE has signed a contract with the Egyptian New & Renewable Energy Authority (NREA) to construct and operate a 20MWac plant within NREA's FIT scheme. The electricity generated is intended to be connected to the national electricity grid. The area is mainly desert area and does not include residential or other human activities. The project is located in plot SBN 1-1 in Benban, Aswan. Figure (1-1) below shows the overall PV solar park and the location of Arinna Solar Power plot within the park.

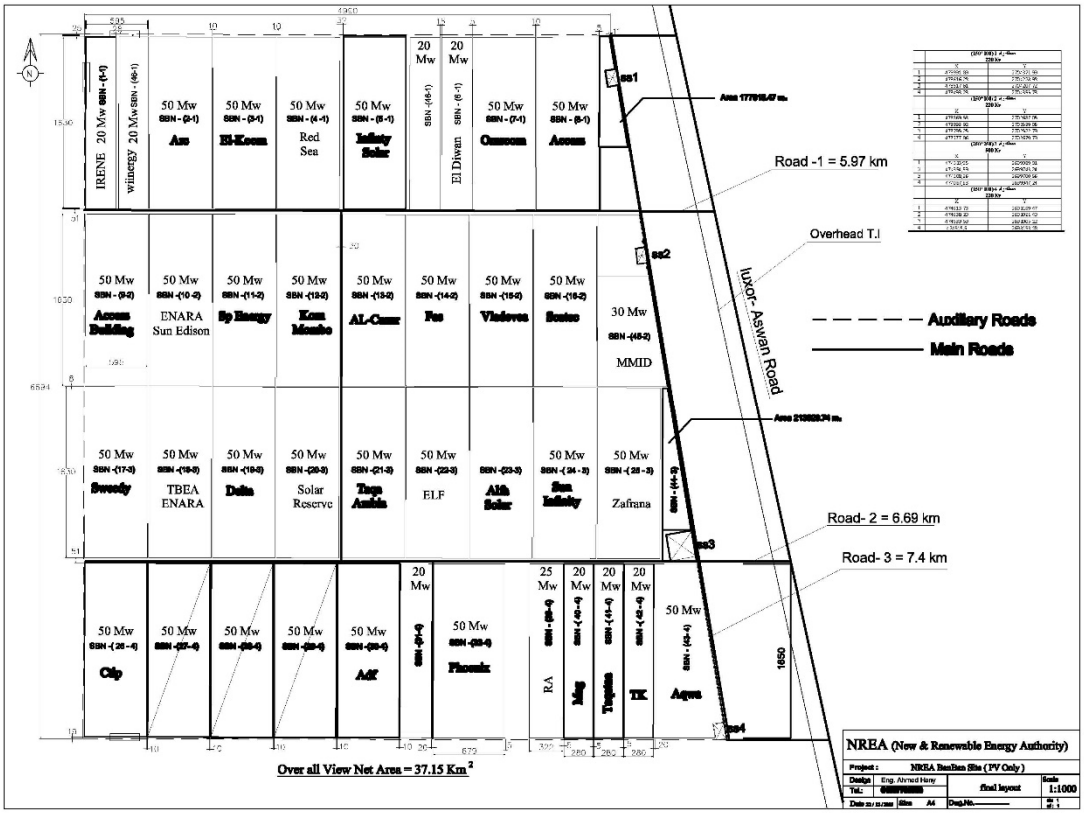


Figure (5-1): PV solar park and the location of Arinna Solar power PV power plant lot 1-1

The project is categorized by Egyptian Environmental Affairs Agency (EEAA) under 'Category C' Projects - which will require a full ESIA including public scoping and consultation activities according to the EIA guidelines issued by EEAA in 2009. However, NREA is currently preparing a Strategic Environmental Impact Assessment Study (SESA) for the wider development location in which the different common and associated facilities are covered. Thus and in this respect, the individual projects will be categorized under the lower EIA level, namely Form B ESIA, which does not require individual stakeholders' consultation and engagement plans.

1.2 Interface with the Strategic Environmental and Social Impact Assessment (SESA)

Within the context of the SESA study initiated by NREA, EBRD and NREA nominated an environmental consultancy to develop a Strategic Environmental and Social Assessment (SESA) for the solar park in Benban-Aswan. The SESA process was initiated in July 2015. It has been prepared as a high level assessment for the environmental aspects of the solar park in Benban. The SESA did not address the project specific characteristics, which are addressed in each project's individual Category B ESIA. The individual ESIAs (Form B ESIA) do not require extensive socio-economic assessment or public scoping and disclosure activities. In this respect, the SESA was intended to support the individual ESIA process and save time for the Category B ESIA preparation as well as reduce cost of consultation process. In this context, although the final SESA report is not made available to the developers, it is assumed that the SESA has comprehensively described the environmental and socio-economic setting of the PV park. Accordingly additional baseline information will be incorporated or referred to in in this ESIA as necessary.

On the other hand the Non-Technical Summary (NTS) of the SESA was made available for developers and has identified, a list of key project aspects that can have considerable cumulative impacts on the surrounding environment and that need to be addressed collectively and jointly by all developers. These are summarized as follows:

- Traffic management
- Water consumption, wastewater and waste management
- Labour influx and workers accommodation
- Community safety and Site security
- Community engagement and grievance systems
- Corporate Social Responsibility

In this respect, the developers association has issued in February 2016 a Request for Proposal for Facility Management, Social and Environmental Assessment, Implementation and Management for all aspects identified by the SESA NTS.

1.3 Project at a glance

No.	Particulars	Description
General Power Plant Location Information		
1	Project site	Western Desert, North-West Aswan City
2	Name of Governate	Aswan Governate
3	Plot Number of Beban Site	Plot of Land No. SBN (1-1)
4	Geographical Coordinates	Point 1: X 468845.31 Y 2704679.94 Point 2: X 468845.31 Y 2703049.95 Point 3: X 468556.26 Y 2703050.53 Point 4: X 468559.63 Y 2704680.53
5	Nearest Settlements	Benban Al Gdeeda and Faris Village
6	Land Plot Area	0.46 km²
7	Annual Global Horizontal Irradiation	2300-2400 kWh/m²
8	Annual Global Normal Irradiation	2000-2200 kWh/ m²
Photovoltaic (PV) Development		
9	Type of PV Technology	Poly C-Si (JA Solar, Suntech, or Canadian Solar)
10	Peak Power Capacity/Module	330 Wp
11	Total number of PV Modules	86,190
12	Number of Modules per String	30
13	Number of Strings	2873
14	Model of Inverter Technology	(Schneider, KACO, SUNGROW or SMA)
15	Total number of Inverters/Transformers	11/11
16	Photovoltaic Generation Capacity	Approximately 28.011MWp (DC) for a 22 MW inverter nominal power (AC)
17	Structure Height and Tilt	1-Axis Trackers, design tilt is also +/- 55º

1.4 Objective of the ESIA

The objective of the ESIA is to ensure that the project is environmentally and socially sound and sustainable, and that any potential negative environmental impacts are recognized early in the project cycle and taken into account before project implementation. Furthermore, it is also intended to satisfy the environmental legal requirements of the Egyptian Environmental Law 4 of 1994 amended by Law 9/2009 and its executive regulations No. 338 of 1995 modified by Prime Minister Decree no. 1741/ 2005, modified in 2011/2012 and 2015 as well as the EEAA (Egyptian Environmental Affairs Agency) guidelines for EIAs issued 2009.

Moreover, the ESIA is also intended to satisfy the environmental requirements of the international funding institutions including specifically the Performance Standards (PS) of International Finance Cooperation (IFC).

1.5 Scope of Work

The ESIA of the proposed project would evaluate the project potential environmental impacts in its area of influence; identify ways of improving project environmental performance during its different stages by preventing, minimizing or mitigating potential adverse environmental impacts and enhancing positive impacts. The ESIA will cover the different components of the plant at the different phases of site preparation, construction, startup and operation.

The scope of work covers the specific "terrestrial" impacts of the plant within the facility premises, which includes construction, operation and decommissioning of the PV plant.

1.6 Outline of ESIA study

This ESIA report includes:

- ***Chapter 1:*** Introduction and background on the project for which the ESIA is developed as well as the scope and objectives of the ESIA study.
- ***Chapter 2***: Description of the local regulatory framework as well as the IFC Performance Standards applicable to the project activities
- ***Chapter 3:*** Description of the intended PV plant construction and operation phases
- ***Chapter 4:*** Description of the baseline environment of the project area
- ***Chapter 5:*** Discussion of alternatives for different project components.
- ***Chapter 6:*** Assessment of the potential environmental impacts and their mitigation measures.
- ***Chapter 7:*** The environmental management and monitoring plan for the PV plant

2. Policy, Legal and Administrative Framework

This section summarizes the environmental legislation and regulations of relevance to the project. They were identified according to the type of the proposed activity (described in detail in chapter 3), its geographic location and the expected impacts. Consideration is first given to the national legislations pertaining to the execution of the ESIA, followed by a review of guidelines of international financing institutions for environmental requirements relevant to the project as well as the Company's environmental, health and safety framework requirements

2.1 National Legislation Pertaining to EIA

According to Law 4/1994, the project proponent must prepare an Environmental Impact Assessment (EIA). Accordingly, environmental requirements are integrated into the existing licensing system.

According to the Egyptian Guidelines for EIA (EEAA, 2009), proposed developments are classified to three categories according to the severity of potential impacts. They reflect the increasing level of environmental impact assessment. The three categories [1]are:

- **Category A:** projects with minor environmental impacts
- **Category B:** projects with substantial impacts
- **Category C:** projects with high potential impacts requiring full EIA

According to EEAA requirements, this project has been classified as category C project. Therefore, the proposed PV plant requires a full ESIA that should cover construction and operation phases and public consultation activities. However, since NREA is currently preparing a Strategic Environmental and Social Impact Assessment Study (SESA) for the wider development, the individual projects will be categorized under the lower EIA level B, namely Form B ESIA, thus not requiring stakeholders' consultation and engagement plans.

According to law 4/1994, modified by Law 9/2009, and its executive regulations (ER), the EIA report will be submitted to the Competent Administrative Authority (CAA), under which jurisdiction the project falls. For the PV Park, the CAA is the New and Renewable Energy Authority (NREA). The CAA would send the EIA to EEAA to issue its response within 30 days. If no response is received beyond this period, the assessment shall be deemed approved.

[1] The IFC World Bank EIA categorization is in a revrese order as it considers Category A projects have the most significant and Category C projects have the least significant impacts

2.2 National Regulations Pertaining to the Project

2.2.1 Air Quality

Article 36 of Law 4/1994 and article 37 of its modified ERs (710/2012) give the maximum allowable limits for exhaust gases from machines, engines and vehicles.

Article 35 of Law 4/1994 and article 34 of its modified ERs give the maximum allowable limits for ambient air pollutants. Table (2.1) gives the maximum allowable limits for ambient air emissions

For this specific project, the legal stipulations related to the induatrial areas apply mainly to potential air emissions during the construction phase.

Table (2-1): Maximum Limits of Ambient Air Pollutants According to Annex (5) of the Modified ERs of Law 4/1994 as well as the international guidelines (IFC)

Pollutant	Area	Maximum Allowable limits			
		1 hr	8 hrs	24 hrs	1 year
Sulfur Dioxide ($\mu g/m^3$)	Urban Areas	300	-	125	50
	Industrial Areas	350	-	150	60
International guidelines (IFC)		-	-	***20***	-
Carbon Monoxide (mg/m^3)	Urban Areas	30	10	-	-
	Industrial Areas	30	10	-	-
International guidelines (IFC)		***30***	***10***	-	-
Nitrogen Dioxide ($\mu g/m^3$)	Urban Areas	300	-	150	60
	Industrial Areas	300	-	150	80
International guidelines (IFC)		***400***	-	***150***	-
Total Suspended Particles ($\mu g/m^3$)	Urban Areas	-	-	230	125
	Industrial Areas	-	-	230	125
International guidelines (IFC)		-	-	***230***	***90***
PM_{10} ($\mu g/m^3$)	Urban Areas	-	-	150	70
	Industrial Areas	-	-	150	70
International guidelines (IFC)		-	-	***150***	***70***

2.2.2 Noise

Article 42 of Law 4/1994 and article 44 of its modified ER (710/2012) give the maximum allowable limits for sound intensity. Table (2-2) shows the maximum limits of ambient noise levels in different areas.

For this specific project, these legal stipulations apply mainly to potential noise levels during the construction phase.

Table (2-2): Maximum Limit Permissible for Noise Level in the Different Zones According to Annex (7) of the Modified ERs of Law 4/1994

Type of zone	Permissible limit for noise level, dB (A)	
	Day time 7 am – 10 pm	Night 10 pm – 7 am
Areas on roads whose width is 12 m or more, or industrial areas which comprise light industries and other activities	70	60
International guidelines	***70***	***70***

2.2.3 Solid Wastes

Articles 37 of Law 9/2009, modifying Law 4/1994, and articles 38 and 39 of the modified ERs are concerned with the collection and transportation of solid wastes.

Article 39 of Law 4/1994 and article 41 of its ERs set the precautions to be taken during digging, construction, demolition or transport of resulting waste and dust so as to avoid wafting, according to the following precautions:

- Construction waste storage is to be carried out at site such that it does not obstruct movement of vehicles and personnel.
- waste subject to emission should be covered to avoid air pollution
- waste is to be submitted to authorized waste contractors

Law 38/1967 concerning cleanliness and sanitation and its executive regulations (decree 134/1968) regulates the collection, transportation, storage and disposal of solid waste.

2.2.4 Hazardous Substances and Wastes

Article 33 of Law 4/1994 specifies that all precautions must be taken when handling hazardous material either gaseous, liquid, or solid form to avoid any environmental damage.

Article 28 of the ERs of Law No. 4 of 1994 identifies requirements for hazardous waste management including the following:

- Identification: using the HW lists issued by the competent authority.
- Minimization: strive to reduced quantitatively and qualitatively the generation of the HW
- Segregation: HW is to be separated from other types of non-hazardous waste. In addition, the different types of HW must not be mixed together.

- On site Storage: HW is to be stored in designated area, and containers must be made of suitable materials and be properly sealed to avoid any leakages or spills into the surroundings.
- Off-site transportation: HW is to be submitted to authorized HW contractors.

For this specifc project, the legal stipulations apply to the generation of waste during construction and operation phase, such as used oil, grease and other lubricating materials.

2.2.5 Drinking water guidelines

The Decree of the Minister of Health 458/2007 provides the acpetable specifications of potable water.The parameters are categorized under five categories as follows:

i. Physical parameters: such as colour, oudour, turbidity and pH.

ii. Inorganic parameters: such as hardness, dissolved salts, sulphates and chlorides and metallic

iii. Heavy metals and organic pesticides

iv. Microbilogical parametsr

v. Radiactive substances

Table (2-3) below presents example parameters relevant to potable water quality for drinking.and domestic purposes

Table (2-3): Example of potable water parameters

Parameter	Maximum allowable limits mg/l
Dissolved salts at 120^0C	1000
Total hardness (as $CaCO_3$)	500
Sulphates (SO_4)	250
Chorides (Cl(	250
Iron (Fe)	0.3
Manganese (Mn)	0.4
Copper (Cu)	2
Zinc (Zn)	3
Sodium (Na)	200
Aluminum (Al)	0.2
Total bacteria count	– Not exceeding 50cell/cm^3 at 37^0C for 24 hrs – Not exceeding 50cell/cm^3 at 22^0C for 48 hrs
Total coliform	– 95% of the samples up to 100cm^3 examined /year should be totally free of coliforms – No sample should exceed 2 cell/100 cm^3 provided that this limit does not occur in two sucessive samples form one sampling source.
Streptococcus pyogenes	– None

Algae	– Microcystene should not exceed 1 microgram/l in case of blue green alge bloom
Microscopic examination	– Totally free of living protozoa

For this specific project, the legal stipulations related to the quality of potable water apply to the construction and operation phases.

2.2.6 Work Environment

The Egyptian Labour Law number 12/2003 organizes working conditions and management of worker relationship. The national labour law in its different articles; addresses the individual labour contracts, terms of employment, wages and leaves, collective negotiations and collective labour agreements and litigations as well as vocational training are addressed in sections one to four. The occupational health and safety requirements are addressed in Book five. A number of explanatory notes and ministerial decrees have been issued detailing the different stipulations of the law.

Part 3 of Book 5 of the labor law number 12/2003, articles 208 through 215, address the responsibility of companies to protect workers against risks resulting from handling of gaseous, liquid and solid chemical substances. The Ministerial Decree 134/2003 requires that organizations hiring more than 50 employees establish an occupational health and safety department to be responsible for the workplace and employees' safety and provide the necessary equipment for measuring and monitoring pollution in the work environment. Besides, Ministerial Decree 211/2003 of the Ministry of Manpower also addresses the requirements to prevent adverse physical, chemical, biological, mechanical hazards and the dynamic electricity hazard in the workplace as well as keeping medical surveillance records for the employees

According to articles 43 and 45 of Law 4/1994 and articles 44, 45, 46 and 47 of its executive regulations, the facility owner must provide the protective equipment and all necessary safety measures for the workers against noise, heat stress and gaseous emissions inside the work place. In addition, it is the responsibility of the facility's owner to provide all closed and semi-closed places with efficient ventilation system. Moreover, article 32 of the decree 211/2003 addressed the protection against high voltage risks in electricity generation plants. It describes measures for occupational safety measures when handling and maintaining electric equipment, wires and cables.

The legal stipulations apply to the workplace conditions during construction and operation phases.

2.2.7 Management of Liquid Wastes

Law 93/1962 sets the conditions for discharging wastewater to public sewer networks. Decree 44/2000 of the Ministry of Housing modifying the executive regulations of Law 93/1962 address the conditions and maximum allowable limits for discharge of wastewater to public sewer network.

As there will be no public sewer system extended to the site. However, the Decree provides general conditions and criteria to be fulfilled for treated sanitary wastewaters that are re-used for agricultural/landscaping purposes (Article 15).

The legal stipulations apply to the discharge of domestic sewage water resulting from workforce during construction and operation activities in case a construction camp constructed on site. If not then this legal stipulation will only apply to the project activities during construction and operation if wastewater is treated on site for irrigation purposes.

2.2.8 Environmental and Other Registers

Article 22 of Law 4/1994 and article 17 of its modified executive regulations stipulates that establishments should maintain an environmental register for its activities. Article 17 and Annex (3) of the ER provide the content of the environmental register and state that the owner of the facility must inform EEAA with any non-compliance.

Furthermore, articles 26, 28 and 29 of the modified ERs are concerned with the rules and procedures of hazardous substances and waste management. Accordingly, a register for the hazardous waste should be maintained as well as record for the hazardous substances used.

In addition, article 211 of the Labour Law 12/2003 and article 34 of the Decree of the Minister of Labour and Manpower no. 211/2003 regarding requirements to prevent adverse physical, chemical, biological and mechanical hazards in the workplace, stipulates that companies should prepare, records/ reports/register for chemical safety.

The legal stipulations apply to constrcution and operation phase.

2.2.9 Legislation applicable to Cultural Heritage

Law No. 117 of 1983 promulgating the Antiquities' Protection Law, as amended by Law No. 3 of 2010, deals with the protection of antiquities. It is the main law in Egypt regarding the protection of archaeological and historical sites. The Ministry of State for Antiquities (MSA) is the authority concerned with the supervision of all archaeological affairs and sites in the country (Article 5). The Ministry of State for Antiquities (MSA) is responsible for discovery of antiquities and all exploration activities on Egyptian territory. MSA must be notified in the event that an unrecorded ruin is found by any person (Article 23). Although there are no cultural heritage areas in the site vicinity, the EIA report will refer to relevant regulations for unlikely cases of chance finds.

The legal stipulations apply to construction phase. However, based on the consultant's knowledge of the project area, no cultural heritage is indicated in the project area or its proximity.

2.3 Guidelines of the International Financing institutions

In addition to Law 4/1994, this ESIA is prepared according to the requirements of the international finance institutions particularly the IFC for projects proposed for financing. In this context, the IFC requires the projects to abide by its Performance Standards to ensure that they are environmentally sound and sustainable. Performance Standards (PSs) are applied to manage social and environmental risks and impacts. The performance standards define clients' roles and responsibilities for managing their projects and the requirements. The standards also include requirements to disclose information. The IFC PSs are:

Performance Standard 1: Social and Environmental Assessment and Management System

Establishes the importance of:

(i) integrated assessment to identify the social and environmental impacts, risks, and opportunities of projects;

(ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and

(iii) the client's management of social and environmental performance throughout the life of the project.

This performance standard is relevant to most projects and applies to the current one.

Performance Standard 2: Labor and Working Conditions

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

This performance standard applies to the aspects of employment during the different project phases.

Performance Standard 3: Pollution Prevention and Abatement

Recognizes that industrial activities often generate increased levels of pollution to air, water and land, which can have potential adverse impact on the surrounding environment.

The performance standard applies to the potential emissions and wastes (solid and liquid) from different sources during construction and operation phases and their potential impacts.

Performance Standard 4: Community Health, Safety and Security

Recognizes that the project activities and infrastructure can increase the potential for community exposure to risks and impacts arising from equipment accidents, structural failure and releases of hazardous materials. Impacts may also arise from exposure to diseases and the use of safety and security personnel.

Regarding the proposed project is a PV power plant and is located inside the premises of Benban Plant at distance of about 2 km from Cairo-Aswan Highway, thus potential exposure of the outside communities, particularly the nearby Cairo-Aswan road users, to the construction risks is expected to be minimal and localized. Moreover, potential impacts on the community, during operation are expected to be insignificant. However, these potential impacts will be addressed in this ESIA. Moreover, options for the site security is to addressed in coordination with the other developers collectively.

Performance Standard 5: Land Acquisition and Involuntary Resettlement

Recognizes that the project design minimizes economic and physical displacement, balancing social environmental and financial costs and benefits.

The location of the proposed project is within Benban Plant premises assigned to NREA, thus no involuntary resettlement for this specific project or change in current land use would take place.

Provisions of this performance standard do not apply to the proposed project since the activities will not involve any involuntary resettlement or change in the land use.

Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management

This PS addresses how projects can avoid or mitigate threats to biodiversity arising from their operations as well as sustainably manage renewable natural resources.

As a significant part of the ESIA, the biological baseline in the project area is to be described. Preliminary information about the proposed project area indicates absence of significant ecological diversity. Yet, the ESIA will describe the different habitats and biodiversity surrounding the area and investigates the potential project impact on them, where/if applicable.

Performance Standard 7: Indigenous Peoples

This PS aims at preventing adverse impacts of the projects on communities of Indigenous peoples and to provide opportunities for development benefits.

Provisions of this PS do not apply to the proposed project since there are no indigenous communities in the area.

Performance Standards 8: Cultural Heritage

The objective of this PS is to protect the cultural heritage from the adverse impacts of the project activities and support its preservation.

No cultural heritage components are expected. Moreover, there are no registered archeological sites within or in close proximity to the proposed project location.However, measures for cases of chance find will be addressed in the ESIA.

2.4 Workplace EHS Guidelines of Arinna Solar Power

Arinna Solar Power adopts a set of policies for environmental issues and defines and communicates the environment, health and safety standards to their employees and contractors.
Arinna Solar Power has a Quality, Environmental, Health and Safety Integrated Management System based on ISO 9001:2008, ISO 14001:2004 and OHSAS 18001.

The Integrated Management System is a tool that helps maintaining a safe workplace to protect the employees and prevent injuries and illness. For this reason, the organization has developed work procedures and instructions to carry out the processes according to the policy and goals of Arinna Solar Power.

All company activities are carried out having concern for the environment and complying with the regulations in terms of Environment, Health and Safety.

The main cornerstones of these systems are

- Setting the Quality, Environmental and Health and Safety standards in the Workplace as strategic elements for the operation of the company.
- Complying with all legal and regulatory requirements and all commitments undertaken related to quality, environment and the health and safety of workers.
- Providing effective technical advice, continuous care, meeting agreed deadlines and immediate care to deal win potential claims
- Promoting training and awareness among employees by ensuring the level of training, motivation and technical means necessary for the efficient performance of their activities
- Targeting efforts to continuously improve the quality of our services as well as the efficiency of our processes, boosting relationships with customers.
- Planning activities in such a way that it ensues the prevention of pollution, damage, and impairment of the health of employees, promoting the continuous improvement of environmental and work-related performance
- Promoting communication mainly by informing employees of the commitments undertaken with regards to quality, environment and occupational health and safety
- Creating a work environment facilitating appropriate personnel participation in all activities and in achieving objectives
- Planning activities so as to ensure pollution prevention, promoting the continuous improvement of performance in the environmental realm.
- Promoting the rational and efficient use of natural resources, and implementing actions aimed at reducing, reusing and recycling the materials generated as a result of activities
- Minimizing the environmental impact caused by activities with particular emphasis on the waste generated, especially hazardous waste.

In addition, Arinna Solar Power seeks to contribute to life quality improvement and the welfare of the local community. In this regard, the following will be implemented;

- Create a more sustainable energy model: where the sun is an inexhaustible and independent resource which does not send emissions to the atmosphere.

- Contributes to job creation: Gestamp employs personnel along the entire value chain: development, production, construction, operation, maintenance and recycling.
- Promotes local employment.

3. Project Description

3.1 Project Location

Arinna Solar Power SEA Solar is planning to establish a 20 MW Photovoltaic (PV) plant within Benban PV Solar Park, NREA has allocated 37 km^2 for generating electricity from solar power. The project site is located in the desert of Upper Egypt approximately 50 km to the north of Aswan airport, 25 km to the west of Kom Ombo city, with an approximately 5.3 km from the paved Western Desert Highway Luxor-Aswan. The project area is desert land and the nearest residential area (Benban village) is about 15 km to the east of the site and at the Nile bank. Figure 3-1 below shows the activities surrounding the proposed location of the PV plant.

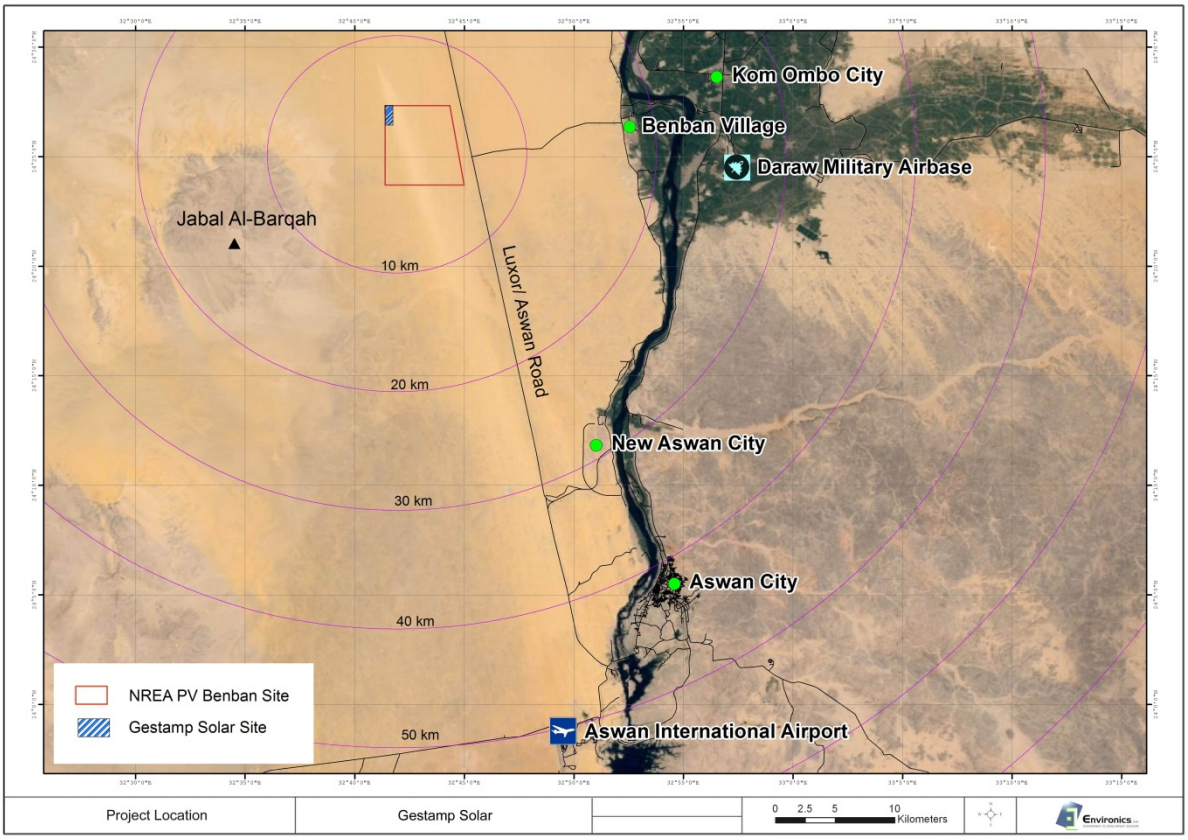


Figure 5-2: The Site and Surrounding Activities

The proposed PV plant will occupy the parcel SBN-(1-1). Currently, the site within Benban solar park is surrounded by empty undeveloped land plots that have been designated for other developers. In the future, the site will be surrounded by other PV plants. Benban village is located at distance of about 15 km from the solar park premises. Kom Ombo city and Daraw military Air base located at about 25 km eastern the solar park premises. Figure (3-2) shows the location of Arinna Solar Power PV site within the solar park

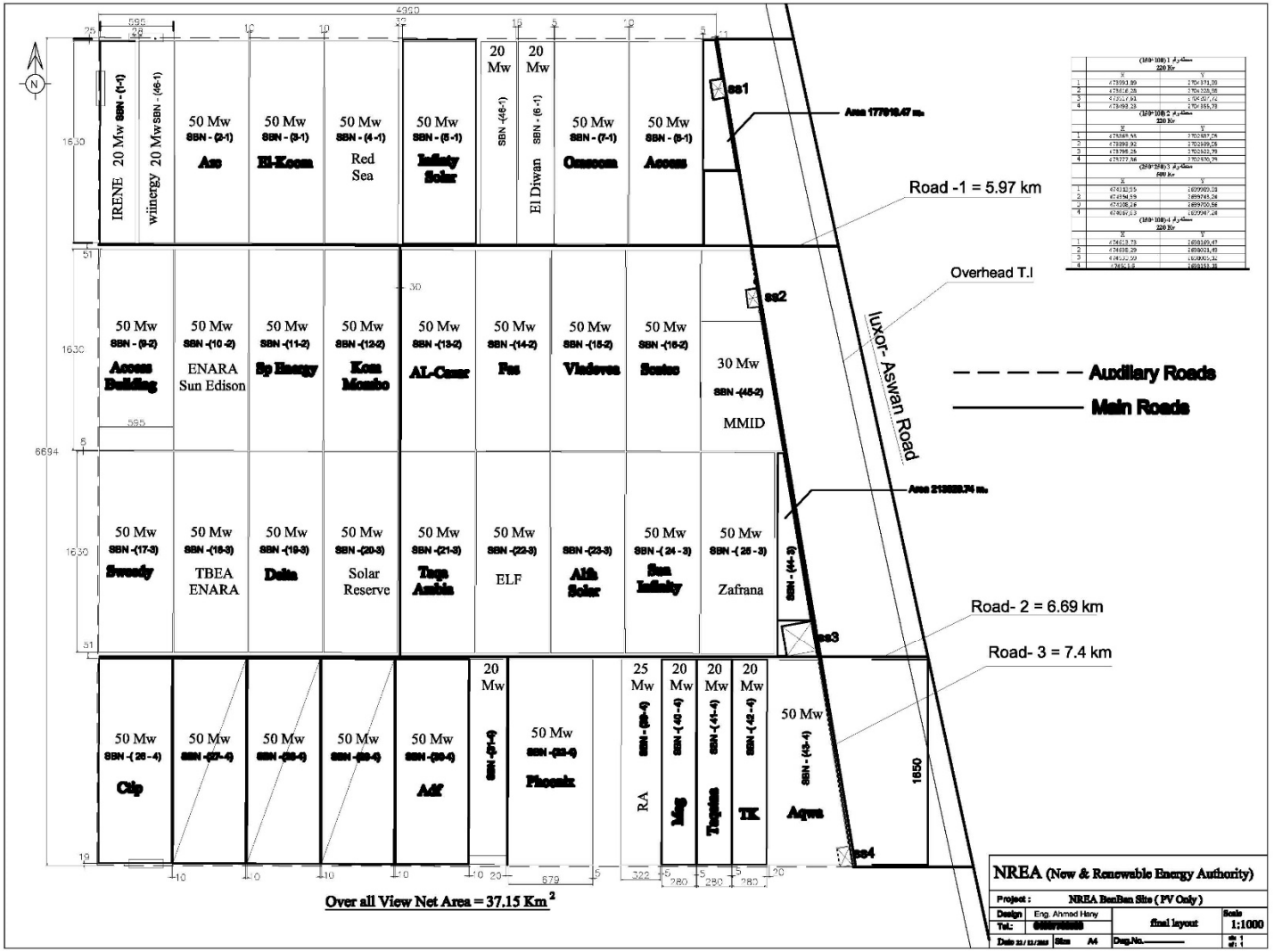


Figure (5-3): Arinna Solar Power SAE Solar Project (plot 1-1)

3.2 Process Description

NREA is planning to construct four substations to connect the electric power produced by PV plants within Benban Complex to the national grid. The proposed PV project is one of these utility scale and grid connected plants.

The proposed project comprises three broad components as follows:

- ***Solar Field (PV Modules):*** The solar energy conversion to electricity takes place in a semiconductor device that is called a solar cell. A number of solar cells are connected together to form a PV module (solar panel). These are the heart of the PV system.
- ***Electro and electromechanical equipment***: The electric current produced by the PV modules is DC current, which is transformed to AC current through the inverters. In addition, transformers and switchgears are used to control the power output of the solar modules.
- ***Connection to the grid***: The project is a utility scale type and will be directly connected to the National Grid through lines and substations to be established by NREA.

The following sections address the process description of the proposed project.

3.2.1 Solar Field

The project involves installation of a 20 MWac capacity solar field plant.

- ***Solar Field Technologies and Positioning***

  PV module technologies can be classified into three categories depending mostly on the module manufacturing technology and/or the main material type and grade employed in producing PV modules. These categories are:

  - Mono and Poly Crystalline Silicon
  - Thin-Film Silicon
  - Compound Thin-Film

  The PV plant will consist on the installation of polycrystalline silicon solar modules mounted on a single axis tracking system.

- ***Orientation of the Modules with Respect to the Angle of the Sun***

  For optimal performance, PV systems aim to maximize the time they face the sun. In static mounted systems modules are often set to latitude tilt, an angle equal to the latitude.

86,190 pieces of 325 Wp Polycrystalline Silicon cells will be installed. PV panels will be installed at a height between 2-2.3 m.

The cells are treated with a special non-reflective layer to ensure consistency of color, preventing discoloring within the module and noticeable aesthetic improvement.

Modules are treated in such a way that they can withstand inclement weather conditions and operate efficiently without interruption during their long useful life.

A combiner box will be used to combine the output of several strings coming from each row into a single DC source output. DC cables from the PV modules to the combiner boxes will be tied to the fixed structure.

It is worth mentioning that adequate spacing will be kept between the PV arrays in order to limit the effect of shade. This distance takes into account maintenance and operation.

3.2.2 Electric Equipment

After combining the DC current produced from the solar field stage (PV modules), power production mechanism takes place through the following electrical equipment:

- **Inverters:** Inverters will be used to convert direct current (DC) from the combiner boxes to alternating current (AC) and are to be constructed by Arinna Solar Power SEA. In addition, the inverters will perform other functions for power quality and control as follows:
  - Automatic operation: The inverter automatically shuts off when the sun goes down.
  - Prevention of stand-alone operation: When the connection with the National Grid is for any reason disabled, the inverter detects the change and stops the PV power generators.

  The facility will be divided in blocks. Each one consisting of one inverter station, total number of 6. Each block has a capacity of 4,000 kWn. The LV AC system comprises the connection from the inverters to the step-up transformer as well as the auxiliary power supply. LV transformer will elevate the incoming voltage from 400 V to 22 kV.

- **Switchgear**

  Once the current is converted into AC 22 kV, the energy will be conducted to the plant switchgear, which is a circuit breaker that protects the downstream circuits against short circuits, over-loads and other electrical faults.

- **MV Step-Up Transformer**

  This is to be constructed by Arinna Solar Power SEA to step up to 220 kV. In this respect, developers would need to coordinate together the cable laying activities to connect to the substations.

  Oil cooled transformers and self-cooling (air cooled) type transformer are used as these are similar to those used by the Egyptian distribution company.

- **Control System**

  One Supervisory Control and Data Acquisition (SCADA) system will be installed to collect information.

3.2.3 Connection to the Grid

As mentioned before, and as part of the interconnection installations, it is planned by EETC to build substations to receive the electrical production from the PV plant (220 kV) and to elevate to the line voltage.

Figure (**5-4** shows a schematic diagram of the project.

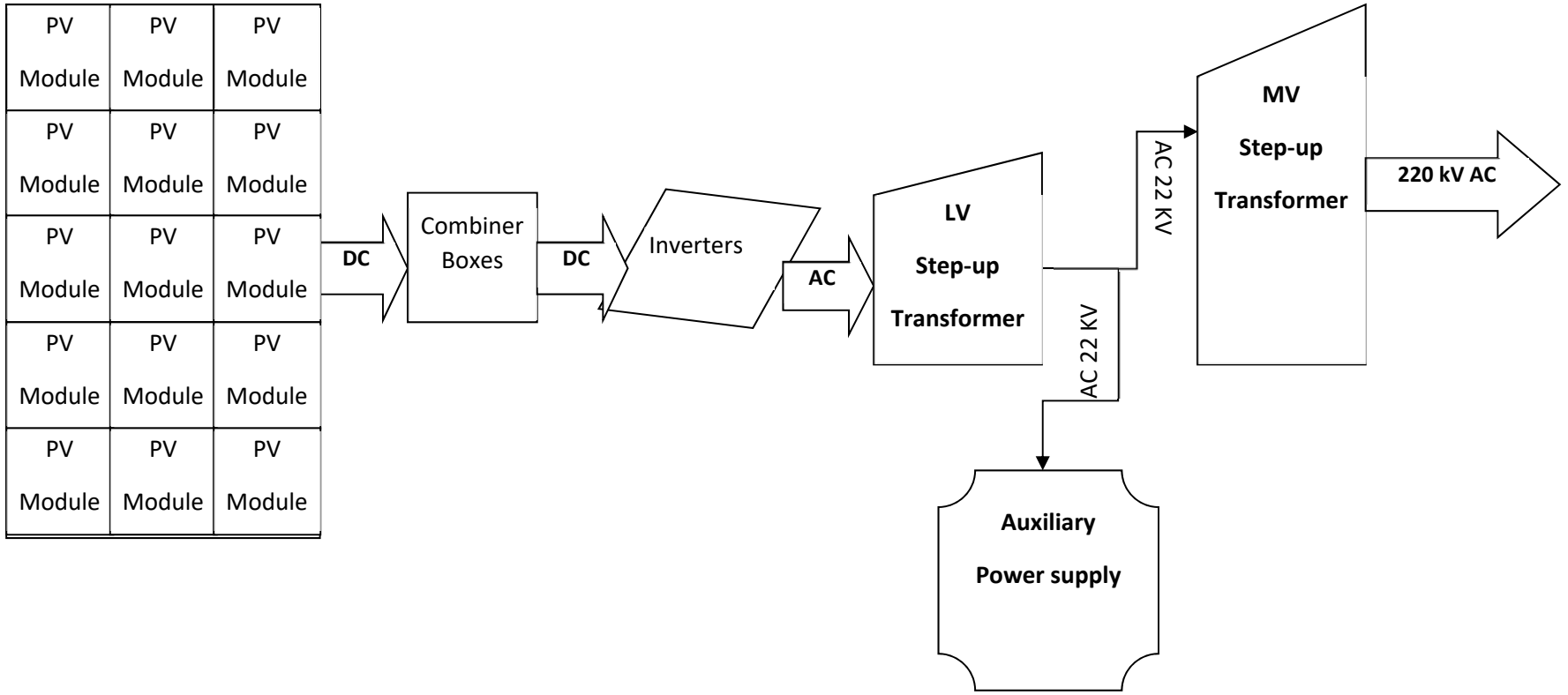


Figure (5-4): Project's Schematic Diagram

3.3 Utilities and Infrastructure

The PV plant will use different utility units, including the following:

3.3.1 Buildings

- **Construction**

During construction the following facilities will be constructed to house and service employees (laydown areas).

- Offices
- Warehouses
- External storage
- Accommodation
- Mess/ eating facilities
- Sanitary facilities

- **Operation**

Buildings will be constructed to house employees and operation and maintenance activities.

3.3.2 Storage tanks

- **Sewage tank**; will be used for the wastewater discharged through the network within the facility during construction and operation. The sewage tank will be emptied by external contractors authorized by the governorate for WW disposal. The wastewater would be discharged at the nearest wastewater treatment plant in Ballana (daily treatment capacity about 3200 m^3/day[2], serving Daraw and Kom Ombo at about 20 km from Benban.
- **Diesel generator and associated tank:** diesel will be used to power a generator for construction works.
- **Emergency diesel tank:** diesel will be used to generate electricity as backup power during operation to move the tracker system to safe operation mode (stall position) during power cut off. Thus, an emergency standalone tank with a capacity of 3 m^3 and made of steel will be constructed to supply the generator in case of emergency.
- **Potable water tank**; during construction, water will be supplied from tanks. A PVC tank will be considered with supporting structure, foundation and the civil works associated to its own pipe network with a total capacity of 10m^3.

  The water is expected to be provided through a subcontractor.
- **Fire protection** Fire extinguishers will be used for fire protection purposes instead of water. The fire extinguishers will be placed in key locations distributed throughout the site, and will be kept near electrical installations or elements that can pose a fire hazard. In addition, three fire water tanks will be installed of capacity 5m^3 each**.**

[2] Aswan Environmental Profile, 2003

3.3.3 Security measures

In the course of ensuring that operation assets and personnel are secured and safeguarded in a legitimate manner, Arinna Solar Power SEA will ensure sound security measures are undertaken. For project security purposes all cables for power and communication will be steel armored to prevent sabotage. Protection against lighting will also be present on site.

An alarm system will be installed. The system will be linked to 24 hour manned control room as per insurance requirement.

3.3.4 Safety measures

For protection against fire,

- fire extinguishers will be permanently installed at each transformer/inverter station
- Adequate fire extinguishers will be present in O&M building
- Perimeter road should serve as fire break.
- a water reservoir will be constructed

3.4 Construction Activities

3.4.1 Main Activities and Schedule

According to the determined timeframe, the overall construction activities will be finished within 13 months from obtaining all the necessary permits and approvals. Site construction works are expected to take 12 months, grid connection is expected to take 1 months. Construction is expected to start in the October 2017. Major on-site activities will include civil works, construction of buildings, installation of equipment and utilities, testing and commissioning of equipment, and piping.

- **Site preparation**

  The following activities will be implemented during the site preparation stage:

  - Site survey and geotechnical investigations will be conducted to prepare the site for construction.
  - Clearing the site of rocks, vegetation, levelling the ground.
  - Ensuring that adequate space is provided for satisfactory operation and maintenance of the plant items.
  - Complying with drainage requirements with minimum site preparation costs.
  - On site soils testing of all foundation compactions.

- **Access roads & entrances**

  To have access to the site, a new road of about 6 km will connect the main entrance PV installation with the existing asphalt road. The entrance of the PV plant will be set on the north side of the parcel.

  Clean surface material will be reused to the most possible extent for road

filling and will be provided on site.
Roads of the solar field will consist of compacted site material and gravel capable of support of the transit loads during construction and operation.

- **Laydown areas**
  - An area designated for storage of equipment and works machinery, and any necessary material production will be laid out in this area.
  - Temporary structures for offices, tool rooms, warehouses and other uses will be provided, as deemed necessary during the execution of the work as mentioned in 3.3.1.
  - It will be furnished for all construction plant and temporary facilities and all equipment, materials and supplies required for execution of the work.
  - Sanitary facilities for workers during construction phase

  When the construction work is completed, all such temporary structures and facilities will be removed from the site and areas disturbed by those structures and their use will be restored to a condition at least equal to their original, undisturbed condition.

- **Fencing and gates**
  The perimeter fence height will be minimum 2.5 meters above grade and have climb-over protection.

3.4.2 Estimated number of the required labor

During Construction: The direct labour force required for the project construction will be in the average of 75 workers at peak construction stage, including skilled and unskilled persons. Approximately, 80% of the work will be undertaken by skilled and semi-skilled workers, while 20% of construction jobs will be undertaken by skilled labour. The company will encourage contractors to hire most workers from local communities. All aspects related to workers accommodation will be addressed through the Management Facility Company that will be designated by the Benban Developers Association (BDA)

3.4.3 Construction Emissions and Wastes

Construction operations may generate gaseous emissions, liquid effluents, noise and solid waste as follows:

- **Noise**

  The main noise sources during construction include heavy equipment, and cutting machines and vehicle movement.

- **Air Emissions**

  Air emissions during construction phase include smoke, fumes, exhaust gases and dust from site clearance, excavations and filling, construction and

transportation of construction materials.

- **Wastewater**

  The generated wastewater will be unloaded by external truck of authorized WW contractors.

- **Solid Waste**

  Non-hazardous solid wastes will include:

  - Packaging and plastic, wood pallets waste
  - Potentially broken panels
  - Unused construction materials, off-cuts from piping and cabling bulks;
  - Civil wastes and debris such as sand, cement, bricks, aggregates, steel parts, aluminium, wood, etc.
  - Municipal solid waste from workforce, offices and administration buildings.

  The solid waste will be collected by a licensed contractor for safe disposal through the approved sites or sent for recycling as feasible. Winnergy will separate non-hazardous wastes in labelled containers prepared for this purpose.

- **Hazardous waste**: include mainly waste oil, contaminated absorbent materials, used sprays, contaminated plastic and metallic containers from machinery and maintenance activities. Winnergy will store, pack and label hazardous wastes according to valid national legislation and remove hazardous waste through authorized waste management officers.

3.4.4 Superficial Water Sources Consumption during construction

During construction, large volumes of water will be required for sanitary purposes. Assuming 50 liters per capita this can amount around 3.75 m3 per day during peak time, plus any water required for construction (concrete production for building work; equipment cleaning). There can also be a requirement to control fugitive dust (e.g. from vehicle traffic on unpaved roads) by water spraying.

		Estimated Water Consumption			
Number of workers	Consumption by workers (liters/day)	Daily		Monthly	
		litre	Cubic meter	litre	Cubic meter
75	50	3750	3.75	112500	112.5

The waste consumption for construction activities and fugitive dust emission control is estimated on 10m3/day

	Estimated Water Consumption			
	Daily		Monthly	
	Liters	Cubic m	Liters	Cubic m
Construction activities	10000	10	300000	300
Workers consumption	3750	3.75	112500	112.5
Total consumption	13750	13.75	412500	412.5

Provision of adequate sanitary facilities during construction will require substantial volumes of water during the construction phase. Assuming 50 liters per day per person on site this could in total require around 3.75 m3 per day (for 75 workers). These volumes are manageable and could even be brought in by tanker.

3.5 Operation Activities

3.5.1 Labour

Permanent employees on site are expected to be 5 workers. According to the company's employment policy, preference will be given to workers from neighbouring areas, depending availability of suitable qualifications.

3.5.2 Operation Emissions and Wastes

- **Wastewater**

  The generated domestic wastewater will be unloaded by external truck of authorized WW contractors.

- **Solid Waste**

  Non-hazardous solid wastes will include mainly municipal solid waste from workforce, offices and administration buildings. The solid waste will be collected by a licensed contractor for safe disposal through the approved sites.

- **Hazardous waste**: include mainly waste oil from machinery and maintenance activities.

3.5.3 Water consumption during operation phase

During operations, water large quantities could be required for panel cleaning; water requirements for sanitary purposes will be low as the number of control and maintenance workers.

Because of sand-blow, panels will have to be cleaned regularly to prevent dust build-up which would affect panel performance. Figure below shows a panel exposed at Benban, covered with a thin film of sand, next to a clean one. A

realistic frequency for cleaning is not known and depends on weather conditions. Cleaning can be done with or without water (brush cleaning), in commercial PV installations often with automatic or semi-automatic cleaning systems. The figures below show examples of both cleaning methods.

According to developers with PV installations operating in similar conditions (desert environment), cleaning could become necessary once or twice per month. Dry cleaning mechanism will be utilized, alternating with „wet cleaning" every two months for optimize the use of water resources an maximizes water use efficiency. Cleaning with water could require between 2 and 4 liters per panel for each cleaning cycle. The estimated water consumption during Operation and Maintenance Phase is presented in the following table.

		Estimated Water Consumption			
		Bimonthly		*Annual*	
Number of PV panels	Liter/ Panel	Liters	Cubic m	Liters	Cubic m
95,220	3	285,660	285.6	1,713,960	1,713.9

4. Environmental Baseline

The content of this chapter is based on review of the available and publicly accessible documentation addressing the relevant environmental aspects of the project in addition to site visits and ecological survey in 28th of July 2015 and 11th of November 2015. In case of additional information/details are provided in the final SESA report, these will be incorporated in this ESIA, when the final SESA is made available to the developers. The environmental baseline addresses in the following issues in particular:

- **Physical Environment**
- **Biological Environment**
- **Socio-economic characteristics**

The environmental baseline also aims to provide assessment of the environmental sensitivity at and/or surrounding the selected site and potential hazards of the study area.

This section provides a description of the main physical environmental components at the project area including climate and meteorology, air quality and noise, as well as electricity infrastructure. The aim of presenting these data is providing benchmark analysis of the status of these components before commencing the project activities to provide information for decision makers as well as secure reference conditions for future environmental monitoring/audit, if any.

The project is planned to be located on the desert in the south Egypt, 50 km approximately to the north of Aswan airport and 20 km to the west of the city Kom Ombo.

The site is located at 15 km to the west of Benban Village which is the nearest residential area. The site is approximately 2.0 km from the paved Western Desert Highway Cairo-Aswan. The following table shows the project coordinates.

Table (4-1): Project Coordinates

Point	X	Y
1	468845.31	2704679.94
2	468845.31	2703049.95
3	468556.26	2703050.53
4	468559.63	2704680.53

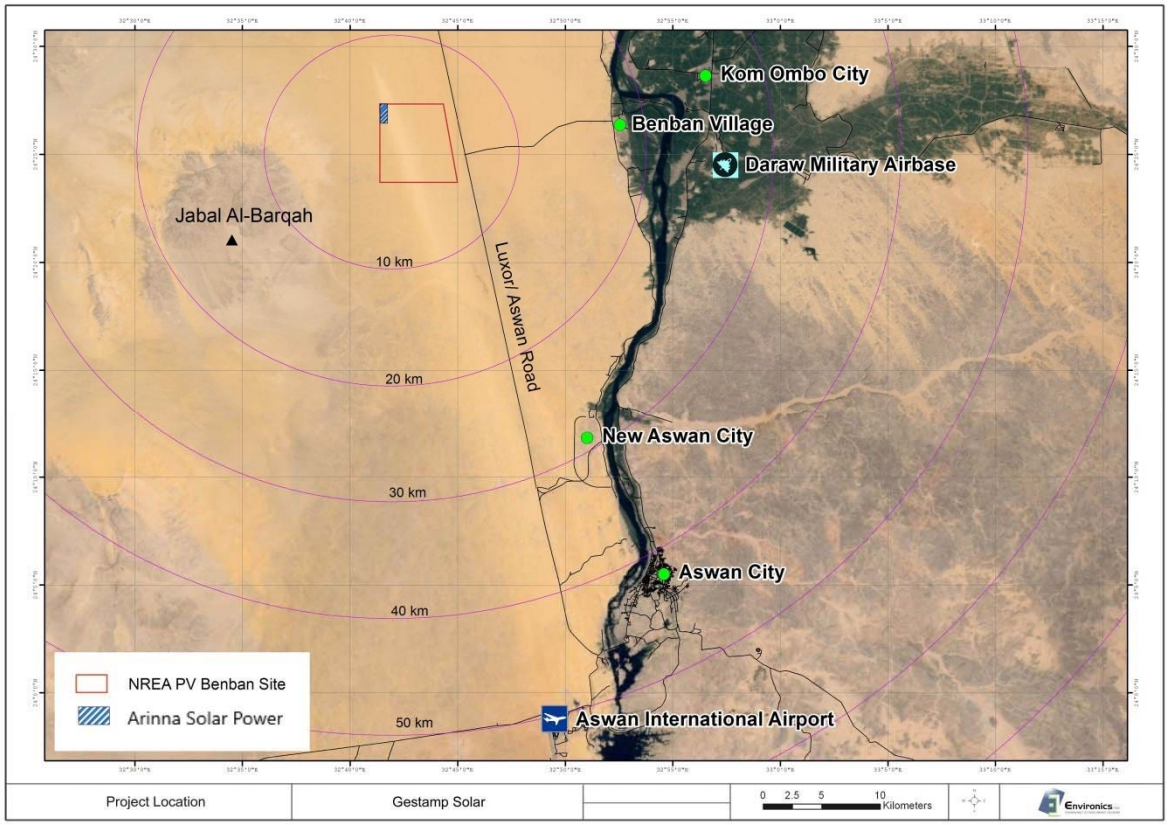


Figure (4-5): Location and Surrounding Area of the Proposed PV plant

4.1 Physical Environment

4.1.1 Climate

The climatic and meteorological data presented herein was obtained from the closest station located in Aswan. The study area is located within the Western Desert, and accordingly is characterized by hyper-arid conditions. The climate is generally extremely dry, bright and sunny year round, with annual average of rainfall about 1.9 mm and averages high temperatures are consistently about 32.5 °C according to Aswan meteorological station, Egyptian Meteorological Authority in 2011 as shown on table (4-2).

Table (4-2): Climate Indicators of Aswan station

Annual average of air temperature	25 °C
Annual maximum average of air temperature	32.5 °C
Annual minimum average of air temperature	17.5 °C

Source: Aswan meteorological station, Egyptian Meteorological Authority, 2011

a) Wind

The prevailing wind is NW-NNW dominate most of the year. Generally, the wind speed varies between 8.3 knots in December and 9.4 knots in April. During winter season at Aswan, the wind speed varies between 8.3 and 9.4

Knots, while in summer season it varies between 8.7 and 9.1 knots, as shown below.

Table (4-3): Monthly average of Wind Speed

Month	Wind Speed (knots)
January	8.7
February	9.1
March	9.4
April	9.4
May	9.1
June	9.1
July	8.8
August	8.7
September	9
October	8.9
November	8.4
December	8.3
Average	8.9

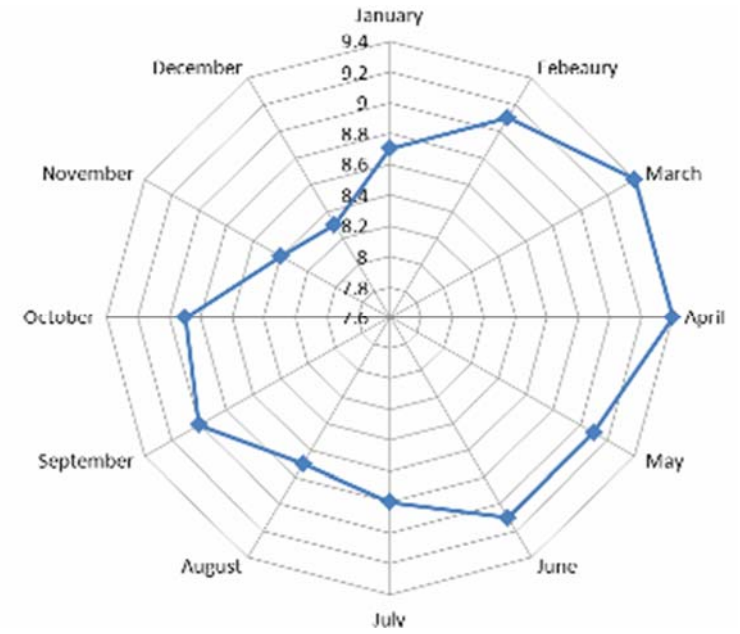


Figure (4-6): Monthly average of wind speed

b) Temperature

January is the coldest month, where it has the minimal air temperature throughout the year about 9.5 ºC, while July is the hottest month and the air temperature reaches its maximum value of about 39.5 ºC. Figure (4-3) shows the monthly distribution of monthly maximum, minimum and

average air temperature in Aswan from the Egyptian Meteorological Authority.

Table (4-4): Monthly maximum, minimum and average of air temperature

Month	Minimum (°C)	Maximum (°C)	Average
January	9.5	23.5	16.5
February	10.5	25.5	18
March	13	28	20.5
April	17.5	33	25.25
May	20.5	37.5	29
June	23	39	31
July	24.5	39.5	32
August	24.5	39	31.75
September	22.5	37	29.75
October	19	34	26.5
November	14.5	28.5	21.5
December	10.5	24.5	17.5

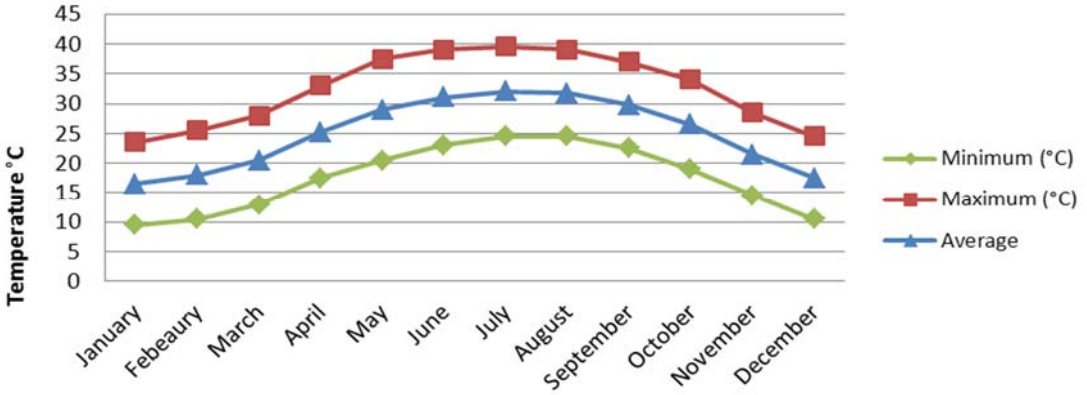


Figure (4-7): Monthly maximum, minimum and average of air temperature

c) Rainfall

In general the rainfall doesn't occur every year and the average rainfall over the year less than 2 mm/year.

d) Global Solar Radiation

An accurate knowledge of solar radiation distribution at a particular geographical location is of vital importance for the development of many solar energy devices and for estimates of their performances. Global radiation is the total short-wave radiation from the sun falling onto a horizontal surface on the ground. It includes both the direct solar radiation and the diffuse radiation resulting from reflected or scattered sunlight.

The Solar Atlas was issued in 1991[3], indicating that Egypt as one of the sun belt countries is endowed with high intensity of direct solar radiation ranging between 2000 – 2600 kWh / m^2 / year from North to South. The sunshine duration ranges between 9 – 11 hours with few cloudy days all over the year.

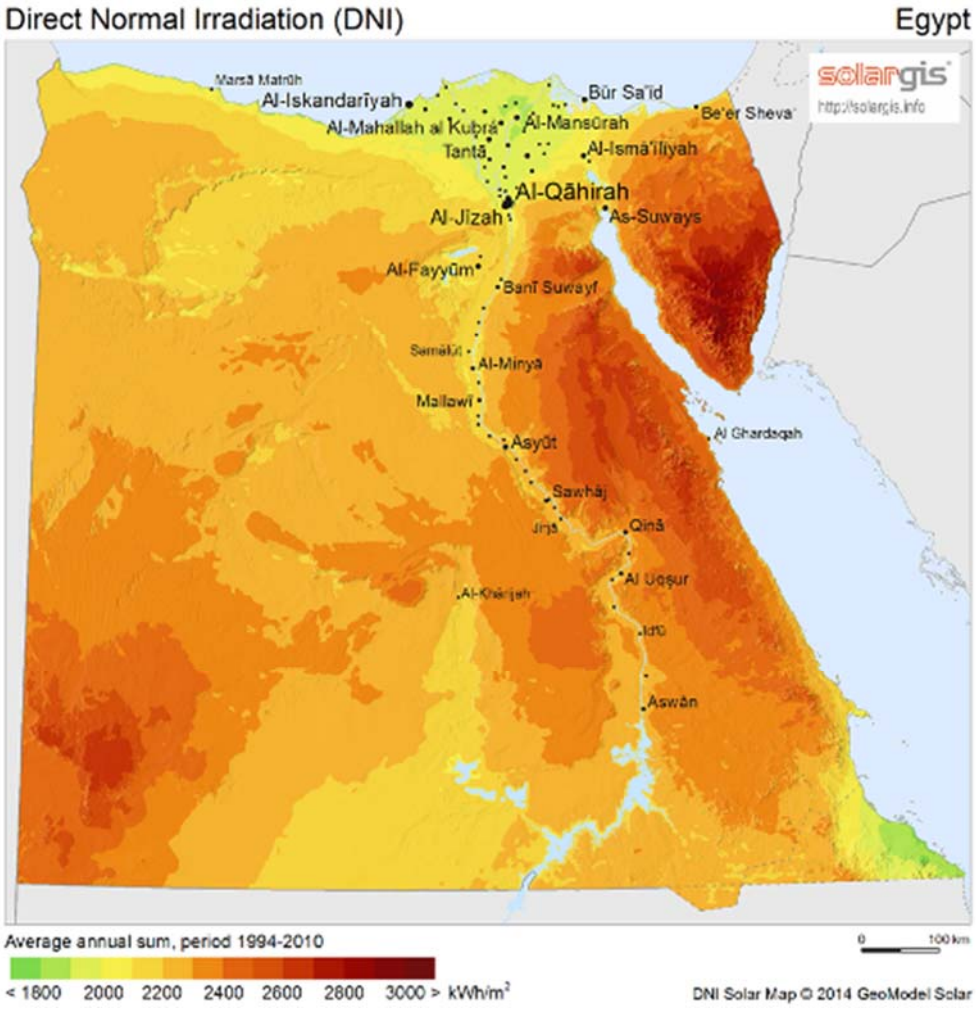


Figure (4-8): Solar Map of Egypt

e) Evaporation

The evaporation rate is generally high in Aswan, with a maximum of 19.3 mm/day in June and a minimum of 6.3 mm/day in January.

f) Relative Humidity

The average relative humidity is 25.25% over the year (table 4-5). It fluctuates according to the air temperature and wind conditions.

[3] New and Renewable Energy Authority (NREA), Ministry of Electricity as part of the Renewable Energy Testing Project initiated and managed by NREA and the US Agency for Inernational Development (USAID) 1991

The relative humidity pattern refers to the presence of two summits through the year in Aswan during January, and December. The average relative humidity varies between 16% during May and 40% during November, as shown on (table 4-5).

Table (4-5): Monthly averages of relative humidity

Months	Average Relative humidity (%)
January	39
February	30
March	23
April	18
May	16
June	16
July	18
August	20
September	22
October	26
November	35
December	40
Average	25.25

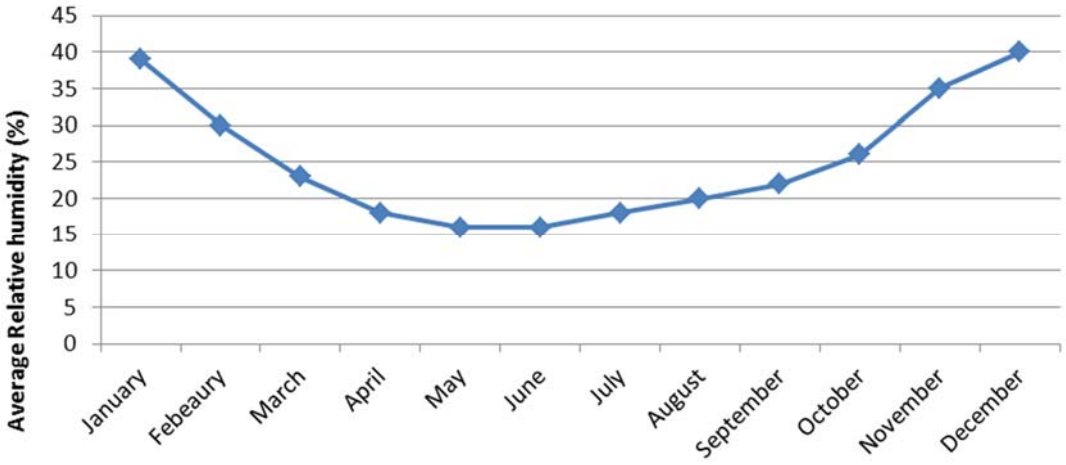


Figure (4-9): Monthly averages of relative humidity

4.1.2 Geomorphology, Geology and Hydrology

a) Surface Topography and Geomorphology

The area is mostly flat lowland with the presence of a few low-height sand dunes ranging between 2 to 4 m high. Elevation in the project site varies between 159 and 164 meters above the mean sea level. The project site is located 50 km west of Aswan City, and it can be accessed through Aswan suspension bridge, which links between east and west parts of Aswan city, for 10 km, then another 34 km along the northern-west side of Aswan suspension bridge. Proposed roads (dusty paths), in the study area, are located at intervals ranging between 3 and 7 km, west of the western desert highway.

Mountain Jabal El Barqah is located at about13 km west of the project site. The rock unit is fragmented sandstone with interventions of gravels and conglomerate.

The study area is located within the upper unit of the Nubian sandstone.

Table (4-6): Geomorphological Characteristics of the study area

Layer	Thickness	Key components
Upper layer	20 - 85 m	Different types of shale with quartzite formations
Intermediate layer	10 - 22 m	Sequences of sand rocks rich in iron components
Lower layer	40 - 55 m	Conglomerate, gravel and fragmented sand rocks

Source: Said, 1962

Nubian sandstones are widespread along the western side of the Nile Valley. While on the Eastern site, Nubian sandstones start narrowly to show north of the High Dam surrounded by igneous and metamorphic rocks; then sandstones starts to show up again. The Nubian Sandstone consists of alternating beds of sandstone and clay. The clay beds are laterally discontinuous and separate. The sandstone is separated into a multi-layered aquifer system, bounded below by impervious basement rocks. The Nubian Sandstone is occasionally overlain by impervious rocks and interbedded by clays.

The thickness of the sandstone system ranges between 500-1000m near the Sudanese borders and in regions north of Kharga Oasis, 500-2000m in Farafra and 500-3500m in regions south of Siwa. The Regional salinity distribution shows a decrease of salinity towards south from highly saline in the north to fresh water in the south with average salinity of less than 1000ppm.

Table (4-7 shows the characteristics of main aquifer systems of Egypt. The proposed project is located within the Kharga aquifer system, as shown in

Figure (4-10 below.

Table (4-7): Characteristics of main Aquifer Systems of Egypt

Name of aquifer	Type locality	Depth of top aquifer (m)	Saturated thickness (m)	Depth to water table (m)	Hydraulic conductivity (m/day)	Porosity (%)	Salinity (ppm)
Granular rocks							
Nile Valley and Delta aquifer	Nile Valley	0–20	10–200	0–5	50–70	25–30	<1,500
	Nile Delta (south)	0–20	100–500	0–5	50–100	25–30	<1,500
	Nile Delta (north)	20–100	500–1,000	0–2	<50	>30	>5,000
Coastal aquifers	Mediterranean	0	<5	±15	15–25	>30	1,000–6,000
	El-Qaa plain	50–100	60–80	50–70	5–10		600–2,500
	El-Arish aquifer	15–30	40–50	0–30	5–20		1,500–6,000
Nubian Sandstone	Western Desert						
	Kharga	50–200	500–700	0–30	2–4	20	<1,000
	Dakhla	200	500–1,000	0–20	6–7	20–25	<1,000
	Bahariya	150–300	1000–1,500	0–20	5–10	20–40	<1,000
	Farafra	200–500	1000–2,000	Flow	2–5	20–30	<1,000
	East Oweinat	10–20	100–300	20–30	10–20	20–30	<1,000
	Nile basin fringes						
	Qena area	100–250	500	Flow	1–2		2,000–2,500
	Laqeita area	100–500	200–400	Flow	1–3		1500–2,000
	Eastern Desert						
	Esh El Mallaha	0–30	>200	Flow			3,000–4,000
Nubian Sandstone	Sinai						
	Nakhla	1000	2,000	200			1,500–2,000
	Oyun Moussa	100–500	1,500	Flow			1,000–4,000
Mohgra aquifer	Natron/Qattara	0–200	500–900	100		20	1,000–1,2000
Fissured rocks							
Carbonates	Wadi Araba	0–100	500	Flow			1,000–1,2000
Hard rocks	South Sinai	0–50		+50			1,000–2,000

Depths are measured from ground surface

Source: Goundwater of Egypt" an environmental overview, M.R.El Tahlawi, A.A. Farrag, S.S. Ahmed, Environ Geol, 2007
Groundwater Assessment in Egypt, K.Hefny, M. Samir Farid, M. Hussein, Planning for Goundwater Development in Arid and Semi Arid Regions, Round Table Meeting October, 1991. "

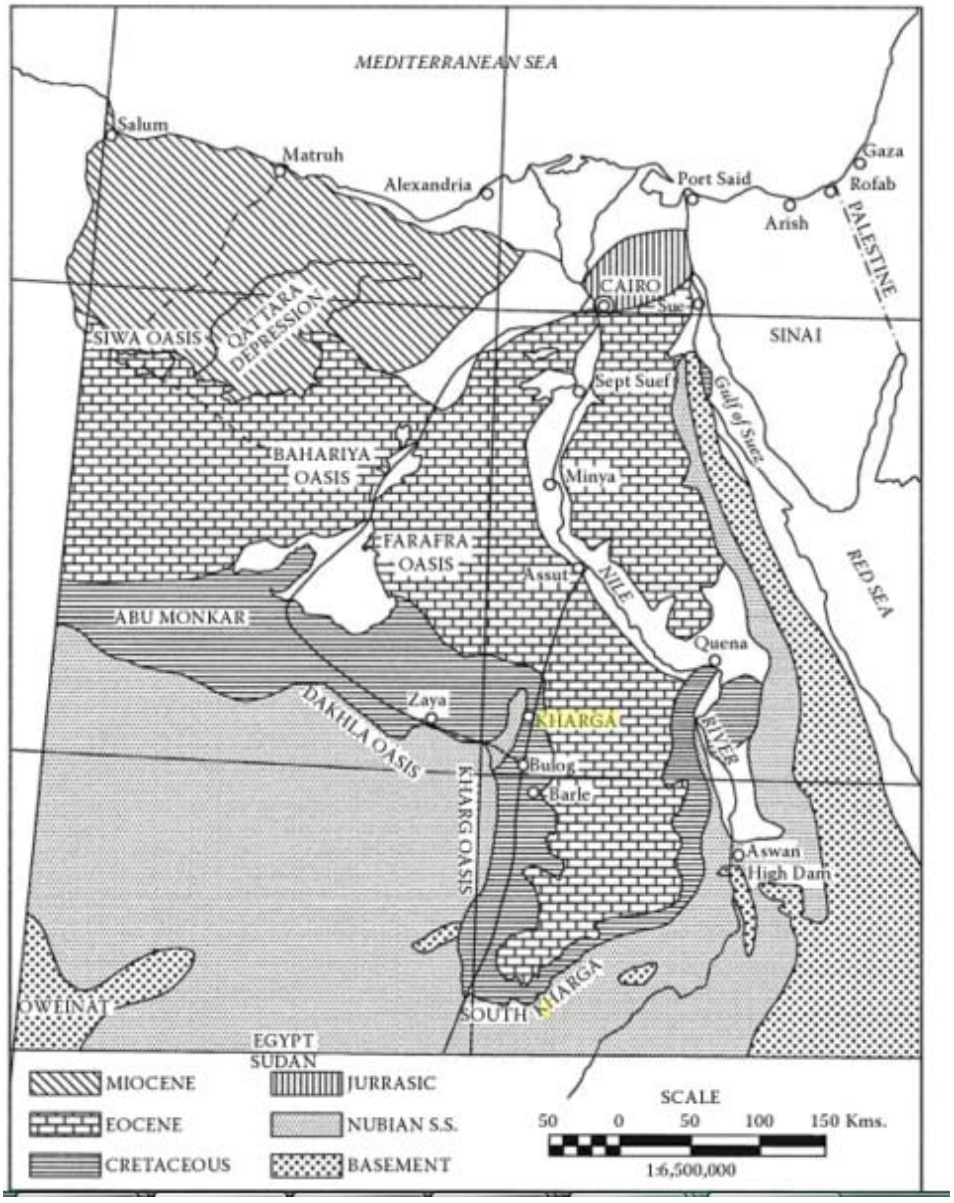


Figure (4-10): Geological map of the project area

Source: Environmental Hydrogeology, Second Edition 2nd Edition by Philip E. LaMoreaux ,James W. LaMoreaux,Mostafa M. Soliman, Bashir A. Memon,Fakhry A. Assaad, 2009

To the north of Daraw, there is a wide valley on the western side of the Nile surrounded by wavy sandstones. On the eastern side, there are sand dunes in Kom Ombo plains in the form of a semi-circle or a large arc starting from New Balana, New Toshka and Enaiba (which represents the middle of the arc) passing through Ibeem and Nasser till its final destination at Al-Selsela mountain with vertical ridges at both sides of the river.

Loose sand sediments are widespread, which are formed as a result of erosion factors that disintegrated sandstones, covering the surface of the area. When wind blows, it carries such sand over a long distance to diposit, when it gets

weaker, behind the isolated heights or at the top of plateaus and dunes interrupting such winds. When sand settles during the journey, it takes the forms of waves or dunes. Resulting shapes are small waves ranging between 1 cm and 2 meters (Mahsoub 1984 p.115).

The soil is well-sorted sand. Followed by consecutive sedimentations of boulders, conglomerate and gravel with a bonding material containing ferrous oxides show up. The following table shows results of the geological survey of soil samples in Benban area.

Table (4-8): Soil Characteristics in the study area

Sample location	Depth (cm)	Clay %	Silt %	Fine sand %	Coarse sand %	Calcium carbonate	Dissolved salts
Benban Bahary (West of Daraw)	0 - 30	7.5	2.5	31.29	55.68	2.78	2.25
	30 - 60	6	3.5	31.22	55.33	3.73	0.22
	60- 100	2.5	1.5	28.81	64.43	2.64	0.12

Annual report of Geological Survey Authority (1954).

Figure (4-11): Some pictures taken during the field visit showing nature of soil at the project site

b) Hydrology and Hydrogeology

The main course of the Nile represents the main source of surface water at a distance of 18 km east of the project site. No flash flood drains, , were noticed in the study area during the site visit. However, based on the Flash Flood Atlas for Aswan Governorate[4] it is indicated that the PV park area is located within an area of low to medium flood intensity and flood risk as shown in the figures below.

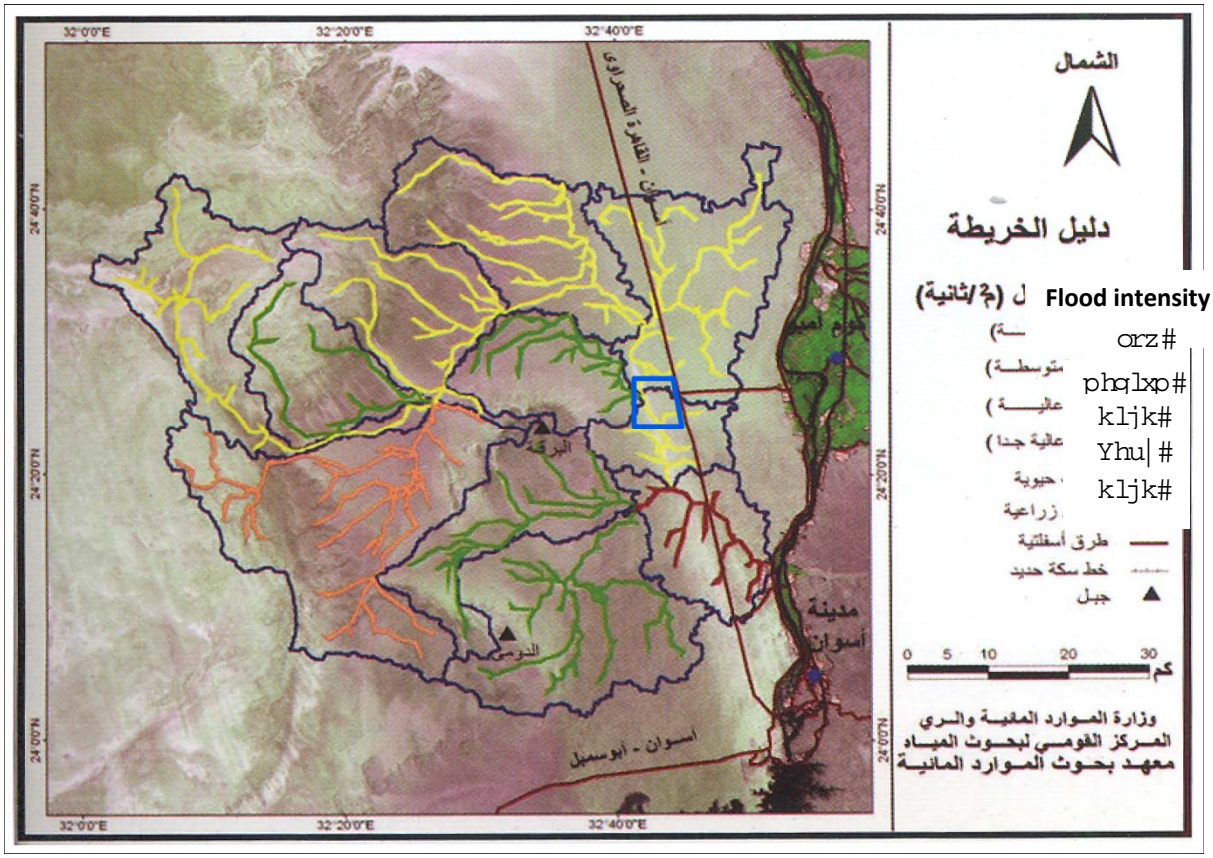


Figure (4-12): Flood Intensity

[4] Flood Atlas for Aswan Governorate, 2012, Ministry of Water Resources and Irrigation

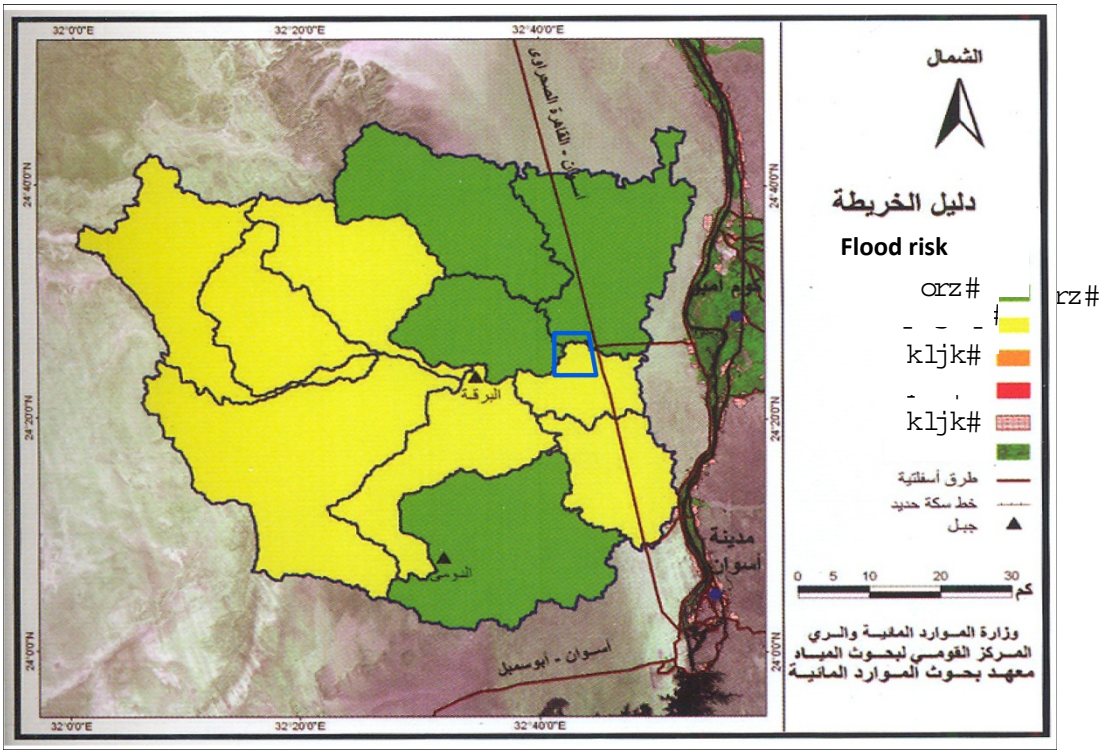


Figure (4-13): Flood Risk

According to the hydrological map of Egypt, the ground water in the project area is about 50 -200m depth.

4.1.3 Seismicity and Earthquake Hazards

The seismicity of Egypt has been investigated through numerous studies, and is well documented (El-Hadidy, S. et al 2003). During the last century, the 1995 Gulf of Aqaba was the strongest event in Egypt since the 1969 Shedwan Island earthquake. In addition, the 1992 Cairo earthquake was the worst in terms of associated severe damage compared to the other events (Abou El Enein K. M. et al 2007). The table below provides information on the highest magnitude earthquakes that took place during the last century.

Values of old seismic activities in the site and adjacent areas (in descending order):

Table (4-9): Earthquake events in Egypt

Degree	Second	Minute	Hour	Day	Month	Year
3.7	3.23	59	2	2	12	1998
3.6	0.46	17	8	20	7	1990
3.4	56.74	10	8	2	8	1990
3.3	17.52	50	13	19	9	1992
3.2	10.28	31	12	14	6	1991
3.0	4.68	43	3	15	6	1991
2.8	42.74	46	14	17	7	1990

Source: Ministry of Scientific Research, Aswan Seismic Observatory (**Shater, B.A., 1995 pp. 120- 124).**

- **Seismic Belts**
  The seismic activities in the Egyptian territory occur along the following belts (El-Hadidy, S. et al 2003):
  - Gulf of Aqaba-Dead Sea trend,
  - Gulf of Suez trend,
  - Cairo-Suez road trend,
  - East Mediterranean-Cairo-Fayum trend,
  - Mediterranean coastal dislocation trend, and
  - Southwest Cairo seismogenic zone.

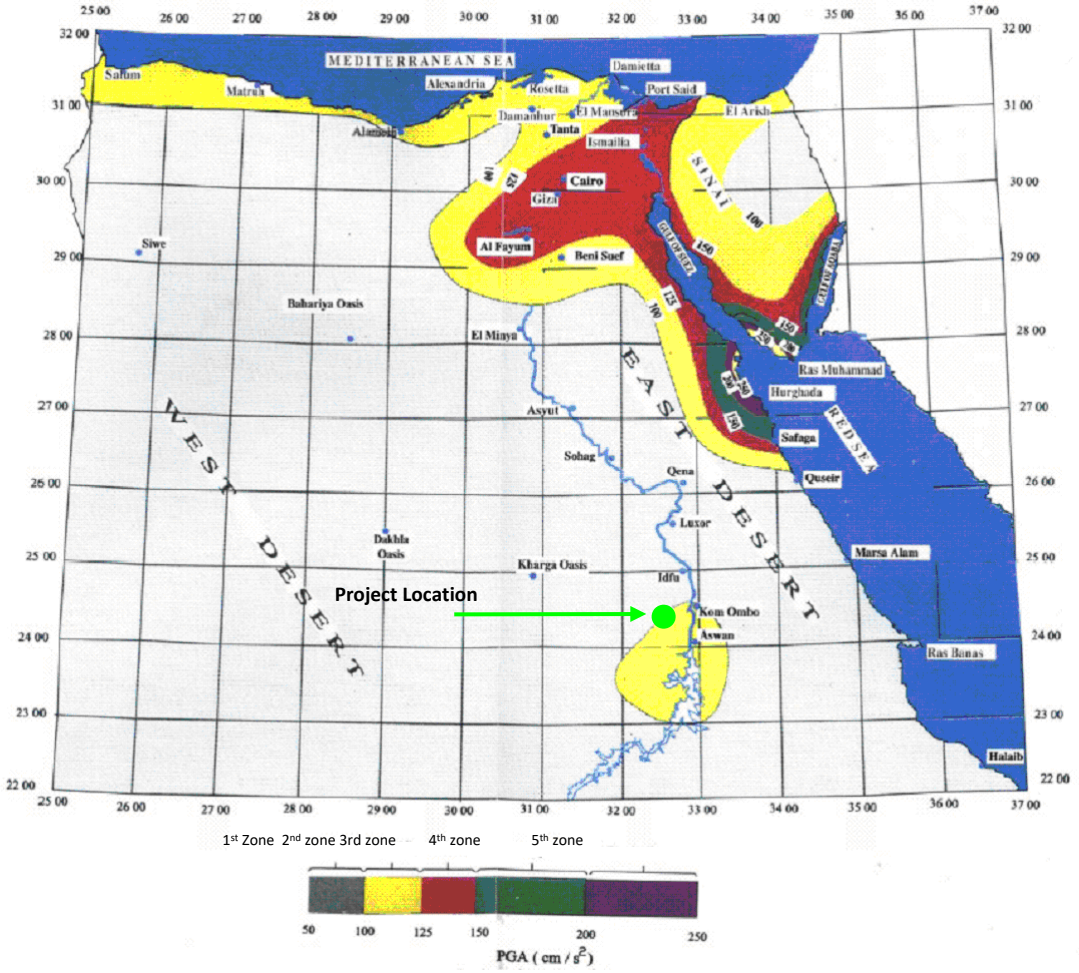


Figure (4-14): Seismic zones of Egypt

4.2 Biological Environment

4.2.1 Habitats

The main type of habitat present in the project's area of influence is sand dunes. This is composed of desert sandy and rocky plains characterized by variable sheet with gravel interaction, and small plateaus mainly composed of boulders and conglomerates. This represents extreme natural habitats characterized by lack of vegetation and water resources.

Figure (4-15): Sand Dunes habitat in the project site

4.2.2 Flora

The proposed project site is located in an arid/extremely arid area, the presence of flora is totally not observed within the project location.

4.2.3 Fauna

The surveyed project area is located in one of the typical western desert faunal habitats that is mainly composed of sandy and rocky plains and represents extreme habitats mostly without any vegetation and water resources.

4.2.4 Mammals

Some of the key mammalian species potentially present in these habitats are *Dorcas Gazelle, Gazella dorcas*, Red fox, *Vulpes* and *Ruepple Fox Vulpes rueppleii* and other small mammals which were recorded before in such western desert habitats.

Figure (4-16): Fox trace in the project site

4.2.5 Birds

Many of the key avian species are recorded in literature which represents these habitats such as Passerines including; wheatears, Larks, shrikes and warblers, also, raptors and some species of family Corvidae.

a) Nearest Protected Areas

The nearest protected area to the project location is Saluga and Ghazal Islands which is declared in 1986 as protected area, the two islands of Salouga and Ghazal in the River Nile are about 3 km north of Aswan dam with total area 0.5 km^2. The project is located about 40 km from the border of the protected area.

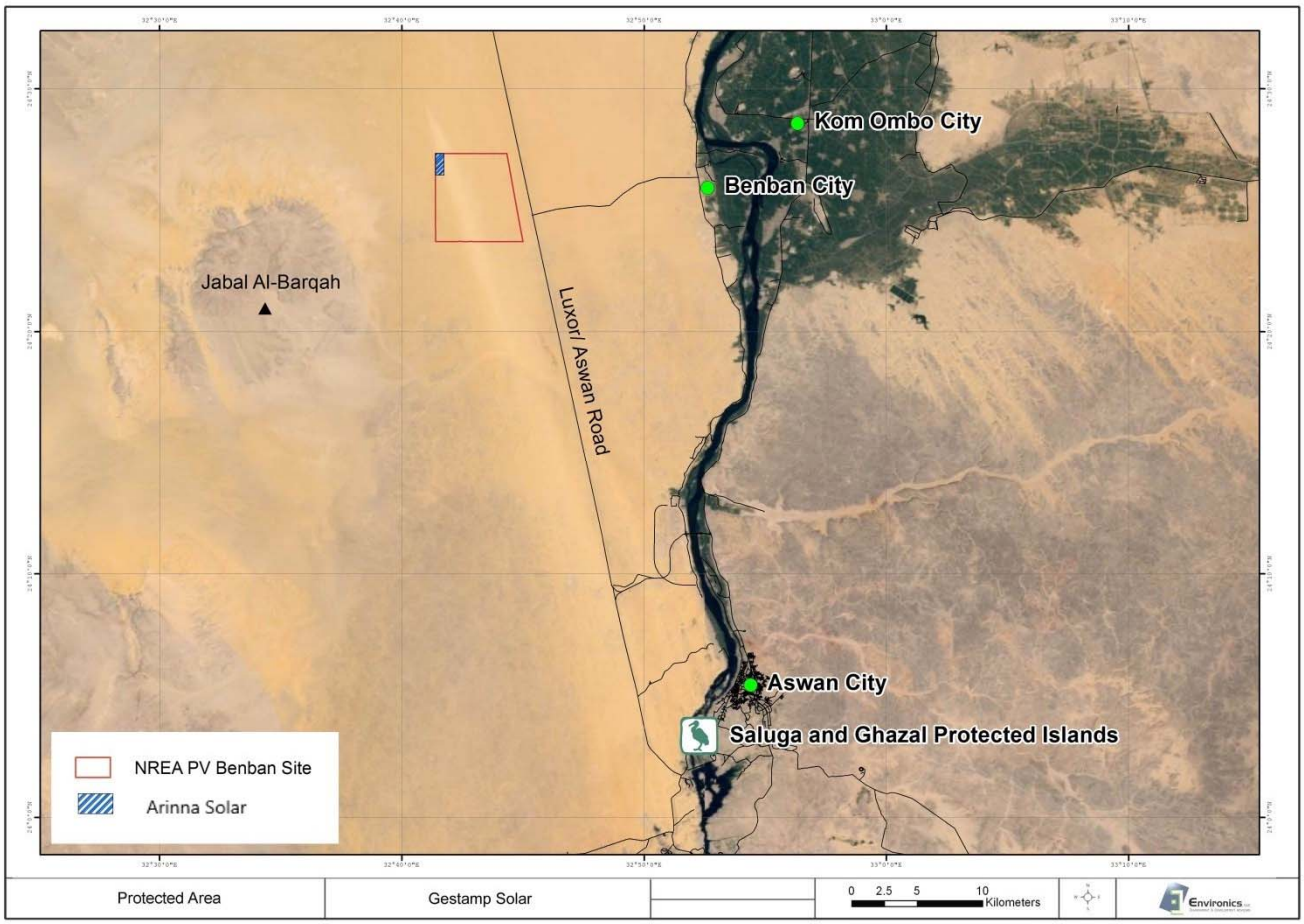


Figure (4-17): Saluga and Ghazal Protected Area

4.3 Socio-economic Environment

The project is planned to be located in Aswan Governorate- Markaz Daraw approximately 40 km north-west of Aswan city and 18 km from nearest city Benban, near the Luxor-Aswan Road. In the following section Daraw and Kom Ombo data from previous census will be shown, because they are the closest urban centers to the project location.

4.3.1 Regional Population

According to the Information and Decision Support Center of Aswan Governorate 2013 Census, the Daraw population was 111,857 capita represent 8.2% of total population, while Kom Ombo was 343,363 capita represent 25.3%. The nearest communities to project site is Benban and Benban Qabli cities with a 16,015 capita represent 14.3% of total population in Markaz Daraw, in addition to Al-Raqabah which represent about 8%.

Daraw is one of the most important trade centers between Egypt and Sudan. It developed fame as it hosts dwellers of Al-Ga'afra, Ababdah and Ansar tribes who live in Egypt. It is also famous for being the most important camel market.

One of the most important villages in Daraw is Benban which is the heartland of Ga'afra tribes in Aswan[5].

4.3.2 Regional Education

The literacy rate (10+) in Daraw was estimated in 2006 at 26.5% and in Kom Ombo was estimated at 28% (CAPMAS, 2006), which is higher than the national average (65.7%) and higher than the urban Governorates average (80.8%). There are two higher education institutions, Aswan University and Arab Academy for Science & Technology and Maritime in Aswan, and 463 primary schools.

In addition, the higher education level in both Kom Ombo and Daraw represent about 4% in each city of the total higher education on the governorate level, whereas the technical middle education (pre-university), mainly in the agricultural field, is about less than 30% of the total middle education on the governorate level.

4.3.3 Regional Employment

Unemployment rates at Daraw were estimated by CAPMAS 2006 at 15%, while in Kom Ombo it was 16.3%. This is considered relatively high in comparison to the national rate (9.9%) and lower than Governorate level (18.7%).

4.3.4 Regional Health services

The closest hospitals to the project site are located in Daraw and Kom Ombo. There following table shows the health facilities in both cities.

Table (4-10): Health Facilities in Daraw and Kom Ombo

	General Hospital	Primary Care Units	Ambulance Points	Ambulances
Daraw	1	22	4	6
Kom Ombo	1	40	4	7

Source: Yearly Statistical Book, Aswan Governorate, 2013

4.3.5 Regional Infrastructure

In Daraw, according to the Information and Decision Support Center of Aswan Governorate 2012, the total volume of produced water is about 10 thousands m^3/year and the total household units are connected to water networks is 65% , there is also a two sewage stations, while 29,949 unit are connected to electricity.

In Kom Ombo, the total volume of produced water estimated for is about 70 thousands m^3/year and the total household units are connected to water networks is 81%, there is also a one sewage stations, while 70,767 units are connected to electricity.

4.3.6 Transportation

Public transport is available along all the major roads leading to the towns. Public and private bus lines link the towns developing centers with other main

[5] Description of Egypt Book, IDSC, 2010

governorates (such as Cairo, Upper Egypt and Nile Delta) with stops in all major settlements and connected by the national rail network. In addition, there are taxis regularly operating the area. The total regional road lengths in Aswan about 1,566 km.

There are no access roads to the location from the main highway. The infrastructure is pending and it will be required for the construction, operation and maintenance period. NREA has confirmed that there will be a road of 20 m width to be constructed to access the PV park.

4.3.7 Economic Activities

a) Tourism

The project site and contiguous areas have no tourism activities, the nearest tourist area is Kom Ombo located 25 km away from the site. Aswan is characterized by several tourist features that made it an international destination for tourists from all over the world, especially in winter as it has a moderate and dry climate due to its location on the Nile banks. It is also an open museum for many archeological landmarks which date back to various ages and spread all over the city.

Aswan Governorate statistics[6] show that there are approximately 21 operating hotels and resorts, with a carrying capacity of 2,363 rooms or 4,714 beds.

Figure (4-18): Tourism tour at the Temple of Kom Ombo

[6] Yearly Statistical Book, Aswan Governorate, 2013

b) Agriculture

Agriculture is the main economic activity in Aswan. The majority of the population works in the field of agriculture, which presents more than 30% of the total economic activities in the governorate. The total cultivated lands represent more than 96 thousand feddans, while cultivated lands in nearby communities of Benban and Kom Ombo represent 10% and 33.3% of the total respectively. The most common crops in project area are wheat, barley and onions.

4.3.8 Cultural Heritage

Kom Ombo Temple is one of the main touristic sites in Aswan and located about 25 km east of project site. It had been constructed in the Age of Ptolemy VI on the eastern bank of the river Nile. The main entrance pylon has now been destroyed, but entering through a portal at the southeast the visitor comes into a large court with remains of a Roman columned portico which has preserved its colour in some places on the walls. The exterior of the temple of Horus contain unique reliefs of a pair of goddesses with surgical instruments related to childbirth.

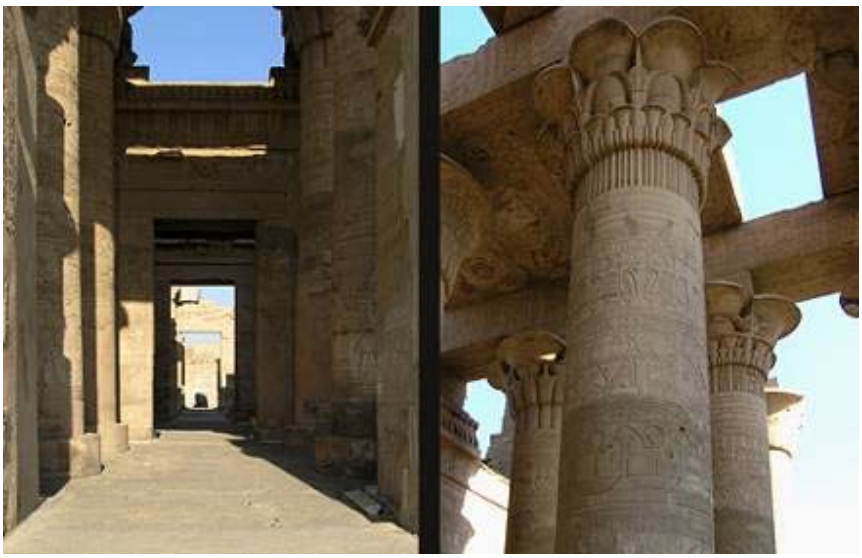


Figure (4-19): Columns of Kom Ombo Temple

5. Analysis of Alternatives

The analysis of alternatives is based on the evaluation of numerous project alternatives during the conceptual and pre-feasibility design phases.

When evaluating alternatives, particular emphasis was placed on the environmental and social implications of the alternatives to ensure that the option selected is environmentally sound and meets the Egyptian Laws and regulations.

5.1 No Development Alternative

The alternative not to develop the proposed plant was used in this ESIA as the scenario with which to compare the environmental and social impacts of project construction, operation and closure.

It is worth mentioning that the project allows Egypt to benefit from one of its main renewable energy resources, namely the solar energy. The project will also contribute to meeting part of continuously increasing needs of the energy requirements in Egypt. In addition, the project contributes in minimizing the greenhouse gases emissions, particularly CO_2, that would have been generated if the same amount of energy was generated from fossil fuel fired power plants as will be described in chapter 6.

It is worth mentioning that if the "no-development" alternative be selected, the land proposed for the development would still be used for other renewable energy projects as the site is owned by NREA and has been designated for renewable energy projects.

Considering the type and nature of the project and that its minimal potential impacts, the "no development" alternative has not been given further consideration.

5.2 Alternative Site Location

All utility-scale solar energy facilities require relatively large areas for solar radiation collection. Solar facilities may interfere with existing land uses, such as grazing, minerals production or any other developmental activities. Solar facilities could also potentially impact the use of nearby designated/protected areas such as areas of critical environmental concern, or special recreation management areas. Proper decision-making is a crucial parameter that would avoid land disturbance and land use impacts. In addition, the cost of land area puts financial burden on the overall project cost.

In this context, the proposed PV project is located within the site area, in the vast and largely unoccupied Western Desert, owned by NREA where other 44 parcels are located and dedicated for solar energy projects over around 37 km^2.

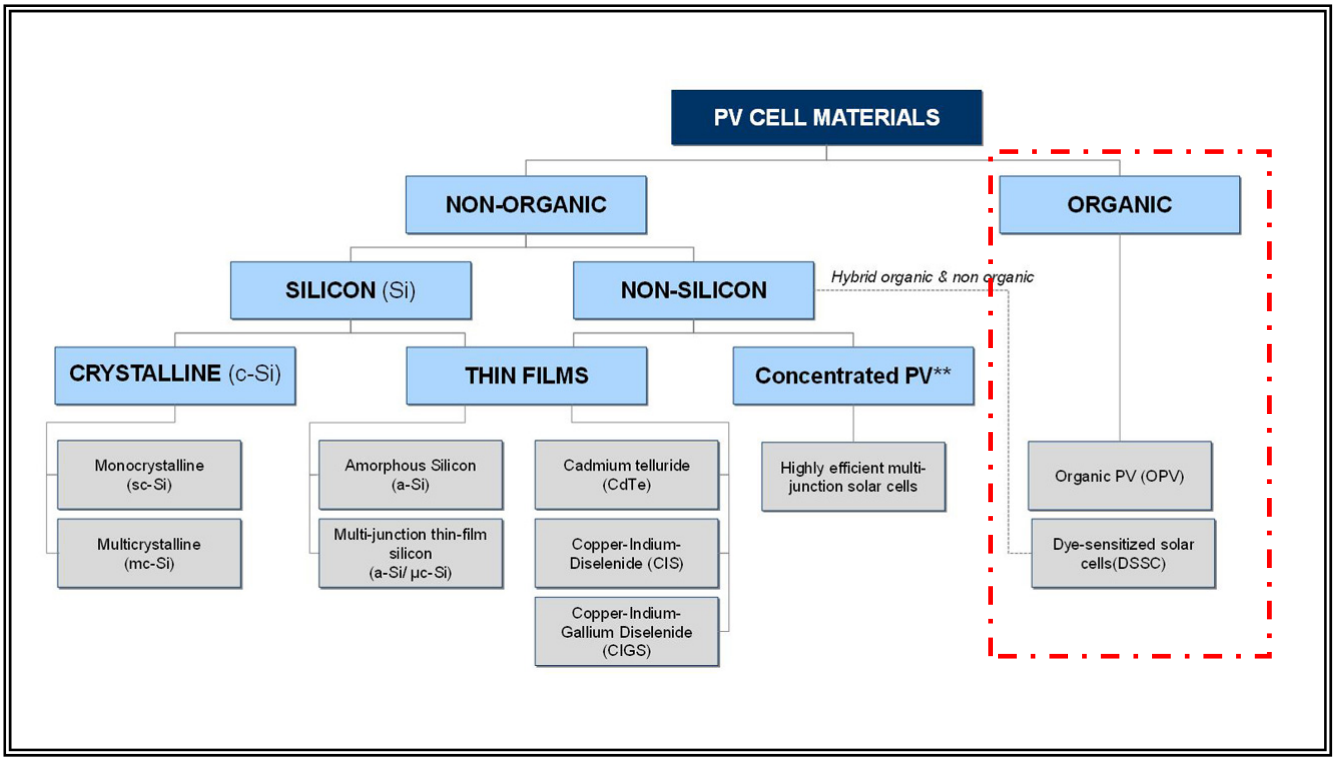
Therefore this location is considered the most suitable to establish the project and other locations outside NREA land area has not been considered.

5.3 Alternative PV technology: CPV

Concentrator photovoltaics (**CPV**) CPV use lenses and curved mirrors to focus sunlight onto small, but highly efficient, multi-junction (MJ) solar cells. CPV systems must track the sun to keep the light focused on the PV cells, and sometimes a cooling system is required to further increase their efficiency. The primary advantages of CPV systems are high efficiency, low system cost, and low capital investment. Reliability, however, is an important technical challenge for this emerging technological approach. CPV systems generally require highly sophisticated tracking devices. Ongoing research and development is rapidly improving their competitiveness in the utility-scale segment. This types of solar technology can be thus used in smaller areas or with limited access to land.

5.4 Alternative PV Types

General classification of the types of PV module is shown in the Figure 5-1. In Figure 5.1, materials marked with red dotted lines means that these are new emerging technologies modules are under research and development stage.



Source: http://sovoxglobal.com/cell_classification.html

Figure (5-1): Types of PV modules

After comparing six possible types in terms of: cost; efficiency; temperature characteristics; life time; environmental consideration; and effect of shade, Poly

Crystalline type is selected as possible module for this project. Table 5-1 shows the comparison between different PV panel options.

Table (5-1): Evaluation Result for each Photovoltaic Module[7]

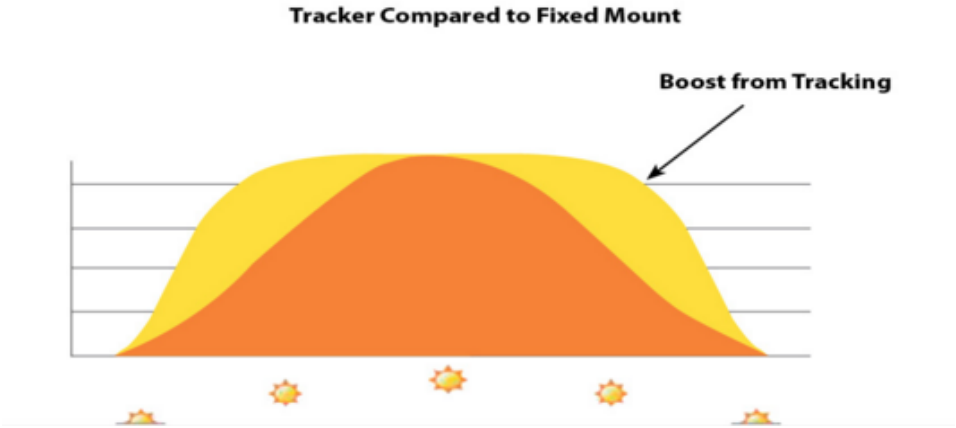
	Silicon crystallized		Silicon Thin film		Compound thin film	
	Mono Crystalline	Poly Crystalline	Amorphous Silicon	MLTF	Cd-Te	CIS
Cost	High	Low	Middle	Low	Low	Low
Efficiency	Excellent	High	Low	Middle	Middle	Middle
Temperature Characteristic	Middle	Middle	Excellent	Excellent	Good	Good
Life time	Good	Good	Middle	Good	Good	Good
Environmental consideration	Safe	Safe	Safe	Safe	Includes hazardous substance Cd	Can include small amount of Cd
Land/per MW	4-5 acres (16187 – 20234 m^2/MW)		7.5-9 acres (30351 - 36421 m^2/MW)			

5.5 Tracking Alternatives

Solar panels can be either fixed to a certain tilt or set to track the sun's movement across the sky. Solar trackers follow the sun`s trajectory and ensure that the solar panels are positioned for maximum exposure to sunlight.

Compared to a fixed mount, a single axis tracker increases annual output by approximately 15% to 25%[8],.

Thus, tracking systems clearly outperform fixed-tilt systems and is selected for this project.



Source: First Solar

Figure 5-2): Daily power production, fixed tilt versus tracking

[7] Developed based on: http://www.sunsinesolution.com/faq.aspx, http://www.slideshare.net/gouravkumar220/solar-panel-technology-ppt - http://www.geni.org/globalenergy/research/review-and-comparison-of-solar-technologies/Review-and-Comparison-of-Different-Solar-Technologies.pdf

[8] Design of a Solar Tracker System for PV Power Plants, Tudorache. T, Kreindler, L. Acta Polytechnica Hungarica, Vol. 7, No. 1, 2010

5.6 Alternative module cleaning

Three methods have been investigated for module cleaning, namely:

- **Dry cleaning** : Wiping modules with dry cloths or high pressurized air
- **Wet cleaning**: Wiping modules with wet cloth
- **Washing**: Washing with high pressure water

The selected cleaning option for Arinna Solar Power will be application of pressurized air. Cleaning will be undertaken by a team of 10 workers..

5.7 Alternative water sources

Water resources are required during construction activities and during operation activities for panel cleaning. For cleaning, fresh water (TDS < 1500 mg/L) may be used to clean the modules. When using water, RO water provides the best results. When RO water is not available, tap water with low mineral content (total hardness <75mg/L) or deionized water may be used. Calcium should not exceed: 75 mg/ml[9].

The site is not connected to any water sources thus the potential options would include:

Groundwater abstraction

There are no existing groundwater wells in the project area. The construction and utilization of groundwater wells needs permits from the Ministry of Irrigation and Water resources as well as Environmental Impact Assessment Study. In this context, the management of wells, potential well clogging and the disposal of the resulting pre-treatment liquid waste (brine and/or backwash of demineralization column) constitute the main constraints facing the option of groundwater usage. Moreover, as mentioned in Chapter 4 above, groundwater in the area is at significant depths and the costs for well construction may be significant.

In this respect, constructing water wells is not a preferred option for the project.

Construction of water pipeline from the Nile

The Nile is at distance of about 18km to the east of the project area. Construction of a water pipeline is to consider the distance, Luxor-Aswan road crossing as well as pumping to the project site. Additionally this option is likely to include water pre-treatment to remove potentially floating debris and/or oil or other immiscible liquids and minimize excessive turbidity. This option is considered economically inefficient and thus not to be considered for this project.

[9] First Solar (FS), FS-Series PV Module Cleaning Guidelines, 2013 www.firstsolar.com/.../PD-5-804_PV-Module-Cleaning

Water trucking

As described in Chapter 3 above, a water tank of capacity is about 15m^3 will be constructed for domestic uses and cleaning. In this respect the water trucking does not involve additional infrastructure. Moreover, the frequency of trucking estimated to be once per week.

6 Environmental and Social Impacts Assessment and Mitigation

6.1 Methodology

Environmental assessment was carried out to cover potential impacts of the project on the environment as well as impacts of the environment on the project. The assessment was carried out in three main steps, as follows:

1. Identification of potential impacts
2. Evaluation and assessment of the impacts in terms of their significance
3. Identification/ proposing mitigation measures for minimizing the effects of the significant impacts.

6.1.1 Identification of Potential Environmental Impacts

Potential impacts of the proposed project are identified based on a modification of the Leopold matrix (Table 6-1). The matrix has been designed so that the key potential impacts associated with the project become immediately apparent. The layout of the matrix is arranged as follows:

- The "rows" of the matrix consist of a list of activities presented according to construction and operation activities. It also consists of the list of aspects associated with each activity or group of activities.
- The "columns" consist of the resources and receptors susceptible to impacts categorized as physical, biological and socio-economic environment. Identified resources and/or receptors were:
  - Air quality
  - Noise level
  - Soil
  - Groundwater quality
  - Marine water quality
  - Terrestrial life
  - Aquatic life
  - Public health
  - Employment
  - Workplace health and safety

6.1.2 Evaluation and Assessment of Impacts

Interaction between the different activities and the environmental receptors, identified through the baseline information, was carried out. Such interactions may result in negative or positive impacts. The different types of impacts were identified.

Based on the analysis of the baseline environmental conditions and the nature of the receiving environment, some aspects were found to be irrelevant to specific activities of this particular project. These are identified as "scoped out impacts"

Potential relevant impacts were subject to a process of impact evaluation, based on the analysis of the proposed project components and activities, in order to

determine the significance of the different impacts. The evaluation process takes into account the information collected in the field, available in the literature and/or based on the professional judgment of the consulting team and public consultation

Impact evaluation is based on pre-set criteria including, impact magnitude, duration, planned mitigation measures, regulatory standards and sensitivity of environmental receptors.

6.1.3 Mitigation Measures

Mitigation measures are either incorporated as integral part of the project design or through environmental management and monitoring measures. By implementing both types of mitigation measures, the residual impacts, which are those potentially, remaining after implementing the mitigation measures, will be minimal/insignificant/ acceptable. As much as possible, the avoidance and prevention of impacts is favored over minimization, mitigation or compensation. Based on the impact identification and evaluation process, irrelevant impacts are scoped out of the assessment process, and mitigation measures are proposed for significant impacts, while minor impacts are integrated within the management plans of the facility.

6.2 Impact Identification

6.2.1 Scoped out Impacts

Potential impacts in the Leopold matrix were identified in relation to their effects on potential receptors. This step would facilitate eliminating and scoping out irrelevant impacts taking into consideration the following:

- Type of project
- Location
- Characteristics of the surrounding environment.
- Receptor sensitivity or importance: depends on its nature, value, scarcity etc. There are three types of receptors:
    - On site receptors encompassing soil and workplace.
    - Receptors surrounding the site such as ambient air, humans, plants and animals.
    - Final sinks/receptors such as surface and groundwater.

Examination of the environmental setting of the area and the operational processes has shown that the following impacts are irrelevant:

Impacts on "surface water quality" and "aquatic life"

The project activities will have no contact with surface water or aquatic life.

Interaction with birds' migration route

The project has no interaction with the bird migration routes. It has no elevated structures that can interfere with the migration routes. Moreover, it is not expected to have birds roosting and perching on the photovoltaic panels.

Moreover, there has been no sufficient evidence that PV are reflective so as to be mistaken by lake surfaces to attract birds[10].

Impact on groundwater

Based on the nature of the project there will not be any interaction with the groundwater in the area especially that the groundwater table is at considerable depth (more than 50mbgl).

Impact on terrestrial environment

The project will be located within a desert land with scarce vegetation and/or wild life.

6.2.2 Positive Impacts

Employment

The project will provide employment opportunities during construction and operation phases. Priority will be given to the local workforce. The results of the SESA regarding potential employment provision will be incorporated when available. Nevertheless, the SESA NTS indicated that it is expected that a proportion of these jobs will be filled by the local people, temporarily alleviating the rate of local unemployment. As per the NTS, discussions held with local authorities and community leaders in Benban village indicated that the local communities in Benban are expected to provide around 2,000 workers, while Fares village may contribute an additional 1,000.

Construction will occur in phases each have a different duration.. In this respect, the availability and duration of jobs will depend on the job function and construction schedule. Not all the jobs will be available at the same time and they will not be available for the entire duration of the construction phase. The limited duration of the some job opportunities will reduce the significance of employment creation in the local area.

Approximately 40 percent of the jobs available during construction will be undertaken by semi-skilled and unskilled labour, while 60 percent of the construction jobs will require skilled labour[11].

An additional direct benefit during the construction phase is the opportunity for 'on-the-job' training for local people. The highly skilled solar energy technicians can provide training to local employees, increasing their skills level so that they will be employable on other solar projects. In this context, it is envisaged that local medium sized businesses will potentially be able to supply the majority of auxiliary components. Work opportunities would also be created for consultancies including monitoring measurements, O&M services etc… In

[10] Guidelines to minimize the impact on birds of Solar Facilities and Associated Infrastructure in South Africa. Smit, Hanneline A., BirdLife South Africa, 2012

[11] Environmental Impact Report Revision 2 Proposed 90 MW Drennan Photovoltaic (PV) Power Facility, Eastern Cape Solaire Direct Southern Africa, 2014

this respect, the positive impact of the project will reach farther than the employment at the site. [12]

It is estimated that during the construction phase of the project would provide about 300 job opportunity to the local community during peak construction stage. During operation, permanent employees on site are expected to be 5.

Accordingly, the project will contribute to positive social impacts including community development and reduction of local unemployment.

Energy demand

This project will directly provide electricity from solar energy at utility scale. Accordingly, it would contribute to minimization of the dependence on the depleting fossil fuels and minimize their environmental adverse impacts.

The project will also allow Egypt to benefit from one of its main renewable energy resources, namely the solar energy. The project will also contribute to meeting part of continuously increasing needs of the energy requirements in Egypt.

Reduction of GHG Emissions

While there are no global warming emissions associated with generating main renewable energy resources, namely the solar energy. The project will also contribute to meeting part of continuously increasing needs of the energy requirements in Egypt. In addition, the project contributes in minimizing the greenhouse gases emissions, particularly CO_2, that would have been generated if the same amount of energy was generated from fossil fuel fired power plants. The mean GHG emissions of manufacturing silicon modules (Lifecycle GHG emissions) is about 85 tCO_2e/GWh compared to 888, 499, 733 tCO_2e/GW [13] for coal, natural gas and diesel oil respectively. In Egypt, the total average CO_2 emission from all thermal power plants is about 540tCO_2e/GWh[14].

Given that the expected annual production of the Arinna Solar Power plant is 58.42 GWh, approximately 31,547 tCO_2e is abated annually.

6.2.3 Potential Negative Impacts

After exclusion of the irrelevant impacts and identifying the positive impacts, the remaining "potential negative impacts" were assessed based on the following criteria:

- ***Magnitude*** of the impact.
- ***Duration:*** period of time that impact lasts.

[12] Prospects of renewable Energy Sector in Egypt, Focus of Photovoltaics and Wind Energy, Environics 2010

[13] Comparison of Life Cycle Greenhouse emissions of various Electricity Generation Sources, World Nuclear Association, July 2011

[14] Annual Report for Performance Indicators for Electricity Generation Companies, Egyptian Electric Utility and Consumer Protection Regulatory Agency, 2012-2013

- ***Mitigation measures;*** its availability whether integrated in the project design or implemented as management measures**.**
- ***Adherence to regulatory standards according to Egyptian legal and regulatory framework*** (described in Chapter 2).
- ***Public concern*** and perception

Where negative environmental impacts are expected, most of them will be experienced during the construction phase. Using the impact identification matrix (Table 6.1), the different types of impacts were identified. The table presents the different types of potentially negative impacts during the construction and operation phases. For each potential negative impact the significance before and after implementing the design integrated measures and/or applying management and monitoring practices is determined.

Table (5-2): Potential / Residual Impacts Matrix

Activities (Sources of impacts)	Aspects	Environmental Attributes(1)								
		Physical Environment				Biological Env.	Socio-economic			
		Air Quality	Noise level	Soil	Groundwater Quality	Terrestrial life	Public Health	Employment	Work place H & S	Infrastructure (Roads)
Construction Phase										
Site leveling Civil Works System components installation Electrical and instrumentation Mechanical completion Pre-commissioning	• Labor	NA	NA	NA	NA	NA	NA	+	NA	NA
	• Dust Emissions	-/I_m	NA	NA	NA	-/I_m	-/I_m	NA	-/I_m	NA
	• Gas emissions (vehicles & equipment)	-/I_m	NA	-/I_m	NA	-/I_m	-/I_m	NA	-/I_m	NA
	• Noise (vehicles & equipment)	NA	-/I_m	NA	NA	NA	NA	NA	-/I_m	NA
	• Construction Waste (including generation of solid and liquid municipal waste)	NA	NA	-/I_m	-/I_m	NA	NA	**NA**	-/I_m	NA
	• Accidents (vehicles & equipment)	NA	NA	-/I_m	-/I_m	-/I_m	-/I_m	NA	-/I_m	I_m
	• Spills (vehicles & equipment)	NA	NA	-/I_m	-/I_m	NA	NA	NA	-/I_m	NA
	• Sewage from workers	NA	NA	-/I_m	-/I_m	NA	NA	NA	NA	NA
Operation Phase										
Activities related to Workforce	• Labor	NA	NA	NA	NA	NA	NA	+	NA	NA
	• Municipal solid waste generation	-/I_m	NA	-/I_m	-/I_m	NA	-/I_m	NA	-/I_m	NA
	• Sewage generation	NA	NA	NA	NA	NA	NA	NA	NA	NA
Operation activities	• Modules cleaning	NA	NA	NA	NA	NA	NA	NA	NA	NA
Transformers and inverters	• Noise from transformers and inverters	NA	-/$I_{d,m}$	NA	NA	NA	NA	NA	-/$I_{d,m}$	NA
Electromagnetic fields	• From cables and high voltage lines	NA	NA	NA	NA	NA	NA	NA	$I_{d,m}$	NA

1)(-): Negative impact(+): positive impact

Im: minor residual impacts acceptable after mitigation through management

Id:minor residual impacts acceptable after design integrated mitigation

NA: Not applicable

6.3 Assessment of Potentially Negative Impacts

6.3.1 Impact on Physical Environment

Air Quality

Construction Phase

Construction activities may result in minor, localized, short term, air quality impacts in the form of dust/particulate matter from soil leveling and emissions from construction equipment and transport vehicles.

A diesel generator will be used for electricity supply during construction. Accordingly, air emissions during construction include dust, nitrogen oxides, sulphur oxides and carbon monoxide.

Such impacts will occur for relatively short duration and expected to affect mainly the workplace environment. On the other hand, impact on public health is unlikely due to the fact that the nearest residential area to the site is Benban village at distance more than 15km to the east of the proposed site.

Mitigation Measures

Arinna Solar Power will ensure that contractors will carry out the necessary measures to minimize impacts. This is to be included in the contractor's scope of work (contract). Potential effective mitigation measures include:

- Dust suppression using minimum water consuming technologies
- Dust management through slowing the driving speed of material transportation vehicles.
- Trucks transporting aggregates will be covered with canvases from their departure to the arrival points.
- Maintaining machinery and vehicles in good working conditions to minimize fugitive emissions and exhaust.
- Have a certificate to prove that machines employed at the site comply with current legislations in terms of sound emissions and are inspected regularly.
- Carry out the tests stipulated under the current legislation for generator sets.

Residual Impacts

The above mitigation measures are anticipated to be efficient for minimizing the potential impacts. Therefore, the residual impacts of construction on the air quality are negligible.

Operation phase

No air emissions are generated during operation.

Residual Impacts

No residual impacts

- **Noise levels**

Construction phase

The use of construction equipment may result in localized, short term, increase in noise levels. Table (6.2) shows typical noise levels, in decibels, expected at various distances from construction machinery. It is not expected that noise from the construction activities would pose impacts on the neighboring areas (roads or nearby communities) as they are located at significant distances.

Table (6-2) Average Noise Levels from Construction Equipment

Equipment Type	Distance from Noise Source (dBA)		
	10m	50m	100m
Crane	72	58	52
Bulldozer	74	60	54
Generator	76	62	56
Backhoe	79	65	59

* Doubling the distance drops the intensity by about 6 dB and that 10 times the distance drops the intensity by 20 dB[16]

Mitigation Measures

- When construction equipment are used, such as during site excavation, earth moving and land grading, workers will be provided with the suitable PPEs to minimize possible impacts from noise.
- Maintain machinery and vehicles in good working conditions to minimize noise generation and ensure that they don't exceed permissible limits.
- Ensure vehicles used comply with preventive maintenance.
- Ensure machines have the corresponding declaration of conformity with respect to noise and bear the guaranteed sound level logo.

Residual Impacts

Noise resulting during construction activities is unlikely to have an impact on the general public. However, the impact of construction activities on workplace can be potentially significant. But with implementing the above mitigations measures and health and safety procedures, residual impacts are considered negligible.

Operation phase

Noise during operation can result mainly from the transformers and inverters which are contained in an enclosure with restricted access.

Noise levels, expected at from the different equipment as shown in the table (6-3) below, are less than the allowable limits of law 4/1994 as described in Chapter 2.

[16] The Inverse Square Law is an idealization because it assumes exactly equal sound propagation in all directions. If there are reflective surfaces in the sound field, then reflected sounds will add to the directed sound and you will get more sound at a field location than the inverse square law predicts. If there are barriers between the source and the point of measurement, the propagated noise intensity may get less than the inverse square law predicts. Nevertheless, the inverse square law is a logical first estimate of the sound at a distant point in a reasonably open area. Estimating Sound Levels with the Inverse Square Law, http://hyperphysics.phy-astr.gsu.edu/hbase/acoustic/isprob2.html

Table (6-3) Expected noise levels from different Instrumentation in workplace

Noise source	Noise level (dB(A)
Inverters	66.4dB(A*)
Transformer	60 dB(A) **

**At 10m from source*

***2 MW transformer with 24 kV voltage rating*

The contribution of the facility to increasing the noise level to the surrounding environment is minimal taking into account the design mitigation measures in place and due to the fact that the distance to the nearest sensitive receptors, namely Benban village is about 15 km, all noise levels produced from the proposed facility would completely vanish by the time they reach the closest sensitive receptors.

Regarding the noise levels within the workplace, implementing the mentioned mitigation measures and implementation of effective occupational health and safety measures including restricted access to the transformers area and providing the workers with the necessary PPEs and limiting the exposure period, the residual impacts in workplace are considered negligible.

Mitigation measures

The following mitigation measures could be implemented during operation to minimize the potential noise impacts:

- Potential noise generating machines and equipment are designed to meet statutory regulations concerning noise.
- Acoustic enclosures are installed for noise generating equipment, wherever possible such as inverters and transformers
- Workers at noise generating machinery and equipment will be provided with the suitable personal protective equipment (PPEs).

Residual Impacts

Potential noise during operation activities is unlikely to have an impact on the public. However, the impact of noise on workplace will be negligible with implementing the above mitigations measures and health and safety procedures.

- **Soil**

Construction phase

Generally, the construction activities are unlikely to result in soil contamination that will need future decontamination and clean-up activities.

Potential impacts during construction phase generally result from domestic wastewater management, material and waste storage accidental spills from machinery, and potential spills from the diesel generator and lube oils.

Wastes generated during construction mainly consist of municipal and construction wastes that will be collected by an approved contractor to be disposed of in designated landfill sites.

Mitigation measures

Mitigation measures mainly involve site management procedures and good housekeeping activities and proper waste management measures. The contractor will implement measures for spill prevention that will contribute to controlling and minimizing any potential impacts.

In addition, during construction contracts with different contractors will include requirements for periodic inspection of equipment and machinery which will contribute to minimizing spills and leaks. The E&S site personnel will follow up on the contacts performance and ensure they abide by the contract EHS stipulations.

On the other hand, municipal wastes will be collected by a licensed contractor for disposal through the designated landfill. Other construction wastes will be safely and temporarily stored on site and periodically disposed through selling to contractors.

A concrete septic tank will be constructed for collection of domestic wastewater. It will be insulated with Bituminous lining for leak prevention. Contents will be emptied regularly for disposal at the nearest wastewater treatment plant at adequate intervals through a licensed contractor.

Residual impacts

Impact on soil during construction activities will be negligible with implementing proper housekeeping and management measures.

Operation phase

During the project operation, potential soil impacts may arise from improper management of chemicals and materials (such as oil leaks during maintenance activities), domestic wastewater and municipal solid waste management.

Mitigation measures

Regarding chemicals, Arinna Solar Power will optimize and rationalize the use of chemical products, when needed. It will also monitor the proper storage of the products, ensuring that they are stored in the right place for such purpose, protected against weather conditions and duly identified. Arinna Solar Power will ensure the availability of safety files for chemical products at storage areas and ensure that not wastes derived from these products directly dumped to the soil or drainage/rainwater runoff systems. Empty containers of hazardous substances must be treated as hazardous wastes. Moreover, hazardous substances will not be transferred or handled on non-paved areas or above manhole drains, to prevent potential spills' direct contact with the soil or drainage/rainwater run-off systems.

As part of its EMP, the project will develop a waste management plan.

Domestic wastewater will be collected in an isolated internal sewage system and discharged to a lined concrete septic tank for periodic emptying through licensed seepage trucks.

Residual impacts

Upon implementation of the mitigation measures potential impacts of the project operation on the soil are negligible.

- **Impact on the Biological Environment**

Important species of conservation value do not occur within the project site. The project area is composed of desert sandy and rocky plains characterized by variable sheet with gravel interaction, and small plateaus mainly composed of boulders and conglomerates. The proposed project site is located in a arid/extremely arid area, no presence of flora was observed within the project location

Construction Phase

The project area represents a small part of the vast desert plain and is not considered a critical habitat. Gaseous emissions, noise from construction machinery are short term and their impacts are considered insignificant.

Mitigation Measures

Develop, implement and update a solid waste management plan to include waste collection, storage, transport and disposal in an environmentally sustainable manner to avoid attraction of vermins .

Residual impacts

Residual impacts are insignificant with proper mitigation and management measures are implemented.

Operation Phase

As mentioned above the project does not include activities that would significantly affect the biological environment in the area.

Thus the impacts on the biological environment are negligible

6.3.2 Socio-economic Impacts

- **Employment**

Construction phase

The construction phase of the project will provide employment opportunities for an average of 300 workers.

Priority will be given to the community local workforce during labor selection to further enhance positive impact on the local community.

Operation phase

The project has the potential to decrease the local unemployment levels by creating employment opportunities. Moreover, it would provide an opportunity for education, training and technology transfer to the Egyptian context related to Solar Energy. This is expected to contribute significantly to disseminating the project in other areas in Egypt.

- **Impact on the community**

It is the common practice for EPC contractors work in Egypt to hire local workforce for the jobs that do not require significant skills, as their number is significant for construction and it is more economically viable. Whereas the required highly skilled labour maybe not from the local communities. For individual projects the number of non-local workers will be considerably low and thus their impact on the community is negligible. However, for the whole solar park the number may be considerable and thus the impact needs to be assessed on the cumulative level.

Potential pressures on the available resources and utilities, may result due to workers influx to the area.

Issues of workers influx and accommodation need to be investigated in the ESIA. It will be beneficial if impact of workers influx for all projects is addressed collectively by the different developers.

- **Energy demand**

The project will contribute to increase of national energy independency which is a positive impact of the project.

- **Impacts on land use**

Large scale PV facilities can raise concerns about land uptake. Concerning the subject project, it will be located in a desert and unoccupied land, which is designated by NREA for solar energy power generation. No land ownership or uptake issue will result as resulted from the project. Therefore, positive impact will arise from the proposed project on land use at the site.

- **Impact of Electromegnetic field**

According to the International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines, the levels for safe general public exposure and for the frequency of 50 Hz are:

• For electric Field strength, $E < 5$ kV m$_i$1

• For magnetic Flux density, $B < 200$ ^{1}T

The relevant levels for safe occupational exposure are:

• For electric Field strength, $E < 10$ kV m$_i$1

• For magnetic Flux density, $B < 1000$ ^{1}T

EMFs are strongest close to a source, and their strength rapidly diminishes with distance from it. Limited data is available about the EMF of utility scale PV

units. However, values from some studies indicated that the measured levels are far below the safe exposure levels[17]. A study by Massachusetts Clean Energy Center indicated that at the utility scale sites, electric field levels along the fenced PV array boundary, and at the locations set back 50 to 150 feet (45m) from the boundary, were not elevated above background levels (< 5 V/m). Electric fields near the inverters were also not elevated above background levels (< 5 V/m). At the residential site, indoor electric fields in the rooms closest to the roof-mounted panels and at locations near the inverters were not elevated above background levels (< 5 V/m).

- **Traffic**

Side-tracks as well as the main roads will be constructed for trucking equipment and construction gear to the project area. About 188,100 PV modules, and 25 inverters are required for this project.

Trucks of various sizes will be required for transportation of all project components distributed throughout its construction period, with varying intensities. Thus it is not expected to have significant impacts on the roads network in the area during the project's construction. The project will manage about 563 containers during the construction phase.

It is important to point out that during the site visit conducted on the 28th of July and the scoping meetings with stakeholders on the 29th of July, it was found that the main road leading to the site, the western desert highway Luxor –Aswan, is a two ways road (for both ways) accommodating different types of transport means. According to the information by the different stakeholders, the road witnesses frequent accidents as the result of poor quality of the road and the lack of maintenance. In this respect, this issue would need to be investigated, from a safety perspective, how this situation would affect the project trucking activities during construction phase, especially, it is expected that a construction activities of neighbouring projects may fall within the same time frame. The Omda (mayor) of Benban village indicated during the meeting that the communities along the road are initiating a community campaign on the Facebook and local media to highlight the problem to the officials in the governorate. Specific issues related to traffic impacts will be addressed by the Management and Environmental and Social Assessment Company as per the RFP issued by the developers association in February 2016

- **Water**

Water consumption during construction is approximately 360 m^3. Maintenance requirements of photovoltaic systems are expected to be minimal and would be mainly related to periodic cleaning. The estimated

[17] Study Of Acoustic and EMF Levels From Solar Photovoltaic Projects, Massachusetts Clean Energy Center, 2012 - Electric and Magnetic Fields Due to the Operation of Roof Mounted Photovoltaic Systems, PIERS Proceedings, Stockholm, Sweden, 2013)

water consumption would be about 15 m^3/month. Water use will be optimized and this quantity will not have significant impact on water resources. Arinna Solar Power will also carry out preventive maintenance of machinery using water (tank truck) to avoid water leaks or losses and monitor the proper functioning of toilets, avoiding leaks, overflows, etc

It is worth mentioning that the impact of this project on water resources consumption is of little consequence, however, on the scale of the entire complex the impact will be more pronounced. Thus, it will be addressed jointly by all developers.

- **Visual Impact**

Visual effects arise from changes in the composition and character of views available to receptors affected by the proposed development (e.g. residents, recreational users, tourists etc). Visual impact assessment considers the response of the receptors who experience these effects, and it considers the overall consequence of these effects on the visual amenity of the view. There are no receptors near the project area, and these are limited to the transient drivers along the Luxor-Aswan Road.

- **Glare and Glint**

To maximize electricity generation, solar PV modules are designed to absorb light and reflections are contrary to their central purpose. However, panel glass remains relatively smooth and homogenous and may be physically capable of producing a concentrated reflection similar to a calm lake can on a wind-free day.

Arinna Solar Power site is located roughly more than 5 km from the Luxor-Aswan road and thus potential glare is not significant.

- **Public Health**

The project does not entail construction of new high voltage networks, but will connect to the existing transmission lines. No additional impacts from construction of transmission lines are expected to occur.

- **Site Security**

For security measures, Winnergy's facility will undertake measures mentioned in 3.3.3 and assign an annually contracted security company to provide security services for the site premises. The security company will provide 3 security guards on site (1 guard during day time and 2 guards during the night), in exchanging shifts.

Moreover, cameras are to be installed on the site perimeter and on the fence and the entrance gate will have one camera. The camera will keep record for 7 days and will be connected with an uninterruptible power supply (UPS).

All plant gates will be under video surveillance and data will be stored for at least 1 week. Motion Detection along fence may be used depending on

the surroundings. The presence of guards may have a negative impact on the community if not properly trained, equipped and monitored.

Mitigation measure
The security personnel will be adequately trained, have appropriate conduct toward workers and community and to act within the applicable law. Furthermore, the grievance mechanism, outlined in Chapter 7, will be developed to allow the potentially affected community to express concerns about the security arrangements and acts of security personnel.

Apart from Arinna Solar Power site security, the overall security of the PV complex needs to be addressed jointly by all developers. The PV park security aspects will be addressed by the Management , Environmental and Social Facility as indicated in the RFP of 2016.

6.3.3 Impact on Archeological Features

There are no registered archeological or cultural heritage features in the project area. However, in case of unlikely chance find, the appropriate chance find procedures will be implemented, which mainly entail halting the activities and fence the area while notifying the concerned authorities immediately according the stipulation of Law 117 of 1983 concerning the Protection of Antiquities.

6.3.4 Impact on the Work Place

Construction Phase

Potential impacts during construction could arise from noise, accidental slipping of the workers and hazards from exposing to dust and emissions from material handling.

Mitigation measures
The project will obligate the contractor, through the contracts, with the following measures and will follow up their implementation:

- Abide by all national occupational health and safety regulations, Law 12/2003
- Provision of suitable PPE
- Equipment periodic maintenance according to manufacturers' schedule

Residual impacts
Through implementation of the above mitigation measures, the expected residual impact on the workers' health is insignificant.

During operation

No significant impacts on workplace during operation

6.3.5 Impact of the Environment on the project

- **Impact of Sand Storms**

One of the impacts of strong wind is sand and dust deposition. The study area experiences sand storms during spring and autumn. Higher wind speeds potentially increases the performance losses due to abrasion and/or

deposition of dust on PV cells. However, the design of the PV module has taken into consideration selection of coating material that will minimize the abrasive effect of dust. In addition, periodic module cleaning and maintenance will minimize the impact of deposited dust.

Thus, with appropriate design materials and with implementing proper maintenance and cleaning procedures the impact of dust will be minimized.

- **Impact of Earthquakes**

As discussed in Chapter 4, Egypt is divided into 5 seismic zones, and the project is located within zone 2. The project is complying with Egyptian codes, regulations, particularly the Egyptian building code with respect to type of construction and design requirements.

Thus, taking into consideration the building code requirements in the project design, the residual impacts will be negligible.

6.4 Cumulative Impacts

The IFC Good Practice Handbook Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets indicates that although the environmental and social impact assessment (ESIA) process is essential to assessing and managing the environmental and social impacts of individual projects, it may be insufficient for identifying and managing incremental impacts on areas or resources used or directly affected by a given development from other existing, planned, or reasonably defined developments at the time the risks and impacts are identified.

The IFC Performance Standard 1 limit cumulative impacts to be addressed to those impacts generally recognized as important on the basis of scientific concerns and/or concerns from Affected Communities. Examples of cumulative impacts include: incremental contribution of gaseous emissions to an airshed; reduction of water flows in a watershed due to multiple withdrawals; increases in sediment loads to a watershed; interference with migratory routes or wildlife movement; or more traffic congestion and accidents due to increases in vehicular traffic on community roadways.

In this context, it is important to point out that PV projects generally do not pose environmental adverse impacts during operation activities, and the potential impacts during construction are localized and short term and considered insignificant for the individual project. In this respect, the main potential ***cumulative impacts*** to be considered by the collective assessment for all projects within the solar park would include:

- Impact on water resources
- Wastewater and solid and hazardous waste management
- Traffic management including equipment and workers transportation
- The influx of workers and worker accommodation
- Community safety and site security

The cumulative impacts have been highlighted in the Strategic Impact Assessment under preparation by NREA. The impact assessment of the cumulative aspects will be studied jointly by the different developers through the facility management to be selected by the Benbban Developers Association (BDA).

7. Environmental Management Plan

The project's environmental and social management plan (ESMP) consists of a set of mitigation, monitoring and institutional measures that should be performed during the construction and operation phase to ensure the sound environmental performance of the project. The plan also includes the actions needed to be taken to implement these measures. The overall objective of this chapter is to describe how the Project plans to deliver the mitigation and management measures outlined in this ESIA Report.

The purpose of the ESMP is to:

- Ensure continuing compliance with all Egyptian legislation, international Guidelines and Project policies;
- Outline the ways in which the potential impacts identified in this ESIA report will be managed;
- Provide assurance to regulators and other stakeholders that their requirements with respect to environmental performance are being met;
- Ensure that appropriate monitoring is undertaken, including the establishment of a monitoring plan; and
- Provide a framework for the compliance auditing and inspection programs that will enable the Project to be assured that its aims with respect to environmental performance are being met.

ESMPs will be developed in detail by the Project and their contractors as the PV project develops and as EPC contractors are appointed. The ESMP is to be considered as operational or 'live' documents that will be frequently updated by the project teams to reflect the activities at the project site

The project's EMP consists of the following:

1. ***Summary of the impacts and Mitigation measures*** to reduce potentially significant adverse environmental impacts to acceptable levels as discussed in Chapter (6).

2. ***Monitoring Plan*** during project implementation to provide information about key environmental aspects of the project, particularly to monitor environmental impacts of the project and the effectiveness of mitigation measures.

7.1 Mitigation Measures

Following is a brief summary of the mitigation measures for the construction and operation phases previously discussed in chapter (6). The mitigation measures either address the environmental aspect (for example preventing/ avoiding/ minimizing the occurrence of the aspect) or address the potential

exposure to the impact. The facility ESMP plan will be developed in accordance with the relevant national regulatory requirements.

Contractors commissioned for the construction and operation will be required to undertake the necessary measures to protect the environment and the workers as per the guidelines outlined in section 2.2. the project will ensure that contractors will carry out necessary measures to minimize impacts. This is to be included in the contractor's scope of work (contract) and addressed in the contractor management plan. This will be in accordance with chapter 2 (construction and work sites) of the Ministerial Decree 211/2003, implementing Labor law 12/2003 as well as the IFC EHS guidelines and the workers' accommodation processes and standards.

The Table (7-1) below presents a summary of the environmental and socioeconomic aspects, mitigation measures and residual impacts as assessed for the different project phases.

Table 7-3: Summary Of The Environmental And Socioeconomic Aspects, Mitigation Measures

Issue	Impact category (not significant, minor, moderate, major)	Mitigation Summary	Residual Impact
Construction Phase			
1- Ambient Air Quality			
• Fuel combustion Emissions from Diesel generator; • Dust emissions during construction activities	Minor	• Maintenance of equipment and vehicles; • Speed limit restrictions will be implemented on site • Dust suppression methods will be adopted where applicable • Excavated materials will be covered, as feasible, to reduce potential for windblown matter	Not significant/negligible
2- Ambient Noise			
• Machinery and equipment • Earth works	Minor	• Equipment and machinery will be maintained in good working conditions, • Use of further reduction measures (e.g. mufflers) may be assessed. • If necessary a grievance mechanism will be adopted for assessing complaints associated with construction noise, if any.	Not significant/negligible
3- Soil			
• Septic tanks • Oil leaks and fuel spills	Moderate	• Proper domestic wastewater and waste management • Proper management of fuels used on to minimize release to soils • At decommissioning develop a re-instatement plan	Not significant

Issue	Impact category (not significant, minor, moderate, major)	Mitigation Summary	Residual Impact
4- Biological Environment			
• Terrestrial biodiversity	Not significant	• Implement and update a solid waste management plan to include waste collection, storage, transport and disposal in an environmentally sustainable manner to avoid attraction of vermin	Not Significant
5- Labor and workplace health and safety			
• Work environment health and safety	Moderate	• A health and safety policy will be applied throughout the project and among all project contractors.. • Abide by all national occupational health and safety regulations, Law 12/2003 • Provision of suitable PPE, training and ongoing safety checks • Equipment periodic maintenance according to manufacturers' schedule	Not Significant
6- Socio-economic			
• Employment	Positive	• work opportunities for local communities mostly during construction phase	Positive
• workers influx and accommodation		• Input from Arinna Solar Power required	
• Water resources used during construction activities	Minor		Minor **If using ready mix concrete the impact would be not significant**
• Traffic: Impacts resulting from increased traffic movements	Moderate	• Transportation for individual project is estimated to be 30 vehicles/day in total during peak	

Issue	Impact category (not significant, minor, moderate, major)	Mitigation Summary	Residual Impact
		construction (SESA NTS). However, the results of cumulative assessment, once made available by Arinna Solar Power, is to be incorporated in this ESIA	
Operations			
1-Ambient Noise Impacts			
• Machinery and equipment	Not significant	• Potential noise generating machines and equipment are designed to meet statutory regulations concerning noise. • Acoustic enclosures are installed for noise generating equipment, wherever possible such as inverters and transformers • Workers at noise generating machinery and equipment will be provided with the suitable personal protective equipment (PPEs . • If necessary a grievance mechanism will be adopted for assessing complaints associated with operation noise, if any.	Not significant
Soil			
• Septic tanks • Oil leaks	Minor	• Proper domestic wastewater and waste management Proper management of fuels used on to minimize release to soils • At decommissioning develop a re-instatement plan • Septic tank integrity checking • Good house-keeping measures; and, Emergency response plan to include response to spill scenarios.	Not significant

Issue	Impact category (not significant, minor, moderate, major)	Mitigation Summary	Residual Impact
2- Impact on Biological Environment			
• Terrestrial biodiversity	• Minor	• Implement and update a solid waste management plan to include waste collection, storage, transport and disposal in an environmentally sustainable manner to avoid attraction of vermin	Not significant/negligible
3- Labor and workplace health and safety			
• Work environment health and safety	• Minor	• A health and safety policy will be applied throughout the project and among all project contractors. • Abide by all national occupational health and safety regulations, Law 12/2003 • Provision of suitable PPE, training and ongoing safety checks • Installing fire detection and fighting system • Equipment periodic maintenance according to manufacturers' schedule	Not significant
4- Socio-economic			
• Employment	• Positive	• work opportunities for local communities mostly during construction phase	Positive
• workers influx and accommodation	• Minor	• Input from Arinna Solar Power required	Not significant
• Traffic: Impacts resulting from increased traffic movements	• Minor	• Transportation for individual project is estimated to be 10 vehicles/day during normal operation (SESA NTS). However, the results of cumulative assessment, once made available by Arinna Solar Power, is to be incorporated in this ESIA	not significant

7.2 Institutional Arrangements

According to the requirements of the Ministerial Decree 134/2003 of the Ministry of Labour and Manpower implementing law 12/2003, ISO 14001, OHSAS 18001 standards, and Arinna Solar Power commitment to the protection of persons and the environment, the facility will have an HSE policy. Arinna Solar Power, the contractor and all sub-contractors will at all times comply with National HSE Regulations, Equator Principles and IFC Environmental, Health and Safety Guidelines. The outline of the HSE policy requirements for the PV project is summarized as follows:

- Carry out Environmental Impact Assessment and management plans
- Apply an HSE plan, which will act as the reference document for the project.
- Provide HSE training for all staff on safety and emergency plans and procedures.
- Apply HSE requirements for Contractors

Moreover, as Arinna Solar Power has an Integrated Management System, it has developed work procedures and instructions to carry out the processes according to the policy and goals of Arinna Solar Power.

Thus, all activities are carried out with consideration for the environment and complying with the regulations in terms of Environment, Health and Safety. In this regard, provisions are made for the following:

- Hazard Identification and Risk Assessment
- Occupational Health and Safety Plan
- Business Activities Coordination
- Incidents/Accidents Investigation
- Operational Control

7.2.1 Health and safety policies

Hazard identification and risk assessment

According to Arinna Solar Power, anyone who detects unidentified risks or a situation that implies changes in the Risk Assessment shall have to communicate it to the Health and Safety Responsible. The Health and Safety Responsible shall modify the risk assessments and shall identify the hazards which can be a risk for the health and safety on sites.

The method of risk assessments shall be based on the current regulations or defined by recognized public institutions.

A qualitative risk assessment method is used for the estimation of the risks; assessing and managing occupational exposures to chemical, physical, radiological, and biological agents. Qualitative risk assessment involves making a formal judgment on the consequence and probability using “Risk = Severity x Likelihood”.

The likely effect of a hazard may for example be rated
- Major, i.e. death or major injury or illness causing long term disability
- Serious, i.e. injuries or illness causing short-term disability
- Slight, i.e. all other injuries or illnesses

The likelihood of harm may be rated
- High, where it is certain that harm will occur
- Medium, where harm will often occur
- Low, where harm will seldom occur

Risks are likely to arise from the following:
- **Safety risks:** for example, people falling from the same/ different levels, objects falling due to collapsing/handling/detachment, electrical contact, exposure to low and high frequency electromagnetic fields, vibrations, noise, air contaminants, chemical hazards, dust, fumes, etc.
- **Ergonomic risks:** for example, forceful exertions, repetitive motions, pushing, pulling, etc.

It is the responsibility of the Health and Safety Responsible to communicate to the employees the Risk Assessment by internal announcement, noticeboard, etc.

The Risk Assessment is updated:
- At the beginning of the preventative planning.
- Technological changes.
- Changes in the working conditions.
- Incorporation of vulnerable workers.
- When new risks are identified due to implementation of corrective or preventative measures and improvements derivative of the accidents investigation.
- Annually.

Risk management approach

Arinna Solar Power approach to managing risk on a project is summarized as follows.
- Identify – Identify risks acting on the project
- Analyze – the nature, likelihood, consequence and timing of the risk
- Quantify – (where possible) the consequence and probability of the risk
- Control – Determine the response to risk – accept, track, mitigate, or transfer
- Monitor – Document and communicate risk management strategy, plan and procedures
- Improve – Continuous improvement in risk identification, analysis, quantification, control and monitoring

<u>Mitigating & managing risks</u>

The risks identified in the Risk Register will be evaluated and allocated a risk management strategy:

- Accepted – Risk is deemed acceptable
- Mitigate: Put in place internal and external systems to reduce either the likelihood or consequence of the risk
- Transfer – Transfer the risk to a third party that is better able to manage the risk

Contractor management

Arinna Solar Power uses a set of forms to incorporate contractors on its projects. The execution of the works will be monitored jointly between the Responsible of Health and Safety of Arinna Solar Power and the Health and Safety Technicians of Contractors/Subcontractors. In case of non-compliances in terms of health and safety, Arinna Solar Power shall act in agreement to non-compliances and corrective actions procedure.

Contractors and Subcontractors shall have to inform to Arinna Solar Power about possible incidents/accidents suffered by workers on site. Arinna Solar Power shall accomplish the pertinent investigation.

7.2.2 Human Resources Policy

Under the human resources policy, Arinna Solar Power is to provide employees with information regarding their rights under national labor and employment law, including their rights related to wages and benefits as per the national labour law as well as Arinna Solar Power HR policies. This policy will be clear and understandable to employees and available in the main language spoken by the workforce. Arinna Solar Power will not employ children or forced labour.

Thus, an HR policy is to cover the following topics:

- Entitlement to and payment of wages; permissible wage deductions;
- Overtime compensation; hours of work and any legal maximums;
- Entitlement to leave for example holidays, vacation, illness, injury, and maternity.
- Entitlement to benefits;
- The employees' right to form and join workers' organizations of their choosing without any interference or employment consequences and to bargain collectively with the employer;
- Rights to privacy and data protection;
- Disciplinary and termination procedures and rights;
- Conditions of work;
- Occupational safety, hygiene and emergency preparedness;
- Promotion requirements and procedures;
- Vocational training opportunities;
- Child labor and equal opportunity.

- Retrenchment plans

With respect to contracted workers, Arinna Solar Power will ensure that the third parties who engage these workers abide by the project's environmental and health and safety management requirements through an environmental communication. This is to be included in the contractor's scope of work (contract). The contract should include ensuring proper housing and accommodation conditions for workers during construction and/or operation, as relevant [18]. In this context, Arinna Solar Power established policies and procedures for managing and monitoring the performance of third party performance. The environmental communication with subcontractors and suppliers covers

- the management of hazardous and non-hazardous wastes
- the rational use of electricity, water, fuel and raw materials
- the use and storage of chemical products
- the management of disposed materials
- the control of noise
- management of emissions

As well as documentation required upon starting work, monthly and upon the completion of works.

7.3 Management Plans

Within its commitment to ensure environmental protection and maintain efficient environmental performance as well as social integrity, the project will develop various environmental and social management plans addressing the different environmental and social aspects as mentioned in section 2.4. The different environmental dimensions will be incorporated throughout the operation of the plant. In this regard, the environmental plans to be developed will address:

- Hazardous and solid waste management
- Preventative and corrective maintenance
- Module cleaning
- Housekeeping
- Fire-fighting and emergency response
- Emergency response plan
- Occupational health and safety plan
- Training and Awareness
- Community Safety
- Information Disclosure and Stakeholder Engagement
- Project Decommissioning Plans

It is worth mentioning that the following services are anticipated to be subcontracted to suitable qualified local companies:

[18] Workers' accommodation: processes and standards A guidance note by IFC and the EBRD, 2009

- Security of the plant
- Construction works
- Waste management
- Vehicles rental
- General cleaning services
- Inverter and transformer maintenance

The following sections provide details of the different environmental management plans.

7.3.1 Hazardous Waste (HW) Management

HW includes mainly used machinery oils. Used oils will be collected and temporarily stored till transferred off site. According to the national used oil management system, used oils are collected by Petrotrade or the supplier. The used oils will then be sent for recycling by a specialized oil recycling company.

7.3.2 Solid Waste Management

Main source is domestic activities from workers as municipal solid waste will be generated from the warehouse and offices.

Solid waste would also include damaged PV modules which could be disposed of as solid waste or sold or return to the supplier for recycling for recycling as they contain substances such as glass, aluminum and semiconductor materials that can be successfully recovered and reused in other relevant products.

Solid waste will be stored on-site till submission to authorized solid waste contractor for final disposal. If possible, when waste disposal is transferred offsite and/or conducted by third parties, Arinna Solar Power will obtain chain of custody documentation to the final destination and will use contractors that are reputable and legitimate enterprises licensed by the relevant regulatory agencies.

Damaged panel management for recycling to be included in the plans overall of the BDA

7.3.3 Preventative and Corrective Maintenance

The main objective of the plant maintenance is to maximize equipment availability at an operating condition.

Planned maintenance

Maintenance will be carried out in accordance with:

- Equipment manufacturers' suggested requirements.
- Scheduled inspections according to good maintenance practices.
- Maintenance programs and procedures developed by Arinna Solar Power, based on their experience in the field.

Preventive Maintenance

The preventive maintenance guidelines are based on:

- A general maintenance plan according to which all maintenance activities are scheduled.
- Regular visual inspections will be conducted in modules, inverters, structures, electric system, weather stations, monitoring system and security system to detect existing and potential defects. It is particularly important to inspect all plant equipment exposed to the weather.

The main tasks proposed as a minimum maintenance scope are:

- **Modules**. All modules will be cleaned periodically because of the soiling due to dust, leaves or bird droppings. Also power measurements will be taken.
- **Inverters**. At least include; thermal inspections, ventilation and event log checks, earthing connection and efficiency measurements and filter replacement.
- **Structures**. They will be regularly checked the tightening of the blots.
- **Electric system**. The maintenance staff will perform measurements of earth resistance, thermal inspection of connection boxes and switches, protection triggering tests and cabling insulation controls.
- **Electronic and Electro-Mechanical equipment** .will include lubricating hinges, bearings and other movable parts such as trackers' motors; adjusting torques of bolts and studs of electrical connections and transformers.
- **Metering**. Power controls will be checked.
- **Weather station**. Calibration of sensors and sensor cleaning will be undertaken to keep the weather stations in an optimal state.
- **Monitoring system**. All the meters will be regularly recalibrated.
- **Security system**. Alarm tests will have a periodical test according to the local laws and best practices
- **Enclosures**. Includes cleaning, painting and inspection and repair of the lighting system.
- **Soil, roads and fences**: road, curb and perimeter fencing checking and repairs and weeding clearance are considered.

Corrective Maintenance Plan and Response Times

Preventive maintenance reduces the frequency of breakdowns but cannot avoid them. Unplanned maintenance involves corrective maintenance and emergency repairs resulting from equipment problems, required as a result of equipment breakdowns or deficiencies. Once a problem occurs, the plant maintenance staff is enough trained to carry out the repairs in a quick response time in order to return to the normal operation levels. Corrective maintenance may involve the participation of specialized maintenance contractors.

7.3.4 Housekeeping

Regarding housekeeping of the plant, periodic inspection will be carried out to ensure proper housekeeping. Good housekeeping practices will be followed such as:

- Optimizing the use of water for cleaning purposes.
- Performing noise measurement in the related places within the project area.

7.3.5 Fighting Plan

Fire hazards may arise from electric equipment, wires and cables. A well designed Electrical Safety Program will protect employees as well as the project. Basic components of the safety program will include:

- Perform an electrical hazard assessment.
- Inform and train employees of the potential hazards and the application of Lockout/tag-out devices and warning labels
- Test and verify that employees are "qualified" to work- on specific equipment.
- Selection and provision of proper personal protective equipment for employees.
- Provide fire alarms
- Installment of fixed and semi-fixed dry chemical fire extinguishing equipment
- Water fire and CO2 fire extinguishers

7.3.6 Emergency Response Plan

Arinna Solar Power recognizes the importance of an emergency response plan and will adopt a strategic approach to engage potential stakeholders in the project's success.

Emergency Situations

Emergency situations are those implying collective danger to persons, material goods or the environment. Emergency situations may take place on specific working areas, may be classified from minor to major depending on their importance as follows:

- **Partial emergency**: this emergency situation cannot be solved as quickly as an attempt and forces the personnel to request help from a group of experts who have more material and human resources.
- **General emergency**: this emergency situation exceeds human, firefighting and emergency resources capacity on site, forcing the alteration of all the organization of the company. It has to be replaced by another emergency organization requested from outside.

7.3.7 Emergency management plan

Arinna Solar Power will identify and assess major-accident hazards, and will take all measures necessary to prevent major accidents or limit their adverse impacts on workers, affected communities and the environment, with a view to ensuring high levels of protection to people and the environment in a consistent and effective manner.

Such measures will be identified in a major-accident prevention/emergency preparedness policy and an appropriate management plan, integrated into the overall ESMS. This plan will include organizational structures, responsibilities, procedures, communication, training, resources and other aspects required to implement such policy to ensure that Arinna Solar Power has the capacity to respond effectively to emergencies associated with project hazards, with the overall objective to:

- prevent, contain and control incidents so as to minimize the effects, and to limit damage to people, the environment and property implement measures necessary to protect people and the environment from the effects of major accidents
- communicate the necessary information to relevant emergency services or authorities, as well as to the potentially affected workers and public provide for the restoration and clean-up of the environment following a major accident.

Emergency control and
All emergencies should be reported to the Arinna Solar Power safety department who will contact the relevant emergency services and personnel to deal with the operational side of an emergency.

Generally, Arinna Solar Power will set basic principles for safety and emergency management systems including the establishment of a major accident prevention policy, the preparation of safety reports, the development of safety management systems and the drawing-up of internal and external emergency plans, as well as, the creation of systems so as to ensure that those plans are tested, revised and implemented.

7.3.8 Occupational health and safety plan

Prior to any work taking place on site, it is necessary to prepare an Occupational Health and Safety Plan.

An Occupational Health and Safety Plan is a document in which the prime contractor identifies, plans, organizes and controls all activities on site from the prevention point of view. The purpose of this plan is to identify and control hazards before they cause accidents or illnesses and respond to emergencies during the construction of the PV plant. An occupational health and safety plan includes the following

- Health & Safety Policy
- Targets and Restrictions
- Responsibilities and communications
- Site Rules
- Training
- Personal Protective Equipment
- Housekeeping
- First Aid
- Fire Prevention
- Monitoring Safety
- Incident and Accident Reporting and Investigation
- Registers
- Health and Safety File

Incidents/accidents investigation

Any workplace incident/accident in Arinna Solar Power Solar's facilities shall have to be notified to the Health and Safety Responsible or Site Foreman. In case

of health damages, it shall contact with the Compensation Insurance for medical treatment. The Labor Department must be notified by the Compensation Insurance which shall issue the Accident Report and develop the Accident Rate.

All accidents shall be recorded and investigated using the incidents/accidents investigation report form. The investigation shall be carried out by the Health and Safety Responsible in collaboration with the Site Foreman, Witness and Workers affected.

After the incident investigation process, the Health and Safety Responsible shall establish correctives or preventatives actions whether he considers opportune. When the measures are not effective, they shall be registered in a "Non-Compliance Report".

7.3.9 Transportation and vehicle movement

Workplace transport is any activity involving vehicles used in a workplace. Activities and operations from which risks arise are mainly

- Getting to and from site.
- Getting in and out of site.
- Moving around the site.

Thus, to manage workplace transport effectively, there are three key areas to assess risks and addressed in the EHS plan: site safety (design and activity), vehicle safety and driver safety.

7.3.10 Training and Awareness

Employees training and awareness

In order to ensure the competence of the project personnel in undertaking the environmental management procedures and plans, training will be conducted for the personnel according to the particular responsibility.

Training programs will involve training staff on safe handling of equipment and wastes and on the use of equipment. They will be informed of any potentially harmful health effects related to the PV plant operations. Moreover, they will also be trained on the use of fire reel hose and fire extinguishers. Training plans will be put in place to

- Ensure that all visitors and site personnel undergo a site specific HSE Induction training session
- Ensure that all records of attendance are kept on file
- Ensure that all visitors and personnel are issued with an access card as proof of site induction
- Provide a list of site specific hazards identified
- Train, inform, communicate and instruct all workers regarding the hazards and risks before any work commences and thereafter at regular intervals as the risks change and as new risks develop. This training will

be carried out in the form of the risk assessment and toolbox talks. A record of attendance will be kept on file

- Ensure that Sub-Contractors will conduct their own task specific risk assessments and keep records in the Health and Safety file

Contractor Training and Awareness

Contractors and vendors that perform work on site will be required to show evidence of appropriate health, safety and emergency response training. Environment, health and safety requirements will be incorporated within the individual contractors' contracts. The project will undertake an induction program to advise contractors and site visitors on basic health, safety, and emergency procedures such as emergency signals and evacuation routes. Contractors and vendors on short-term assignments that do not have safety and emergency response training will work under the supervision of the company staff.

7.3.11 Community Safety

In the course of ensuring that operation assets and personnel are secured and safeguarded in a legitimate manner, Arinna Solar Power will assess the risks and impacts upon workers, local society and communities in and surrounding the project area of influence resulting from the use of arrangements provided by security personnel, whether privately outsourced or publicly provided .

The Contractor will ensure safe access and security of the site, and ensure the safety of all Employees and visitors to the site .

For security measures, Arinna Solar Power will contract a company to provide security services, hiring from local community, senior officers from the company side. The security company will provide security guards on site, exchanging shifts. The guards will be mainly located at the premises of the site.

Security personnel will have not been implicated in past abuses, appropriate conduct toward workers and community and to act within the applicable law. Furthermore, the grievance mechanism will allow the potentially affected community to express concerns about the security arrangements and acts of security personnel. Arinna Solar Power will investigate any allegations of unlawful or abusive acts of security personnel, take action (or urge appropriate parties to take action) to prevent recurrence, and report unlawful and abusive acts to public authorities.

7.3.12 Community Development

Community service is a key component for the ESIA. It is understandable that community needs could not all be addressed by one investor/project but should be addressed through collaborative efforts of the different developers. A number of potential opportunities for community development exist and these can be categorized into:

- Training
- Health services

- Infrastructure

Training: This can include training courses for potential employment candidates as well as technical training for university students.
Health services: This can include providing ambulance services and improving local health units.
Infrastructure: this can include the construction of schools, roads and associated facilities.

It is of utmost importance that the means of community development is chosen and undertaken in full coordination with the governate and local government entities.

7.3.13 Cultural Heritage

As indicated in Chapter 2 above as well as in the SESA NTS, The Antiquities Authority confirmed that no archaeological finds have been reported on the site and thus issued a "No.objection. for the Benban Solar Park. However, archaeological/antiquities chance finds remain a possibility. As per the antiquities law, and the IFC PS 8, procedures in case of chance finds should be developed for the site as a whole and for individual investors.

7.3.14 Information Disclosure and Stakeholder Engagement

To ensure the correct level of engagement is being achieved by each stakeholder, the Project will develop a Communication Plan and strategies to communicate project related information to key stakeholders in a proactive and timely manner. Stakeholders engagement usually involves the following:

- the disclosure of information,
- consultation with affected communities, and
- the establishment of a grievance mechanism.

The receipt of community contacts through a well-functioning system addresses one part of the communication to be maintained with the community.

In this respect, the project will implement a Stakeholder Engagement Plan (SEP), during construction and operation of the project, which will include but might not be limited to the following components:

- Description of the regulatory and/or Arinna Solar Power requirements for consultation and disclosure
- Description of resources and responsibilities for implementing stakeholder engagement activities
- Description of how stakeholder engagement activities will be incorporated into the promoter's environmental and social management system (ESMS).
- Regular liaison with neighboring villages, district councils and the municipal authority to keep them advised of the project programme, progress and planned activities;
- Timely and appropriate disclosure of information about planned activities to neighbours and the local community prior to and during

construction including, in particular, information about any disruptive activities such as transport of abnormal loads or noisy activities;
- Timely and appropriate disclosure of information regarding any significant changes in any activities, as relevant
- Timely and appropriate information about any non-routine activities during operation that could cause disruption, for example major maintenance or repair works;
- Clear information about Emergency Planning arrangements for the local community. Information will be disseminated to stakeholders in a culturally appropriate manner and will be freely accessible through forms of communication adequate to the relevant community.

Grievance mechanism

In addition, the project would develop a Grievance Mechanism that allows the stakeholders to address its comments, worries and complaints that should be accessible. An example of a basic structure for such system is shown in the figure below.

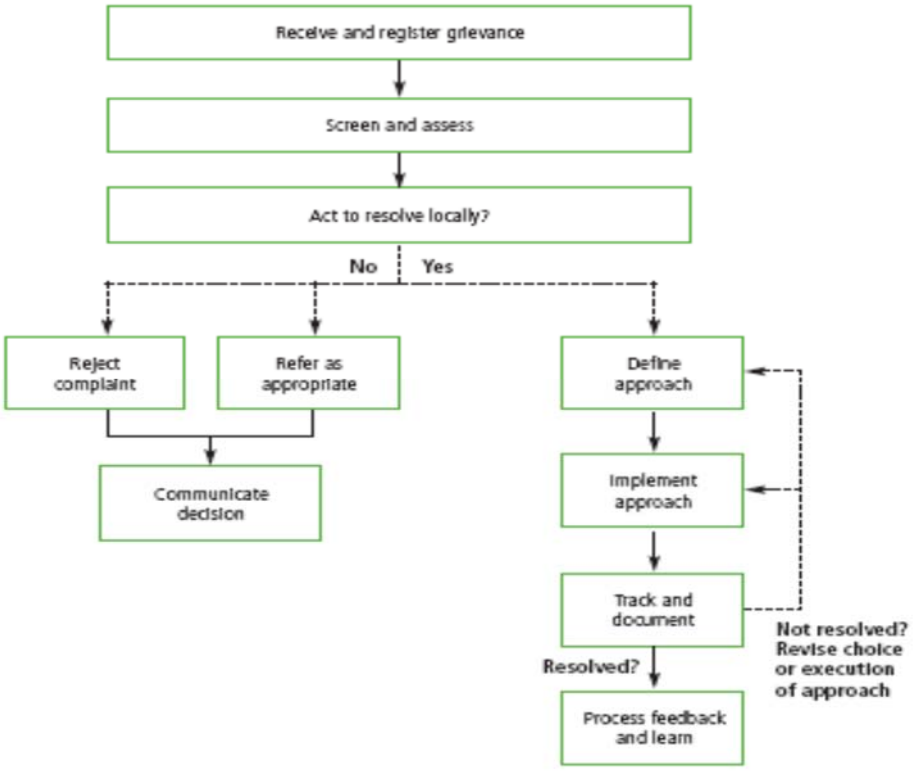


Figure (7-1): Example of Grievance Mechanism Structure

(Source: A Guide to Designing and Implementing Grievance Mechanisms for Development Projects, The Office of the Compliance Advisor/Ombudsman for the International Finance Corporation (IFC), 2008)

All employees shall be informed of this mechanism at the time of recruitment or no later than before start of any work on site.The grievance mechanism shall also include an anonymous communication channel such as a "suggestion box."The mechanism involves the site management and will address issues and concerns promptly. All issues raised will be addressed using a transparent process that provides timely feedback where applicable, without retribution.

The procedure for the grievance mechanism for both workers and local community is described below.

- A concern is raised, either anonymous or with known name and source. All issues raised are tracked in the projects "Issue Log", and a responsible person for the issue is identified. Project Manager is ultimately responsible for all issues, but a concern/issue may be delegated to Site Manager, HSSE Manager or QA Manager as required (these might be the same person)
- Any concern indicating danger for human life, significant environmental damage or corruption will demand an immediate shut down until the concern has been investigated.
- Identified concerns are investigated. All concerns will be evaluated and corresponding actions to be agreed within 72 hours
- For all community related issues the agreed action is added to any planned agenda for information meetings or report. For all workers related issues the agreed action is communicated through the suppliers foreman to all relevant personnel at first convenience
- Once agreed actions are completed the issue is closed and final notification is given.

Any concern related to possible corruption, significant security or safety breaches or other potential major concerns gives anyone on site the right and duty to stop work and report to Site Manager.

All concerns and corresponding actions are included in reporting to management as defined in the project charter and relevant reporting templates.

7.3.15 Project Decommissioning Plans

Decommissioning is defined as the close down of operations, the removal of process equipment, buildings and structures and carryout site cleanup and remediation if required. The expected lifetime of the project ranges between 20 - 25 years that will be renewable as long as the proper predictive maintenance measures are taken and all the necessary revamps and upgrades are done. Following are the main issues addressed by the facility's decommissioning plan:

- Development of the decommissioning plan according to international and best practices guidelines.
- Removal procedures for all above ground structures
- Disassemble the PV Modules: The components of the plant will be disassembled and removed. Thereafter they will be reused and recycled (where possible) or disposed of in accordance with regulatory requirements.

Moreover, the PV modules could be sent for recycling through the PV Cycle Scheme[19].

7.4 Monitoring Plan

Once the identification and the assessment of risks have been made, according to the results obtained, a number of measures are defined in order to minimize or remove them. Taking as a reference that information, a control for each of risks identified and evaluated are conducted.
Besides, Arinna Solar Power will establish private operational controls for particular preventive activities. Technical instructions will be established in order to control and measure the following activities:

- Medical assessment
- Personnel protective equipment control
- Health and safety technician/Qualified personnel
- Security inspections

Arinna Solar Power will draw up technical instructions of operational control, follow up and measurement for more specific activities or countries when it is necessary. Operational control guidelines established are subject to follow-up and inspection for appointed personnel by the Health and Safety Responsible.

The follow up and measurement is made monthly on site. Thus, Arinna Solar Power knows about the failures of the Management System and the measures to be adopted in order to improve thereon.

Furthermore, it's verified that the measures proposed after the identification and evaluation of risks are implemented and effective.
The need for filing for non-compliances might arise after detecting aspects causing unsafe situations or aspects that don't comply with the regulations in terms of workplace Health and Safety.

7.4.1 Workplace Monitoring

Labour Audit

A Labour Audit is the most widespread spot-check mechanism used nowadays to monitor labour standards. Essentially, it is a tool used to ensure and support the application of the labour standards; it amounts to the thorough formal examination of the labour practices of a particular workplace or company, based on corroborated evidence .

Thus, an audit aims to check these practices against a defined standard and may well extend to supply chains.

[19] PV CYCLE applies so-called "Best Available Techniques Not Entailing Excessive Costs" (BATNEEC) that allow our take-back and recycling system to be effective and cost-efficient, PV module recycling enables the recovery of various raw materials and thus helps conserve our valuable natural resources. By increasing resource efficiency and decreasing waste, PV CYCLE contributes to the European Union's environmental targets. PV CYCLE organizes the recycling of all PV technologies that are commercially available today, whether they are silicon or non-silicon based technologies. **http://www.pvcycle.org/pv-recycling/**

In addition, monitoring will cover grievances received from workers and external stakeholders, and how they were resolved.

Workplace Noise

During Construction

During construction, the project will ensure that the noise level from all operating equipment would not exceed the allowable limit set by Law 4/ 1994 for 8 hours duration shift (90 dB). In case the noise levels exceeded this limit, the exposure periods will be carried out according to those indicated in Annex (7) of Law 4/1994. Moreover, ear plugs will be provided for the workers at the locations generating increased noise levels. Noise level measurement will be carried out quarterly.

During Operation

Sources of noise inside the plant result mainly from transformers and inverters. The measured noise levels will be compared to the levels set in Annex (7) of Law 4/1994. In case the noise exceeded the maximum limit of 90 dB, exposure periods will be proceeded as stipulated in Law 4/1994. Table (7.4) shows the noise monitoring locations and frequencies and the estimated monitoring cost. Regular checks will be carried out twice a year for areas of direct exposure to equipment. Moreover, proper PPEs will be provided for the workers at the given locations.

Health monitoring

Arinna Solar Power will ensure that workers' health is not affected by their work. To this end, three kinds of medical assessment are made:

- Periodic medical examinations, made once a year.
- Medical examinations for new employees or after the designation of new tasks with new risks. This is to protect the workers and to avoid allocating tasks for people that they can't perform them physically
- Medical examinations following a long absence for health reasons. These medical examinations will be made as per medical opinion or when the sick leave is equal to or greater than 60 days after starting a job.

Health monitoring is carried out using the specific and suitable "Health monitoring protocols" for each work station, according to the risks inherent to job. The result of medical examination (medical report) is confidential and is delivered to the affected worker. The Mutual Insurance Company will just provide the conclusions about said medical examination in terms of:

- Certificates of competency or worker adequacy to his/her work station or role.
- If necessary, the need to improve the protection measures or prevention.

Whether a medical examination is needed or not will depend on the applicable local regulations in terms of Health and Safety.

Personal protective equipment

The Occupational Health and Safety Regulations require that the employer protects their employees from workplace hazards that can cause injury. Collective protection measures must be given priority over personal protection measures. Contractors and Subcontractors must use work practice controls to manage or eliminate hazards to the greatest extent possible.
Contractors and Subcontractors must provide personal protective equipment (PPE) to their employees and ensure its use. Examples of PPE include such items as gloves, foot and eye protection, protective hearing devices (earplugs) hard hats, and respirators as necessary.
Some types of protective equipment available are:

- **Head protection**: protects from impact from falling or flying objects, risk of head bumping, exposure to chemical drips or splash, exposure to high temperatures and electrical contact.
- **Hearing protection**: is compulsory in those positions that overtake an equivalent noise level of 85 dBA or a peak noise level of 135 dBA. The use of hearing protection is recommendable as of 80 dBA.
- **Eye and face protection**: it must be used to reduce flying particles, metal speck, liquid chemicals, dust, gases, vapors, toxic, corrosive and irritating substances or potentially injurious light radiation.
- **Respiratory protection**: it must be used in absence of oxygen or presence of particulate atmospheric contaminants.
- **Hand and arm protection**: it must be used when employees are exposed to electrical contact, high temperatures, chemical substances, burns, dirt, welding works, cuts, vibrations and mechanical works.
- **Foot and leg protection**: it must be used to prevent heavy objects from falling or rolling over the foot, sharp objects penetrating the sole of the foot or cutting through the top, electrical and chemical contacts, slips or falls due to wet or slippery surfaces and environmental conditions.
- **Skin protection**: it must be used in case of products that can affect the skin of the employee.
- **Body protection**: the use of equipment such as jackets and protective aprons is recommended where tasks can hurt the body of the workers. It is compulsory to use fall protection for employees who may be exposed to fall hazards.

Health and safety technician, qualified personnel

Arinna Solar Power requires the appointment and presence of one Health and Safety Technician or Qualified Personnel according to the local regulations and company requirements. For the appointment, a “Health and Safety Technician appointment or qualified personnel" form will be used.
This technician will:

- be able to identify all those present and predictable risks in the surroundings and work conditions unsanitary or dangerous for the employees.
- take immediate corrective measures in order to remove risks.
- have knowledge about the local Health and Safety regulation applicable and training in this subject.
- draw up a follow-up report about Health and Safety management every 7 or 15 days.

Security inspections

Inspections will be conducted by the Health and Safety responsible or qualified personnel

All construction sites must be inspected once a month at least. These inspections allow accurately detecting practices or habits which could result in incidents, to determine the needs of training and to check if work methods are suitable. During the inspection, the inspector must avoid distracting the worker and avoid interrupting the worker unless s/he is doing something really dangerous. Once the inspection is finished, the inspector must communicate with the personnel all the negative details noticed as well as the positive points. Once the inspection has been made, it'll be decided whether it's necessary to file a non- compliance due to dangerous situations or noncompliance with the current workplace Health and Safety regulations.

Document management

Arinna Solar Power has a tool (platform) of document management for the management and control of documentation which is very useful during the construction process. Such tools will be adopted to Benban site specific conditions. Documentation must be sent to the company 48h before starting the works with the objective of reviewing and controlling it. The Contractor has to upload to this platform all Health and Safety documentation at the level of Company, Workers and Machinery independently and duly identified.

7.4.2 Monitoring Air Quality

During Construction

Workplace air monitoring of equipment exhaust will be performed quarterly. Emissions are generated from exhaust from construction equipment and motor vehicles and particulates during site works. Monitoring results will be compared with the allowable limits of Law 4/1994 provided in Chapter (2) of this study.
The following parameters shall be measured:

- Carbon monoxide, CO
- Sulfur dioxide, SO_2
- Nitrogen oxides, NO_x
- PM_{10}

7.4.3 Solid and Hazardous Wastes

Non-hazardous solid wastes will be recorded in the Environmental register of the plant. On the other hand according to Law 4/1994, a register will be prepared for hazardous wastes. Information of the HW register should include types and quantities of hazardous wastes, storage means and disposal.

7.4.4 Approximate Monitoring Costs

An independent consultant would be hired for carrying out the monitoring activities. The following table (7-4) provides approximate monitoring costs for guidance purposes only. The costs only cover analysis and field measurements. However, they do not include specific sample collection costs.

Table 7-4: Approximate costs for Environmental Monitoring

Parameter	Description	Approximate annual cost (L.E)
Construction Phase		
Noise level	Measurement at two locations quarterly	1200
Air quality (SO_2, NO_2, CO, PM_{10})	Measurement at 2 locations quarterly	1800
Operation phase		
Workplace noise	Measurement at 2 locations twice a year	800

Table 7-5: ESMP Summary

Aspect	Issues of concern	Actions	Party Implementing the Action	Indicator of completion	Estimated Cost	Required completion Date
Construction Phase						
Air Quality	Dust emissions	- Water Spraying using low water consuming suppression equipment - Implementing a speed limit for construction vehicles	Construction contractor	– Monitoring plan – Air quality measurements	1800 L.E	Throughout the construction phase period
	Working conditions of machinery	- Ensure good working conditions through frequent inspection of all construction equipment	Construction contractor	Maintenance logs	Cost of maintenance	
Noise Level	Working conditions of machinery	- Ensure good working conditions through machinery maintenance	Construction contractor	Noise measurements and Maintenance logs	1800 L.E and cost of maintenance	Throughout the construction phase period
	Provision of PPEs	- Providing necessary PPEs for workers	Construction contractor			
Soil	Housekeeping practices	- Develop and implement site	Construction contractor	– Solid/hazardous waste and	– Part of construction	

Aspect	Issues of concern	Actions	Party Implementing the Action	Indicator of completion	Estimated Cost	Required completion Date
Construction Phase						
	Waste/wastewater management	management plan and a solid waste management plan	Developers (include provisions in the construction contracts. Developers to ensure contractors compliance)	wastewater management contract – Contractor follow up documents	activities management – Cost of transportation and disposal	Throughout the construction phase period
Occupational Health and Safety	Site Staff and Workplace Safety	- Developing HSE procedures according to national requirements and IFC standards	Contractor	HSE provisions in the construction contracts	Construction cost	Before construction activities
Emergency Response	Site Staff and Workplace Safety	- Develop procedures for emergency control	Developer	Emergency response plan		Before project commissioning
Biological Environment	Native floral species, if relevant	- Use, as much as possible, native floral species for landscaping, if relevant	Construction contractor			

Aspect	Issues of concern	Actions	Party Implementing the Action	Indicator of completion	Estimated Cost	Required completion Date
Construction Phase						
	Waste management	- Developing a solid waste management plan	Construction contractor	Solid waste management contract	Cost of transportation and disposal	Throughout the construction phase period
Cultural heritage	Chance find	- Halt activities and immediately notify the concerned authorities	Construction contractor	Procedures for chance find		Throughout the construction phase period

Aspect	Issues of concern	Actions	Party Implementing the Action	Indicator of completion	Estimated Cost	Required completion Date
Operation Phase						
Water Resources consumption	Water consumption for of cleaning process	- Workers training - Use of efficient cleaning equipment	Developer	Workers training on utilization of cleaning equipment plans and selection of cleaning equipment	Operation cost	Throughout the project lifetime
Labour rights and welfare	Working conditions	Develop Human Resources policy	Developer	Contracts (with workers)	Operation cost	Throughout the project lifetime
Training and Awareness	Competence of the project personnel	training for the personnel according to the particular responsibility	Developer	Training plans		Throughout the project lifetime
Occupational Health and Safety	Site Staff and Workplace Safety	- Developing HSE procedures according to national	Developer	Development of HSE policies	Operation cost	Before project commissioning

		requirements and IFC standards				
Emergency Preparedness and Response	Operation risk management	- adopt a probabilistic risk assessment framework	Developers	Emergency response plan	Operation cost	
Cumulative Aspects						
Traffic (construction)	Traffic during peak construction periods	Develop common traffic management plan for all developers	All developers	Common traffic plan		During construction
Labour rights and welfare (construction)	workers accommodation and working conditions	Include provisions in contractors scope of work (contracts)	Developer (through contracts with construction contractors) and Contractor	Contracts (with contractors)	Construction cost	During construction phase
Stakeholders Engagement	Distribute Traffic	- Distributed over several side roads leading to the site location	Contractors			

	Community liaison activities	- Develop Grievance mechanism - Endorse the SESA Master Disclosure and Engagement plans	Developers	- Develop SEP - Grievance mechanism developed - % resolution of grievances within stipulated timeframes	Projects operation cost	Throughout the project lifetime
Community health, safety and site security	- Risk of road traffic accidents - Site security	- Endorse the common site security and safety plans developed jointly by all developers	Developers	Need to reflect in the individual project plans to make sure that workers are aware of the BDA plans		Throughout the project lifetime

Appendix A

Environmental Impact Assessment - Form (B)

Arab Republic of Egypt
The Cabinet of Ministries
Ministry of State for Environmental Affairs
Egyptian Environmental Affairs Agency

The information required in this form should be filled in an accurate and legible way. The Competent Administrative Authority should review and stamp the form, then send it to EEAA for review and feedback. Site visit report or any additional attachment should be also submitted.

Environmental Impact Assessment - Form (B)

1. General Information

1.1 Project title:
20MW PV Power Project – Arinna Solar Power SAE

1.2 Type of the project (infrastructure-industrial, agricultural, energy, health care project, tourism, etc.):
Energy Project

1.3 Address of the Project:
The project is located within the photovoltaic solar park of the New and Renewable Energy Authority near the village of Benban in Aswan Governorate**.**

1.4 Name of the owner: (individual, company, etc)
Company: Arinna Solar Power

1.5 Name of person in charge: Sameh Hassan Gemei

Telephone: + (202)26781829 **Fax**: + (202)22726790

E-mail: sameh.gemei@techpdgroup.com

Entity/individual preparing the form:

Plant Systems – Agriculture Yield Management

Telephone: +20 1001020222 - +202 22714514

E-mail: **ezzat@plantsystems-eg.com**

1.6 Competent Administrative Authority:

New and Renewable Energy Authority

1.7 Type of project

New √ Extension and its type ☐

- **If the type of project is an extension, has an EIA study been submitted for the original project?** Yes ☐ No ☐
- **Date of obtaining the previous EEAA approval (attach the approval):**

  Not Applicable
- **Date of obtaining the first project license:**

  Not Applicable

1.8 Is the project located in a larger development (industrial estate, tourism center, etc.)

Yes √ NO ☐

The project is located in a photovoltaic solar park (about 1740 MW of AC) near the village of Benban, Darao Center, Aswan Governorate. The new and renewable energy authority has prepared a strategic study for environmental impact assessment (SESA) for the development site.

Has an EIA been submitted for this development? Yes √ NO ☐

Date of obtaining EEAA approval and attach the approval: Date 17/3/2016

2. Project Information:

2.1 Total area of the project (m^2): 0.46 km^2

2.2 Primary product: Electrical Power from Solar Energy

2.3 Secondary Product: Not Applicable

2.4 Project Location and Site: The project is located within the photovoltaic solar park near the village of Benban in Aswan Governorate.

Chapter (1): A map describes location of the site

2.5 Distance between the site and the nearest residential area:
The project area and the nearest residential area (Benban village) is about 15 km to the east of the site and at the Nile bank.

2.6 Nature of the area in which the project is located (could be more than one selection):

☐ Separate building	☐ a building with residence above	☐ City
☐ Village	☐ In a residential area	☐ Outside residential area
☐ Agricultural area	√ Desert area	☐ Industrial area
☐ Vocational area	☐ Coastal area	☐ Protected Area
☐ Archeological area	☐ other (please specify) ----------	

2.7 General Description of the Project Area
The project is located about 50 km north of Aswan airport and 25 km west of Kom Ombo city, and about 2 km from the Western Desert highway between Luxor and Aswan. The study area is located within the borders of Western Desert and is therefore characterized by the conditions surrounding extremely precarious conditions. The climate is generally very dry and sunny throughout the year. The physical, biological and social environment in the project area was described through a review of available and published documents

and research, as well as a field visit and an ecological survey. The general description of the project area addresses the following components in particular:

- Natural environment.
- Biological environment.
- Socio-economic environment.

Chapter (4): A description of the natural, biological, social and cultural environment in the project area.

2.8 Infrastructure

Water supply (network)	☐ **Available**	√ **Not available**
Electricity supply (network)	☐ **Available**	√ **Not available**
Sewers	☐ **Available**	√ **Not available**
Roads/railways	√ **Available**	☐ **Not available**
Sources of fuel	√ **Available**	☐ **Not available**

2.9 Proposed alternatives to the project site

The proposed photovoltaic station is located within the boundaries of a vast and largely uninhabited area in Western Desert, which is owned by the New and Renewable Energy Authority and is divided into 41 plots of land for solar projects on an area of about 37 km2. Therefore, this site is considered the most suitable for the establishment of the project and will not be considered alternative sites outside the area of the New Energy and Renewable Energy Authority.

3. Description of Project Phases:

3.1 Construction stage

- **Construction date:** In accordance with the schedule, all construction activities will be completed within (12) months from the date of obtaining all necessary permits and approvals.
- **Time schedule for construction:** Construction work is expected to take about 12 months, and network connections will take about 1 month. Construction is expected to begin in December 2017. Basic site activities will include civil works, construction of buildings, installation of equipment and facilities, experimentation and experimental operation of equipment and lying of cables.

3.1.1 Brief description of the activities during the construction phase:

The main activities of the site will include:

- **Site survey and geotechnical studies needed to prepare the site for construction.**
  - Clean the location of rocks of different sizes and settle it.
  - Ensure that sufficient space is provided for the operation and maintenance of station elements.
  - Compliance with sanitation requirements when processing the site.
  - On site soil testing.
- **Roads and entrances**

In order to reach the site, a new road of about 2 km will be connected to the main entrance of the photovoltaic power station with the existing asphalt road.
The roads in the solar field (photovoltaic station) will consist of ground-breaking materials and gravel capable of carrying loads.

- **Water sources:**

A water tank will be constructed at the site to supply the administration, warehouses and workers' building with potable water. Water will be transported from the reservoir to the building by underground HDPE pipes. The water transfer to the site will be shipped and pumped into the water tank according to need. During the construction phase, drinking water is to be supplied from a 10 m^3 water tank.

Uses: Water for drinking **Consumption rate:** 112.5 cubic meters per month

- **Fire water tank:**

A fire water tank capacity of about 3 cubic meters will be constructed. In addition, suitable fire extinguishers will be distributed in the main places of the site, especially near electrical installations and components that can result in electrical hazards.

- **Fuel type:**

Diesel will be used to generate electricity during the construction phase.
Fuel source: Domestic market.

- **Expected workforce and accommodation location**

The direct manpower needed to undertake the construction work for the project will be nearly 75 workers during the peak construction phase, including qualified and unqualified workers. The company will encourage contractors to recruit the majority of workers from the surrounding communities. All aspects concerning the accommodation of workers according to the recommendations of the strategic study approved in March 2016 as well as through the Facility Management Company, which will be identified by the Benban Investment Association.

3.1.2 Waste generated from construction and methods for disposal:

- **Solid waste:**

Non-hazardous solid waste will include:

- Waste packaging and wood and plastic wastes.
- Unused construction materials, pipe and cable locks.
- Residues of civil works such as sand, cement, bricks, aggregates, parts of reinforcing steel, aluminum, wood, etc.
- Local solid waste resulting from the work environment, offices and administrative buildings.

Disposal methods:

Solid waste will be collected by an approved contractor for safe disposal.

- **Air emissions (smoke, odor, particulates):**

Air emissions during the construction phase will contain fumes, vapors, exhaust gases, dust from settling, drilling, filling and site construction and transfer of construction materials.

- **Noise**

The main noise sources during the construction phase will include heavy equipment, piling equipment and activities and vehicle movement

- **Hazardous waste**

Potential hazardous wastes that may result from the project include mainly contaminated container oils from machinery and maintenance activities. The company will collect and store hazardous waste according to legal requirements and disposal by approved waste management officials.

Chapter (3): provides a detailed description of the project activities and its various components in the construction phase.

3.2 Operation stage

3.2.1 Detailed description for operation phase (attach illustrative figures):

- **Solar field (photovoltaic panels):** Solar energy is converted to electricity using a semiconductor device called solar cell. A number of solar cells are connected to each other, which are photovoltaic panels. This is the main component of photovoltaic power system.
- **Electronic and electromechanical equipment:** The voltage generated by photovoltaic panels is a continuous electric current (DC) and is converted into an alternating current by inverters. Transformers and switchgears are also used to control the output of the solar field.
- **Connection to the network:** The project as one of the stations within the photovoltaic solar park power stations with large production capacity will be connected directly to the unified network through one of the four power transformers that will be established by the new and renewable energy authority.

Chapter (3): presents a detailed description of the project activities and its various components in the operational phase

- **Sources of water (municipal/groundwater/surface water/…):** A water tank will be constructed at the site to supply the buildings with potable water
- **Consumption rate (m3/day):** 285.6 m3 / month (for modules cleaning).
- **Type and source of fuel:** Part of the generated energy is directed to the lighting system and buildings.
- Attach a description of activities for each project component (supported by illustrative figures and activities flow charts) while illustrative the inputs and outputs of each component and their quantities).
- **Expected workforce and accommodation location:** The direct labor force during operation is about 5 persons. According to the company's recruitment

policy, recruitment will be prioritized according to the appropriate qualifications available to employees from neighboring areas.

3.2.2 Wastes, their treatment and disposal

- **Air emissions:** contains fumes, vapors, exhaust gas, dust from settling, drilling, filling and site construction and transfer of construction materials.
- **Liquid waste:**
  - **Sewage:**

    Wastewater is collected in an area that is periodically cleared by approved contractors. The wastewater discharge is expected to be disposed of at the Balana drainage station (daily capacity is about 3200 m^3 / day[20]).

In case there is a sewage treatment unit: No

Industrial wastewater: No

Disposal method:

☐ Directly on the public sewer system
☐ Collected in a septic tank with no treatment to be swept afterwards
☐ Discharged to a water body, indicate its name ----------
☐ Others ----------

In case there is an industrial wastewater treatment unit: No

3.3 Alternatives taken into account for inputs, technology, design, distribution of activities, etc.

Analysis of alternatives is based on the evaluation of several project alternatives during the design stages and initial feasibility study.
In evaluating the alternatives, particular emphasis was placed on their environmental and social impacts in order to ensure the integrity of the selected alternative from the environmental point of view and its compatibility with Egyptian laws and regulations.
The project alternatives examined include the following:

- Alternative to non-implementation of the project
- Project site alternatives
- Photovoltaic technology alternatives
- Alternatives to photovoltaic cells
- Panel cleaning alternatives
- Alternatives to water sources

Chapter (5): A description of the various alternatives studied

4. Legal Framework

Chapter (2): Detailing environmental legislation relevant to the project during the construction and operation phases.

[20] Aswan Governorate Environmental Profile 2003

5. Analysis of Environmental Impacts

Chapter (6): Analysis and evaluation of various environmental impacts during the construction and operation phases.

6. Environmental Management Plan

The project plan for environmental management consists of a set of mitigation and monitoring procedures and institutional procedures that must be taken into consideration during the construction and operation phases to ensure proper project environmental performance. The plan also includes activities to be undertaken to implement these procedures. It is worth mentioning that Arinna Solar Power will integrate environmental management requirements that will be developed at the collective level and will be prepared through the Facility Management Consultant, who will be selected by the Investors Association in June 2017.

Chapter (7): The project's environmental and social management plan is detailed in the construction and operation phases

7. Attachment

Insert a table of contents for the attachments. Attach the required documents and provide justification for any unattached document. (Other attachments could be added as needed)

No.	Attachment	Was it Attached, (Yes, No)?	Reasons It Was Not Attached
1.	EEAA approval of the EIA for the original project (in case of extensions)	Not applicable	The project is new and not expansions
2.	Copy of the project license (in case of extensions)	Not applicable	The Project is new
3.	EEAA Approval of the integrated EIA of the development (in case the project is located in a wider development)	Yes	
4.	Chapter 1: General description of the project site with a map	Yes	
5.	Chapter 4: A description of the natural, biological, social and cultural environment in the project area.	Yes	
6.	Chapter 3: Description of the project activities with illustrative figures	Yes	
7.	Chapter 5: Description of project alternatives	Yes	
8.	Chapter 2: Environmental legislation relevant to the project	Yes	
9.	Chapter 6: Assessment of environmental impacts	Yes	
10.	Chapter 7: Environmental and social management plan for the project	Yes	
11.	Expected analysis for air emissions	Not applicable	The project is the production of electricity from solar energy
12.	Specifications of the sewage and/or industrial wastewater treatment unit	Not applicable	There is no sewage treatment unit at the site and it's periodically cleared by approved contractors

Declaration of the Project Proponent

I, the undersigned, certify that the statements made by me are true, complete and correct and that in case of any modification of the information stated above, the EEAA shall be instantly informed through the Competent Administrative Authority.

Name of the project owner: Arinna Solar Power SAE.

Name of the responsible person: Sameh Hassan Gemei

Phone / Fax and Address: 27, Abdel Hakim El Refai, Nasr City, Eight Area, Cairo, Egypt

Form filled in by the Competent Administrative Authority

Administrative authority:----------

Name:----------

Professional title:----------

Signature: ----------

Official Stamp

Arab Republic of Egypt
The Cabinet of Ministries
Ministry of State for Environmental Affairs
Egyptian Environmental Affairs Agency

General Instructions to Fill in the Environmental Impact Assessment Form

- This is the environmental impact assessment form for category (B) projects.
- All information should be filled in accurately and in a legible way while attaching al information needed for review.
- The form is submitted, after being filled, to the CAA representative to be ratified and stamped with the republic stamp and sent to EEAA .
- EEAA reviews the form and provides its opinion form the environmental point of view only and notify the EEAA with its decision and with the conditions required (approval or objection or information request, etc.) within a period of maximum 60 days from the date of receipt of documents at EEAA.
- In case the study is rejected, the project proponent has the right to appeal the decision and apply in writing to the Permanent Review Committee at EEAA within 30 days of the notification date.
- The project should abide by all environmental conditions included in EEAA EIA approval and this will be inspected to check the extent of compliance of the project with the law and environmental conditions.
- This form is distributed free of charge.