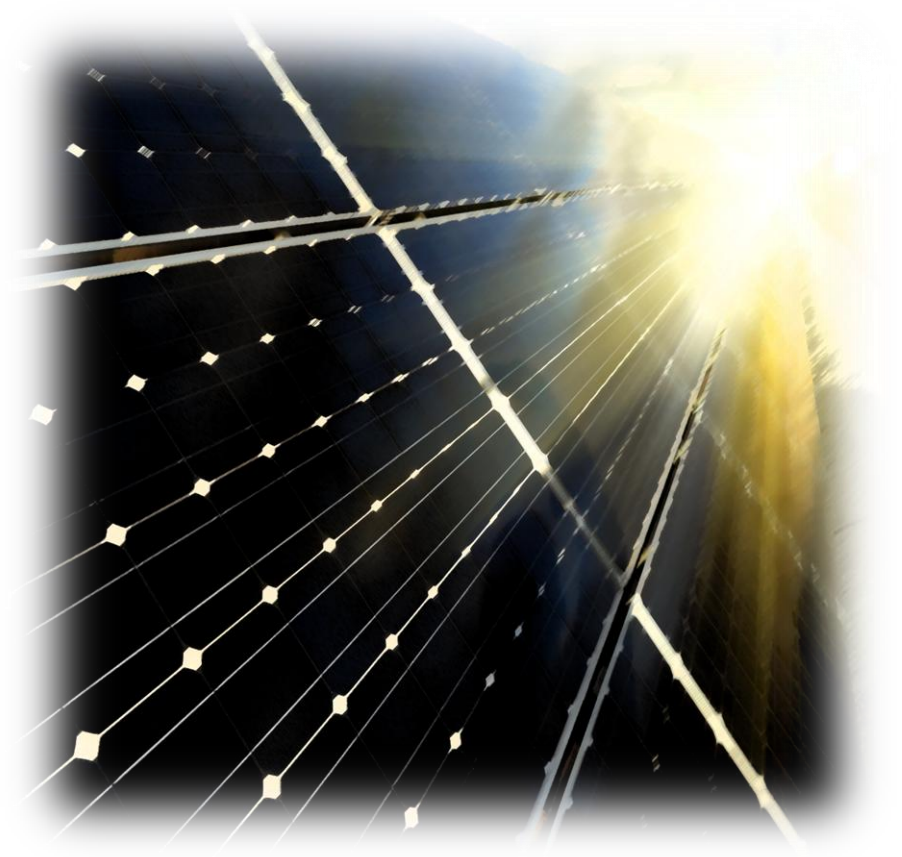
Environmental Impact Assessment (EIA) for developing a 50 MWac PV Power Plant Project in Al Mafraq



Draft Report

December 2015

ARABTECH JARDANEH
Define . Design . Deliver

FRV FOTOWATIO RENEWABLE VENTURES

Document Title: Environmental and Social Impact Assessment (ESIA) Draft Report

Project : ESIA for Developing a 50 MWac PV Power Plant Project in Al Mafraq

Code 1705

Client: FRV Services Middle East

Main Contributors	Aspect/Section	Notes
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Abbreviations

AJ	Arabtech Jardaneh
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental Social Management Plan
FRV	Fotowatio Renewable Ventures
GoJ	Government of Jordan
ICP	In situ Conversion Process
IFC	International Finance Corporation
MoEnv	Ministry of Environment
MEMR	Ministry of Energy and Mineral Resources
MDC	Mafraq Development Corporation
MoU	Memorandum of Understanding
NRA	Natural Resources Authority
PEA	Preliminary Environment Assessment
PPA	Power Purchase Agreement
ToR	Terms of Reference
WMP	Waste Management Plan

1 EXECUTIVE SUMMARY

[Will be prepared following Client review]

2 INTRODUCTION

FRV Services Middle East (FRV), has been granted an approval from the Government of Jordan, represented by the Ministry of Energy and Mineral Resources (MEMR), to develop a 50 MWac grid connected Photovoltaic project in Mafraq.

FRV Services Middle East aims to develop the solar energy project using PV technology to generate electricity in Jordan. The project will help to decrease the country's dependency on traditional forms of energy by increasing the availability and use of solar energy. The generated electricity will be injected into the national grid, to support the country in meeting its renewable energy target of 10% by 2020.

MEMR and the National Electric Power Company (NEPCO) have successful track record with independent power projects (IPPs) that include top international power developers with active projects in Jordan

Arabtech Jardaneh (AJ) is committed to preparing the EIA in accordance with the requirements of the Jordanian Environmental Impact Assessment (EIA) Regulation no. 37 of 2005, and the International Finance Corporation (IFC) and World Bank guidelines and standards in order to support the application for an environmental permit from the Ministry of Environment (MoEnv).

Arabtech Jardaneh (AJ) was appointed by FRV Services Middle East to prepare the Environment Impact Assessment study (EIA) for the project activities during the three phases of the project construction, operation and decommissioning, and considered this Preliminary Terms of Reference (ToR) as the initial stage of the EIA process as stipulated within MoEnv's requirements.

The ESIA study will be used to support the application for an environmental permit from the MoEnv in line with the Jordanian Environmental Impact Assessment "EIA" Regulations 37/2005.

In accordance with MoEnv's requirements, the ESIA assignment will consist of the following phases:

- Preparation of Preliminary ToR(completed);
- Attend and document scoping session with stakeholders(completed);
- Finalize and submit ToR following input from MoEnv(completed);
- Perform ESIA study and prepare ESIA report(completed);
- Preparation of an environmental and social management plan (ESMP), to be incorporated into the ESIA report(completed)

2.1 ESIA Objectives

The Environmental and Social Impact Assessment (ESIA) study will be used to:

- Support the application for environmental approval from the Ministry of Environment (MoEnv.) in line with the Environmental Impact Assessment ("EIA") Regulation No. 37 for year 2005;
- Evaluate the likely environmental, social and health impacts that may potentially be generated from the project.
- Minimize / eliminate negative impacts, maximize positive impacts; and
- Ensure that environmental, social and health factors are considered in the decision-making process; and
- Inform the public about the project.

2.2 The Proponent

FRV Services Middle East is the Proponent for the proposed Solar Power Plant Project. The contact details for the proponent's primary contacts are provided below:

Eng. Ahmed Mulla
Development Director MENA
P.O. Box 392632. Dubai, UAE
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2.3 The Consultant

AJ has prepared this Preliminary ToR for an EIA on behalf of the project proponent in accordance with the MoEnv guidelines. The primary contact for AJ is:

Khaled Nassar
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P.O. Box 9532
Amman 11191, Jordan
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2.4 ESIA Reporting

This ESIA report is submitted to MoEnv. to include the key environmental issues, existing (baseline) conditions, anticipated activities that will cause impacts, a general suite of mitigation measures, and assessment on the likely remaining (residual) impact following mitigation. The ESIA report will be prepared in compliance with the requirements of FRV as well as the MoEnv requirements.

The final ESIA report will be submitted within two weeks of receipt of one set of written and consolidated comments from FRV and MoEnv. With the exception of the Executive Summary, the reporting will be in English.

The final ESIA report, which when approved, will form the basis of the Environmental Permit, together with supporting environmental, social and health management plans, as well as the waste management plan.

The ESIA report will include:

Executive Summary	Summary (in **English and Arabic)** of the project, main findings and recommendations
Introduction	Overview and purpose of the project and scope of the ESIA
Review of Legislation and Standards	Details of the applicable legislation and regulations and other standards in Jordan with potential implications to the project
Project Description	A clear and concise description of different activities over the life of the project. The description should be sufficient to allow the risks and impacts to be identified, described and evaluated
Environmental &Social Baseline	Assessment of the baseline conditions against which the impacts of the project can be assessed
Assessment of Impacts	Assessment of the impacts of the project (and methodology used), which shall include a listing, description, assessment (including quantification of impact), and discussion of the possible negative and positive impacts of the project on the environment and social fabric, including socio-economic context
Stakeholder Identification and Engagement	Summary of the stakeholder engagement process which will identify the affected parties and details how the project will communicate, inform and discuss the substantive issues with all interested and effected parties
Analysis of Alternatives	A comparison of the project alternatives considered and their potential impacts
Mitigation and Monitoring measures	Recommendations for mitigation measures to minimize the identified impacts and any ongoing monitoring requirements
Environmental/Social Management Plan	Details of specific activities to be carried out during different phases of the project and project activities to ensure the identified mitigation measures are implemented

3 PROJECT DESCRIPTION

The project area is located at Al-Mafraq Governorate within Mafraq Development Corporation (MDC) area, over 1,400 dunums within the solar area as shown in the **Figure 1** below.

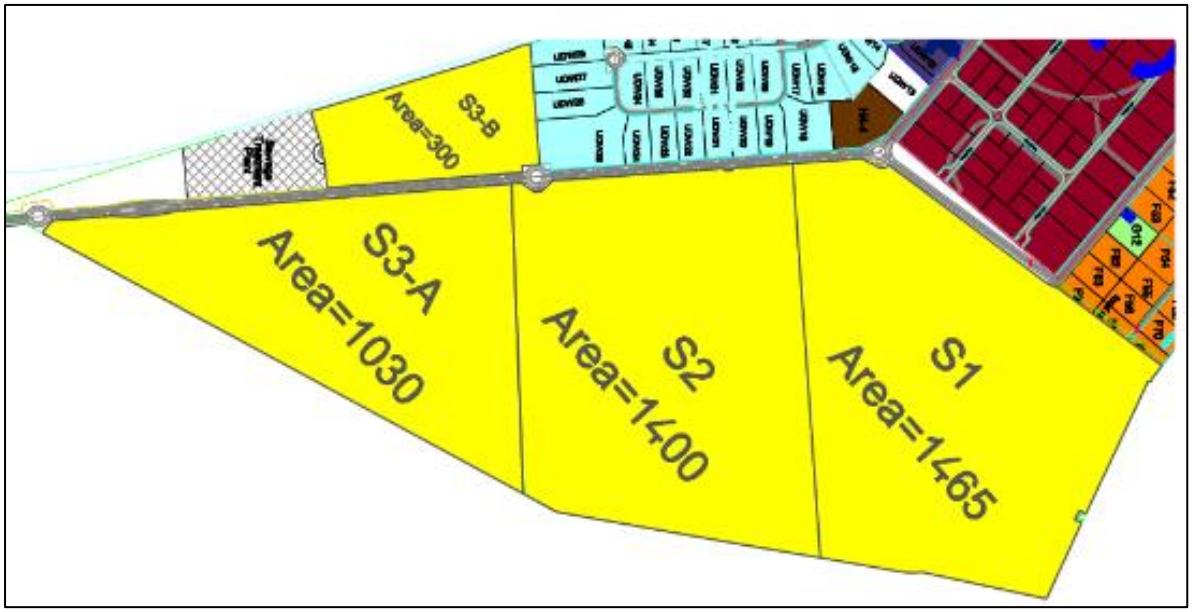


Figure 1: Project area within MDC

As shown in the figure above, Plot No. S2 was allocated for FRV to build FRV Jordan One 50MW PV plant. The nominal capacity of the plant is 50MW AC and will have peak capacity of approximately 65MW DC. **Figure 2** below is a general layout of the PV plant. Final detailed engineering design is ongoing and subject to compliance with all PV requirements and regulations in Jordan.

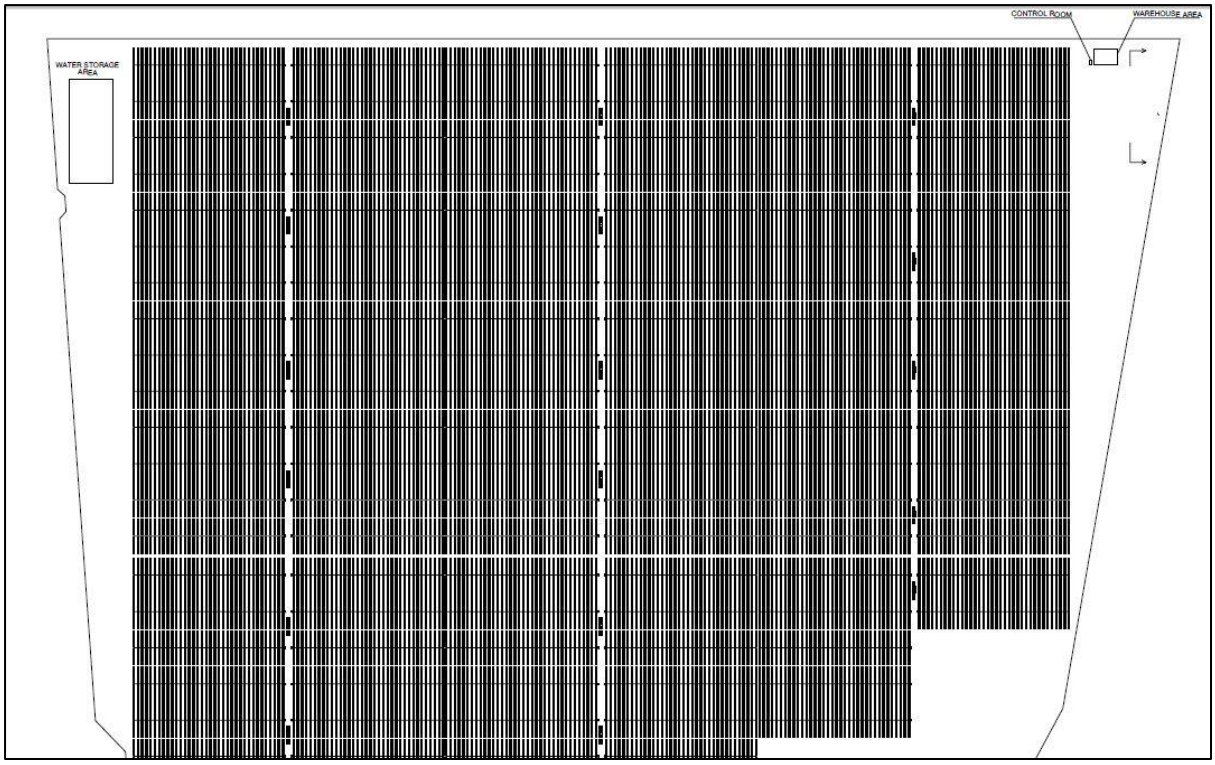


Figure 2: Rough Layout of the PV Plant

PV plant will be constructed with Polycrystalline PV modules and single axis trackers system to maximize the annual energy yield. Plant will have a control room for the monitoring and guards, a warehouse area for extra equipment and a water storage area for cleaning the PV modules.

The Plant is proposed to be connected to the existing 33/132kV Substation of NEPCO at 5km from the project location. Plant will be connected via 5km of 33kV underground cables for evacuation to the grid. Interconnection is subject to final Interconnection Agreement to be received from NEPCO and MEMR.

Construction period is expected to be of 12 months. It will employ approximately 120 people during the peak of construction period. During operational period that will extend for 20 years, approximately 8 people will be working full time to operate and maintain the PV plant.

For the PV modules cleaning, two cleaning machines are planned to be used for PV module cleaning and to minimize the used water during this process. These machines designed to use 8-10 times less water from the conventional cleaning method (50000 liters of water per cleaning).

4 REGULATORY FRAMEWORK

The importance of this section is to outline main institutions that are related to environmental issues, in addition to laws, regulations, etc.., relevant to the natural environment of the Jordan and describes relevant international conventions and treaties signed and ratified by Jordan and incorporated into the national law.

Specifically, the legislative framework presented in this section is relevant to the solar power plant project.

4.1 Relevant Environmental-Related Institutions

A selection of the main Ministries, Institutions and Authorities that are directly related to environmental issues are as follows:

4.1.1 Ministry of Environment

The Jordanian Ministry of Environment (MoEnv.) is the principal environmental institution in Jordan and responsible for the evaluation of the environmental impacts of the project and issue of associated project licenses and clearance.

MoEnv was established in 2003, and its mission is maintaining and improving Jordan's environmental quality through sustaining and conserving the environmental resources thus contributing to sustainable development. MoEnv develops environmental policies that are implemented and enforced throughout the Kingdom, moreover, it is dedicated towards ensuring that legislation is enforced; raising public awareness, inspection and monitoring, encouraging co-operating with national, regional and international bodies.

The Ministry of Environment has the legal strength of the environmental law that provides the Ministry with the tool to perform their duties. The Environmental Protection Law was one of the temporary laws issued in 2003, and was officially endorsed by the Jordanian Parliament in 2006 and issued as the Law No. 52 for the Year 2006.

The law considers the Ministry of Environment to be the competent authority for the protection of environment in the Kingdom, and the official and national authorities shall be bound to implement the instructions and resolutions issued under the provisions of this law which give the Ministry all the judicial powers it requires for implementing the law.

Law No. 52 provides the Ministry with the legal power to inspect any facility, and according to the findings of the audit, gives the Ministry the right to order a facility shutdown until the proper mitigation and control measures are implemented and the environmental violation eliminated. This inspection system was further strengthened with the establishment of the Environmental Police in 2007 where the police are now acting as an implementation tool and a full-fledged partner in the implementation of the environmental law.

The Environmental Protection Law has also introduced a system of an environmental "pre-emptive" assessment of all economic and developmental projects to be established in Jordan. This process is known as the Environmental Impact Assessment (EIA) where any

developmental or economic project should carry out a detailed assessment of the expected environmental impacts potentially arising from the implementation of the project, and how these impacts can be mitigated through remedial action at the technical, legislative and public levels.

According to the Environmental Protection Law, the EIA study should be done before the project is initiated and sent to the Ministry of Environment where it will be reviewed. Please refer to EIA Regulation No. (37) / year 2005 classifies projects into three categories according to their environmental impacts.

- Category 1: Projects that require comprehensive ESIA
- Category 2: Projects that require PEA
- Category 3: Projects that don't require an ESIA.

This regulation sets out the process for conducting an EIA study and the items to be included in the Study, procedure for obtaining an environmental clearance. In addition, it lists the projects that require a full EIA or a preliminary EIA. Any project which may pose potentially significant impacts on the environment must have a full EIA carried out and will be classified as a Category 1 Project according to the EIA regulation, the study must be conducted prior to obtaining environmental clearance from MoEnv for construction and operation activities. This will apply to this project.

FRV Services Middle East, the Proponent, is responsible for submitting the ESIA study to MoEnv. upon an agreement with AJ (the ESIA Consultant) who will be conducting an ESIA Study for the project in compliance with all Jordanian legislation mentioned in the following sections.

If the impact assessment is approved, the project will get the license and start its activities while adhering to the environmental mitigation and management systems specified and approved in the study. Any deviation from those guidelines would render the project to violations.

EIA Regulation in Jordan

According to the Jordanian ESIA Regulation no (37) / Year 2005, this project is classified as Category (1), i.e. it needs a full ESIA. In accordance with Article (9), the Project Owner, i.e. FRV submits a preliminary draft of the Terms of Reference (ToR) for the ESIA Study, which has been submitted on September 22nd 2015, MoEnv, The project owner and AJ will then agreed on a scoping session date in which all relevant stakeholders and concerned parties such as governmental directorates, ministries, Non-Governmental Organizations, relevant associations and institutions and so on were invited by MoEnv.

The Scoping Session was held on November 15th, 2015 at the Geneva Hotel in Amman, Jordan. The Final ToR was submitted on November 22nd, 2015 and approved by the Ministry of Environment on December 3rd 2015.

4.1.2 Other Relevant Ministries

Ministry of Energy and Mineral Resources (MEMR)

MEMR was established in 1984 and entrusted with administering and organizing the energy sector in a way that achieves the national objectives. the responsibilities of the Ministry were amended to include the comprehensive planning process of the sector, and setting the general plans and ensuring their implementation in a way that achieves the general objectives of the energy sector, the most important of which is providing energy, in its various forms, for the development process, organizing its affairs, exchanging electric power with neighbouring countries, and attracting international capital for investment in this field, especially the generation of electric power, the generation of oil derivatives, transportation of oil and gas, and utilizing local energy sources.

The main strategic objectives of the ministry are to ensure energy efficient practices in all sectors, promote energy efficiency projects, development and efficient exploitation of local energy sources such as renewable energy.

Ministry of Agriculture (MoA)

The Ministry of Agriculture (MoA) is responsible for managing public rangelands and forests, protecting soil, pasture-land and flora, provision of agricultural loans, support farmers, the granting of permits for import and export of agricultural products of plant, animal and veterinary medicines and vaccines, and live birds, the establishment and renewal of licenses for companies, factories, shops, galleries, nurseries and agricultural farms and olive presses, provide training for farmers, protecting and managing wildlife, issuing fishing and hunting licenses and regulations. Some wildlife protection and permitting tasks are the responsibility of the Royal Society for the Conservation of Nature (RSCN).

Ministry of Water and Irrigation (MWI) / Water Authority of Jordan (WAJ)

These organizations work collectively in order to determine the national water policies and regulations in order to protect water from contamination. In addition, the ministry is responsible for water protection and monitoring studying irrigation patterns and sewerage. Moreover, groundwater, aquifer management and abstraction monitoring and licensing are the responsibility of WAJ.

Generally, WAJ is responsible for the public water supply and wastewater services, as well as for the overall water resources planning and monitoring, while JVA is responsible for management and protection of water and land resources, including their supporting infrastructure.

Ministry of Health (MoH)

The Ministry of Health undertakes all health affairs in the Kingdom, and its tasks and duties include: maintaining public health by offering preventive treatment and health control services; organizing and supervising health services offered by the public and private sectors; providing health insurance for the public within available means; establishing and controlling the management of health educational and training institutes and centers according to relevant provisions of the legislations enacted; and working, in coordination with concerned parties, to raise public health standards.

In terms of this project, the Ministry of Health will have a supervisory and monitoring role through enforcing all applicable legislation to ensure FRV 's compliance with all relevant aspects and provisions of: the General Health Law, no. 47 for the year 2008 (in particular chapters 8 to 10 and 13). In summary, the ministry's roles will include but not limited to the following:

- Chapter 8, Drinking Water: Monitoring of drinking water quality and its sources to prevent any potential contamination;
- Chapter 9, Chemicals: Monitoring and supervising of chemicals imported into the country, handling methods and chemicals used in industries, through screening chemical types and categorizing them into a list with permitted chemicals and prohibited types depending on the degree of hazard. Chemicals used in industries are to abide by the list of permitted chemicals proposed by the Ministry to ensure public health protection;
- Chapter 10, Health Hazards: Compliance with the Instruction No. (1) For year 2011 for the prevention of occupational hazards related to health hazards resulting from labour housing units' onsite to avoid any health hazards to workers or others such as, dust, odor, and noise and ensure proper disposal of generated wastes and wastewater;
- Chapter 13, Trade and Industries: the Ministry will ensure compliance with the Trade, Industry and Occupational Safety Law No. (16) For the year 1953. This can be done through inspections in order to prevent any potential health or occupational hazards.

Ministry of Municipalities

The Ministry is taking up the supervisory role over the activities of the Municipalities and the Joint Services Councils (JSC) operating in all over the Kingdom with a total of (93) Municipalities and (22) JSCs. The main duties are: to provide the various facilities to the municipalities to enable them to perform their functions and support them in improving the services efficiency; oversee, coach and monitor the financial, administrative and organizational performance of the municipalities; enhance the institutional capabilities of the sector; manage the financial transactions and arrange with the relevant parties to provide the necessary funding for the programs and projects; set, develop and implement the legislative, administrative, financial and institutional framework that are effective for the Municipal operations; prepare the regional, organizational and detailed construction plans for the municipalities; monitor and control the implementation of the regulations, policies and instructions of the municipalities and joint services councils and draw up the regulatory bills of the municipal affairs sector and review and supervise the infrastructure projects of the municipal councils and develop the designs, technical specifications and tender documents in addition to sustaining and developing the inhabited clusters that have no municipal councils.

Ministry of Public Works and Housing

The Ministry of Public Works and Housing aims to develop a network of public roads in the kingdom, linking towns, villages and communities and sites of industrial production,

agricultural and tourist areas and archaeological sites; and to link the Kingdom and neighboring countries and sustain this network and keep it in a good technical level.

The Ministry is also working on upgrading the quality of the roads and the promotion of safety requirements in addition to keeping abreast of the latest updates and techniques of modern roads and lighting.

Ministry of Transport

The Ministry assumes the following responsibilities under the Transport Law No. (89) / year 2003 and authorizations needed in order to carry out its mission such as: devising the general policy for transport and overseeing its implementation in coordination and cooperation with all related parties; regulating and monitoring the road freight transport sector and its services; issuance of necessary permits for individuals and companies operating in the sector; regulating and monitoring the freight transport by rail sector and its services, as well as issuance of necessary permits for operating in the sector and many other responsibilities.

Jordan Institute for Standards and Meteorology (JISM)

JISM plays a proactive role in protecting the interests, health and safety of citizens and environment and enhancing the competitiveness of Jordanian products in the national, regional and international markets in keeping with the national goals and contributing to achieving them within the defined priorities. JISM prepares, approves, revises, amends and monitors the implementation of standards and technical regulations with regard to all services and products (with the exception of pharmaceutical and food products, medicines, veterinary medicines, serums and vaccines).

The main objectives of JISM are:

- Adoption of a national system for standardization and metrology based on accepted international practices;
- Keeping pace with scientific and technical developments in the fields of standards, metrology, conformity assessment and laboratory accreditation;
- Ensuring the health and safety of the Jordan's citizenry and protection of the environment by making sure that products are in compliance with the technical regulations adopted by the Organization for the purpose; and
- Raising the quality of local products through the adoption of appropriate Jordanian Standards in order to enhance their competitiveness in the local and international markets and thus support the national economy.

Department of Antiquities (DoA)

DoA was established in 1928 as the official institutional authority mandated by law to be responsible for the protection, conservation and presentation of antiquities.

The two main policies are:

- For the protection of antiquities, conservation measures that do not require physical intervention to the remains are preferred as the first choice where possible; and
- For the presentation of antiquities, including research, survey, excavation and site management.

Electrical Regulatory Commission (ERC)

ERC was established based on the Council of Ministers decision issued in 2001. ERC aims mainly to ensure applying the rights of consumers and to resolve any complaint that may occur between the consumer and Electricity companies and encourage investment in this sector in addition to improving the operational efficiency and sale of electric power at reasonable prices.

ERC also works to ensure the provision of safe, secure, reliable and high quality services in all electric sector fields and to ensure the compliance of the activities in the sector with applicable environment protection standards and general public safety conditions enforced in Jordan.

National Electric Power Company (NEPCO)

NEPCO is the official successor to Jordan Electricity Authority (JEA) since 1999; NEPCO owns the electric transmission network and is responsible for construction, planning, development, operation, maintenance and management of the control systems, and the electric transmission and interconnection networks. The company also manages to purchase electricity from all available sources and sell them to distribution.

Ministry of Labour (MoL)

MoL has undertaken the responsibility of accomplishing the general objectives of labour and labourers affairs and issues in Jordan. To keep pace with social and economic development, the Labour Law No. (8) and its amendments for the year 1996 was issued and the administrative regulation No. (38) of the year 1994 was established, along with its amendments.

The tasks of the Ministry include:

- Organizing the labour sector, as well as updating labour legislation so as to meet the needs of the labour market in light of the social and economic developments within a framework that maintains the production parties rights, and contributes in encouraging the foreign investments;
- Contribution to the development of workforces through the Vocational and Technical Training and Educational Council;
- Collaboration in human resources and workforces development projects;
- Organizing the foreign labour in the Jordanian Labour Market;
- Maintain available job opportunities to employ Jordanian Labour;
- Building up labour market databases;

- Consolidating cooperation and partnership with the private sector;
- Consolidating regional and international cooperation and partnership;
- Consolidating partnership and cooperation with corporations concerned with preparing and developing Human Resources.

4.2 Principal National Legislation

4.2.1 Laws

- Industry & handicraft law (No. 16, 1953);
- Management of Natural Resources Law (No. 12, 1968);
- Land Acquisition Law (No. 12, 1987);
- Water Authority Law (No. 18, 1988) and its amendments;
- The Antiquities Law (No. 21, 1988) and its amendments;
- Labour Law (No. 8, 1996) and its amendments;
- Civil Defence Law (No. 18, 1999);
- General Electricity Law (No.64, 2002);
- Transportation Law (No. 89, 2003) and its amendments;
- The Environment Protection Law (No. 52, 2006);
- Municipalities Law, No. (14) of 2007;
- The Free and Development Zones Law (No. 2, 2008);
- Public Health Law (No.47, 2008);
- Traffic Law (No. 49, 2008);
- Renewable Energy and Energy Efficiency Law (No. 13, 2012)

Development Zones Law

Transforming the Development Zones vision into a reality, the regulatory framework; manifested in the Development Zones Law No. (2), was passed by the Parliament in early 2008, introducing a legal foundation that facilitates the creation of economic growth within certain zones, and ensures a business-friendly and investment attracting environment.

The law strongly enables and empowers the private sector to lead in the development and management, delegates full power to the Development Zones Commission provides

streamlined quality of service and governance, defines a clear land ownership policy, removes all restrictions on foreign capital and offers a comprehensive customs and tax Incentives coupled with transparent implementation practices.

4.2.2 Regulations

- Regulations for Protection of Birds and Wildlife and rules covering their hunting (No. 113, 1973);
- Regulation of Protection and Safety from Industrial Tools and Machines and Worksites (No.43, 1998) – Issued by the virtue of the provisions of Paragraph (c) of Article (85) of the Labour Law No. (8) Of 1996 and its amendments;
- Groundwater Control Regulation (No. 85, 2002), Issued pursuant to Articles 6 and 32 of Water Authority Law No. 18 for the year 1988;
- Soil Protection Regulation (No. 25,2005);
- Regulation for the Protection of the Environment from Pollution in Emergency Situations (No. 26, 2005);
- Regulation of Solid Waste Management (No. 27, 2005);
- Air Protection Regulation (No. 28, 2005);
- The Environmental Impact Assessment Regulation (No. 37, 2005);
- Land use planning Regulation (No. 6, 2007);
- The Development Zones Law (No. 2, 2008) (Environmental Protection Regulation still unofficial).
-

4.2.3 Instructions

- Instructions for the Limitation and Control of Noise for the year 2003;
- Instructions for the Selection of locations for Development Activities for 2007 issued in accordance with paragraph (d) of Article (4) of the Environmental Protection Law no. 52 for 2006.
- Instructions No. (1) for the year 2013 for the prevention of occupational hazards related to health hazards resulting from labour housing units onsite, issued in accordance to article 49 of the Public Health Law No. (47) For the year 2008.

4.2.4 Standards

- Standard for lighting levels in work environment (No. 524/1987);

- Standard for heat levels allowed to be exposed to in work environment (No. 525/1987);
- Standard for maximum allowable limits of air pollutants emitted from the stationary sources (No. 1189/1998)Standards for reclaimed domestic wastewater (No. 893/2006);
- Drinking Water (No.286/2008) Standards.

4.3 IFC Environmental and Social Standards

The World Bank's International Finance Corporation (IFC) Performance Standards, Environmental, Health and Safety Guidelines and Practice Notes, and the Equator Principles (which also adopts the IFC's performance standards) provide guidelines on conducting environmental, social and health assessments and address a variety of issues for different types of projects and sectors. These performance standards and guidelines have been taken into account during the preparation process of the ESIA.

The IFC's eight performance standards establish standards that the project owner i.e. FRV is to meet throughout the life of a project or investment by IFC or other relevant financial institution. These eight main standards are listed as follows:

- Performance Standard 1: Social and Environmental Assessment and Management System;
- Performance Standard 2: Labour and Working Conditions;
- Performance Standard 3: Pollution Prevention and Abatement;
- Performance Standard 4: Community Health, Safety and Security;
- Performance Standard 5: Land Acquisition and Involuntary Resettlement;
- Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management;
- Performance Standard 7: Indigenous Peoples;
- Performance Standard 8: Cultural Heritage.

In addition to the above performance standards, other relevant IFC guidelines and practice notes relevant to the project issues will be reviewed simultaneously, and will be considered for the proposed project where applicable. These include but are not limited to the following:

- General Environmental, Health and Safety (EHS) Guidelines;
- Thermal power industry sector guideline;
- Mining industry sector guideline;
- Health Impact Assessment guidelines;

- Practice Note on addressing grievances from project-affected communities (guidance for projects and companies on designing grievance mechanisms);
- Pollution Prevention and Abatement Handbook;
- A Guide to Biodiversity for the Private Sector –Mining Sector;
- A Guide to Biodiversity for the Private Sector –Oil & Gas Sector;
- Practice Note on Effective Public Consultation and Disclosure;
- Practice Note on Addressing the Social Dimensions of Private Sector Projects;
- Handbook for Preparing a Resettlement Action Plan (RAP).

4.4 Regional and International Agreements and Protocols

The Kingdom of Jordan has signed and ratified (that is, placed into national law) the following international protocols and agreements relevant to this project (dates of entry into force noted in parentheses):

- International Plant Protection Convention (24/4/1970);
- Convention Concerning the Protection of the World Cultural and Natural Heritage (17/12/1975);
- Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES) (14/3/1979);
- Amendment to the Convention of International Trade in Endangered Species of Wild Fauna and Flora (art. XI) (13/4/1987);
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (5/5/1992);
- Convention on Biological Diversity (10/2/1994);
- Framework Convention on Climate Change (21/3/1994);
- International Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (26/12/1996).

4.5 Specific Relevant Standards and Guidelines

All projects within Jordan depend on the specific project design requirements and applicable agreements with environmental permitting authorities. Specific requirements relating to the following are provided below:

- Ambient Air Quality;
- Ambient noise;

- Soil;
- Groundwater Quality; and
- Solid Waste Management

4.5.1 Ambient Air Quality

Ambient air quality limits recommended by the Ambient Air Quality Jordanian Standards (JS No. 1140/2006) and the World Health Organization WHO guidelines are summarized and presented in **Table 1**.

Table 1: Ambient Air Quality Standards

Air Pollutant	JS No. 1140/2006			WHO Guidelines ($\mu g/m^3$)
	Average Time	Maximum Allowable Concentration in the Ambient Air	Number of Allowed Exceedences	
Sulphur Dioxide (SO_2)	1 Hour	0.3 mg/kg	3 times within a given month in one year	--
	24 Hour	0.14 mg/kg	Once a year	125 (IT 1) 50 (IT 2)
	1 Year	0.04 mg/kg	--	--
Carbon Monoxide (CO)	1 Hour	26 mg/kg	3 times within a given month in one year	--
	8 Hour	9 mg/kg	3 times within a given month in one year	--
Nitrogen Dioxide (NO_2)	1 Hour	0.21 mg/kg	3 times within a given month in one year	200
	24 Hour	0.08 mg/kg	3 times within a given month in one year	--
	1 Year	0.05 mg/kg	--	40
Total Suspended Particles (TSP)	24 Hour	260 $\mu g/m^3$	3 times within a given month in one year	--
	1 Year	75 $\mu g/m^3$	--	--
PM_{10}	24 Hour	120 $\mu g/m^3$	3 times within a given month in one year	150 (IT 1)
	1 Year	70 $\mu g/m^3$	--	70 (IT 1)
$PM_{2.5}$	24 Hour	65 $\mu g/m^3$	3 times within a given month in one year	75 (IT 1)

Air Pollutant	JS No. 1140/2006			WHO Guidelines (µg/m^3)
	Average Time	Maximum Allowable Concentration in the Ambient Air	Number of Allowed Exceedences	
	1 Year	15 µg/m^3	--	35 (IT 1)
H_2S	1 Hour	0.03 mg/kg	3 times within a given month in one year	--
	24 Hour	0.01 mg/kg	3 times within a given month in one year	--

IT: Interim Target of the WHO.

4.5.2 Ambient Noise Limits

Article (4) of the Standards for the prevention and elimination of noise (2003) indicated that all projects and noise producing facilities should comply with International Noise Standards (No. 2204) and related amendments for issues related to measurement of noise and other associated technical issues.

Article (5) of the same standards established a list of activities is prohibited by law. Those relevant to the proposed Project are:

- All construction activities utilizing noise producing plants and equipment (e.g. rigs, mixers and vibrators) must cease between 8:00 pm and 6:00 am, unless a permit is granted by the MoEnv;
- Work activities within light industrial areas with residential dwellings are prohibited to continue between 9:00 pm and 6:00 am (summer) and between 8:00 am and 7:00 am (winter).

Article (6) of the noise standard specifies the maximum allowable noise level (dBA) for specific times and areas. The maximum allowable noise levels applicable to this project are detailed in **Table 2**.

Table 2: Maximum Allowable Noise Limits

Area	Allowable Limits for Noise Levels (dBA)	
	Day	Night
Residential areas within the City	60	50

Area	Allowable Limits for Noise Levels (dBA)	
	Day	Night
Commercial areas	65	55
Industrial areas (Heavy Industry)	75	65

4.5.3 Occupational Noise

The Instructions for the protection of workers and institutions from occupational hazards/risks issued by the virtue of Article (79) of the Labor Law no.8 of 1996 discuss the provision of workers with necessary personal protective equipment, rest areas and other facilities in addition to lifting limits and other occupational health and safety considerations. Furthermore, Article (16) mentions that each company or establishment must ensure to prevent or minimize noise generation so as to prevent any occupational risk on workers, which should not exceed the intensity mentioned below:

Table 3: Acceptable Noise Exposure

Noise Intensity (dBA)	Acceptable exposure during that day (in Hours)
80	16
85	8
90	4
95	2
100	1
105	1/2
110	1/4
115	1/8

As for Intermittent noise in the form of strong quick strikes can be calculated as per the below:

Table 4: Daily Acceptable Noise Exposure

Noise Intensity (dBA)	Number of times acceptable per day
140	100
130	1,000
120	10,000

4.5.4 Soil

The Soil Protection Regulation No. 25 for the year 2005 states the requirements to protect soils and prevent its contamination through proper management and monitoring.

4.5.5 Groundwater Quality

The general rules of the Groundwater Control Regulation No (85) of 2002, issued pursuant to Articles 6 and 32 of Water Authority Law No. 18 of 1988 are that “the groundwater is state-owned and subject to its control. It is not permissible to pump out or utilize underground water without obtaining a license issued according to the provisions of the law. The purpose usage and the quantities of pumped-out water and any other conditions should be identified in the license”. Owning land does not include water ownership that is stored underground. The license is required for drilling wells; in addition, supervision from the authority is required, plus a pumping test before utilization.

“Anyone who is granted a license to extract groundwater shall be committed not to cause water pollution or depletion and to strictly comply with the conditions of the license”.

The regulation also covers licensing rules and fees as well as water prices, pollution control, and requirements from private well owners.

4.5.6 Solid Waste Management

Regulation of Solid Waste Management No. 27 for the year 2005: The objective of the Regulation is to ensure the management of solid waste in a way that maintains environment protection and public health.

It lists details, responsibilities and tasks to be undertaken including observing and collecting operations, transportation of wastes, permitting, supervising, scheduling, archiving and outlining the responsibilities and tasks for the Ministry of Municipalities. In addition, it sets the duties to be fulfilled by the Ministry in cooperation with the related bodies. These duties include picking up the waste, defining stipulations of storage, collecting, sorting, recycling, treating, and training and awareness programs, in addition to dealing with compliance, offences, punishments and fines.

5 BASELINE CONDITIONS

Following is an overview of the findings of the data collection and literature review work. A listing of the data obtained and reports reviewed is presented in the section below, and the overview of the physical, biological, socio-economic and Occupational Health & Safety (OHS) baseline conditions is described below:

5.1 Data Sources and Literature Reviews

All available information sources have been reviewed and relevant information extracted, analyzed and presented in the context of this study. A detailed references list of reports and documents reviewed for information is presented in **Section 11– References** of this report. A literature review has been conducted in order to summarize the most up to date data needed for preparation of the project description, the environmental baseline as well as documents of a more technical nature to better understand the potential impacts and to propose mitigation measures of the project's activities.

Information has been collected from various sources, to the extent possible. Some sources include relevant government institutions such as DoS, Jordan Meteorological Department (JMD), MEMR and MWI.

Some of the major topics reviewed as part of the Literature Review included:

- Hydrological, Hydrogeological and Water Resources Studies;
- Ecological Studies and Reports on the Flora and Fauna;
- Archaeology;
- Geology of the Area; and
- Meteorological Data.

5.2 Physical Environment

5.2.1 Meteorology and Climate

Jordan's climate varies from Mediterranean in the west, to desert in the east and south, but the land is generally arid. The proximity of the Mediterranean Sea is the major influence on Jordan's climate, although continental air masses and elevation also modify it. The prevailing winds throughout the country are westerly to north-westerly, but spells of hot, dry, dusty winds blowing from the southeast off the Arabian Peninsula frequently occur providing the country with its most uncomfortable weather (especially during the khamasin period April-May).

The country's climate is a result of both its geographical location in the Eastern Mediterranean region and its relief, which ranges from 416 m below sea level at the Dead

Sea shoreline to 1800 m above sea level in the Southern Highlands (GTZ, Water Resources in Jordan, 2004).

Jordan is vulnerable to the potential impacts of climate change, since ecosystems and water resources are affected by changes in the hydrological cycle (MoEnv, Environmental Profile of Jordan, 2006).

According to JMD, historical data collected suggests a decreasing trend for annual precipitation, which in turn is expected to impact related ecosystems and available water resources.

A map showing the bioclimatic zones of Jordan is presented in

Figure 3.The Figure indicates that the project area belongs to the Arid Mediterranean-warm Zone.

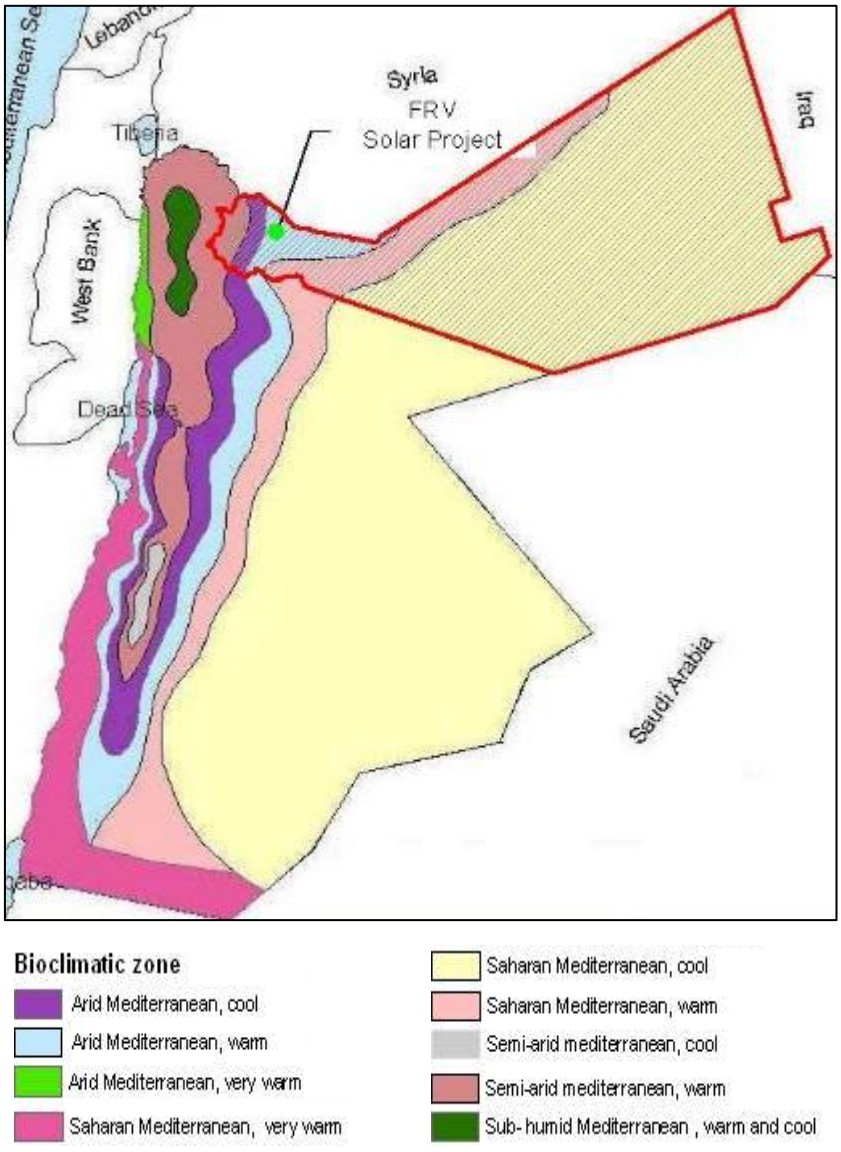


Figure 3: Bioclimatic Zones of Jordan

The initial meteorological characteristics have been obtained based on the data averages for the years (2004- 2013) recorded in Mafraq weather station which is located around 7 south west of the project area. The raw data provided by JMD. Table 6 below summarizes the average annual temperature, rainfall, and wind speed readings, over the period of year (2004-2013) as registered in Mafraq weather station

Table 5: Main Meteorological Parameters for Weather Stations

Parameter	Mafraq Weather Station
Ave. Max Temp (ºC)	24.8
Ave. Min Temp (ºC)	10.2
Ave. Mean Temp (ºC)	17.5
Ave. Annual Rainfall Amount (mm)	119.9
Ave. Mean Humidity (%)	59.8
Ave. Mean Wind speed (Knot)	4.7

All parameters mentioned above are calculated based on data for ten years period (2004 - 2013); the following Figures represent part of monthly averages records.

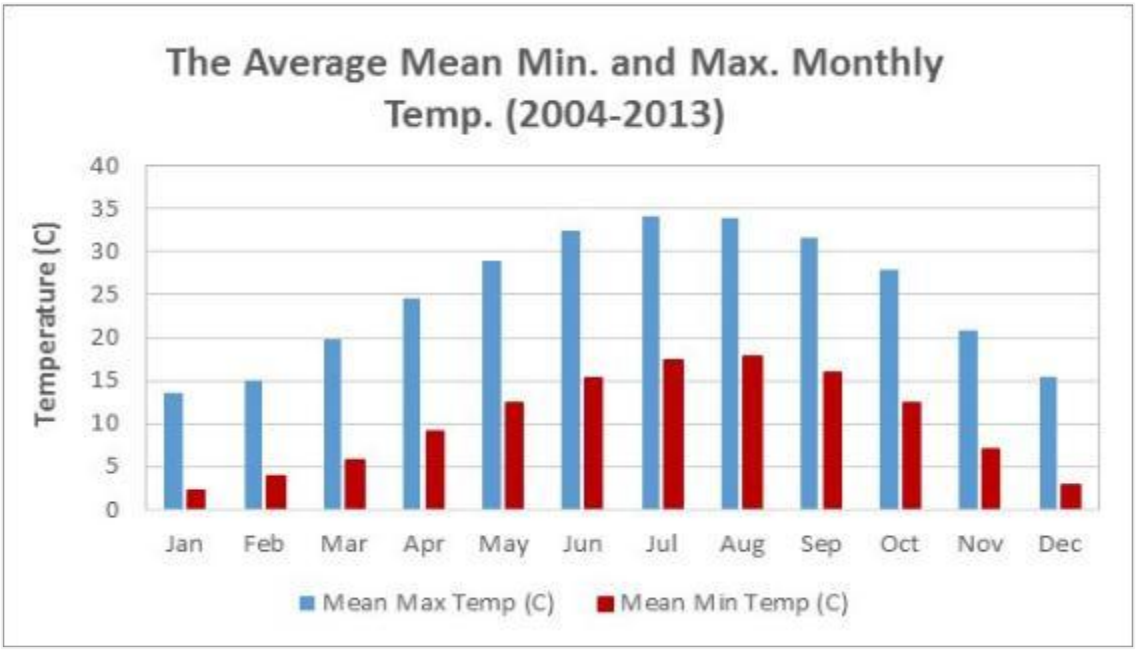


Figure 4: The Average Mean Min. and Max. Monthly Temp. (2004-2013)

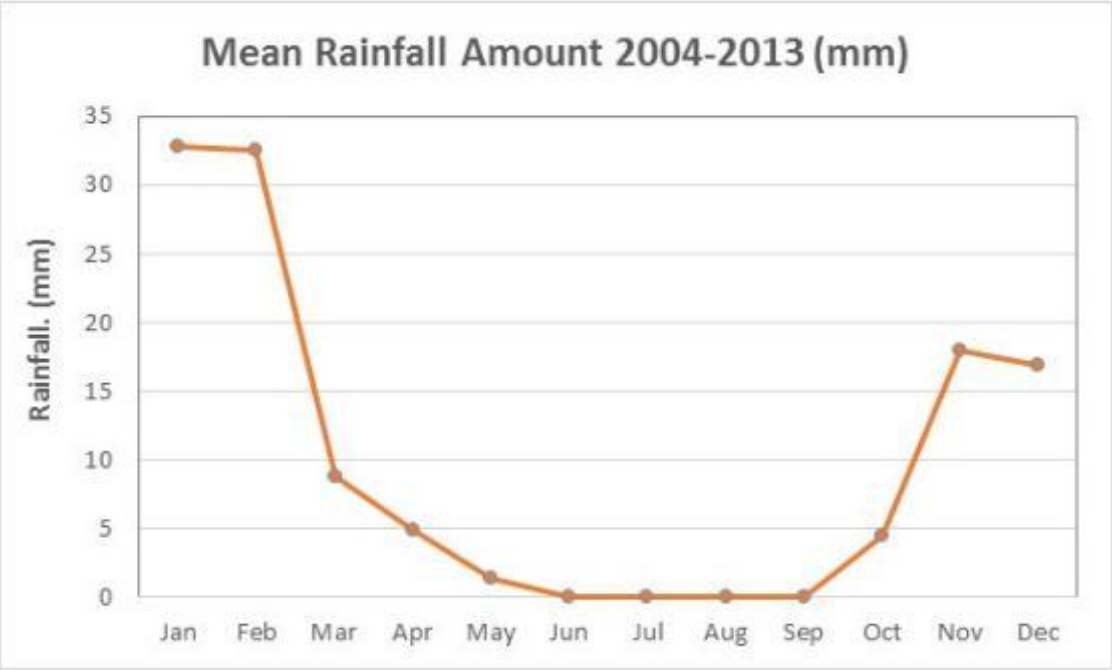


Figure 5: The Mean Rainfall Amount for the Period (2004-2013)

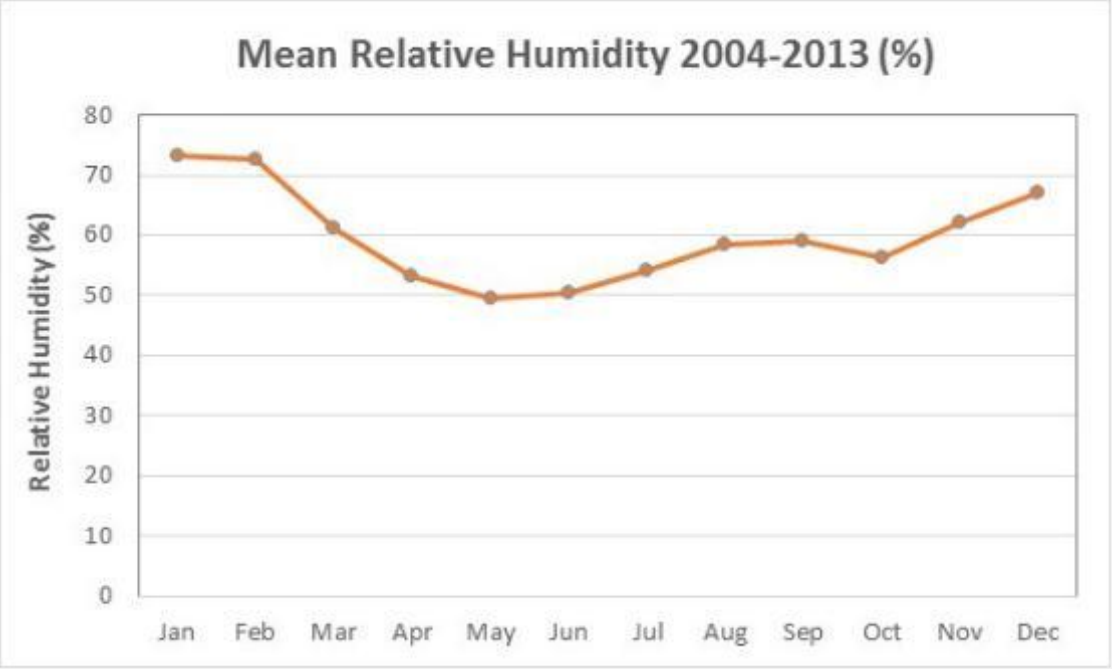


Figure 6: The Mean Relative Humidity for the years 2004-2013

The yearly average wind velocity in Mafraq is 4.7 Knot based on data for nine years period (2004 - 2013).

5.2.2 Air Quality

The main aim of the baseline assessment of air quality is to determine whether there will be potential changes of specific parameters and pollutants adversely affecting ambient air

quality. The anticipated emissions resulting from project activities will be limited to those resulting from the construction machineries and or vehicles during construction phase. Those emissions will be mainly to CO, CO_2 and PM_{10}, and they are likely to disperse rapidly leaving no noticeable change to the ambient air quality within the project area. Meanwhile, the weather conditions are impacted and increase the concentration of the PM_{10} and $PM_{2.5}$ then in order to monitor the PM concentration within the project area.

The air pollution concentration vary spatially and temporally causing the air pollution pattern to change with different locations and time due to changes in meteorological and topographical condition. Air pollutants can be natural or may be the result of various anthropogenic activities like industrial, vehicles and waste emissions.

Daily average, Hourly average and 15- minutes max average ambient air quality sampling and monitoring were carried for one week.in order to present an overview of the ambient quality baseline conditions for the site.

Objectives:

- The general objectives of the air quality monitoring practice are:
- To assess the ambient concentrations of selected air pollutants in the immediate vicinity of the identified project site.
- To determine if the Jordanian Ambient Air Quality Standards (JS 1140/2006) were violated or exceeded at the project site
- To establish ambient air quality baseline data within the project site.
- To ensure that possible adverse impacts are identified and avoided or minimized.

Methodology:

The Jordanian standard for the ambient air quality (JS 1140/2006) include strict and clear guidelines and methods that were followed when monitoring for ambient air quality criteria pollutants. The standard include specifications for sitting monitors, use of only equipment that has demonstrated the capability, repeatability, and reliability needed to collect accurate data, and operation of the equipment within established methods. A tremendous amount of effort was expended to ensure that the Jordanian standard is followed. All monitoring and sampling equipment were calibrated immediately before use.

Major Findings:

- No exceedances were recorded to the maximum allowable limits for PM_{10} that specified in Jordanian standards (1140/2006).
- No exceedances were recorded to the maximum allowable limits for $PM_{2.5}$ that specified in Jordanian standards (1140/2006).

Detailed data of all relevant averages of all parameters are shown in **APPENDIX A.**

5.2.3 Noise Levels

Spot noise monitoring was carried out at proposed construction location for Solar Power Plant Project in order to determine the ambient baseline sound level profile. Monitoring was undertaken using data logging Sound Level Meter Model Extech HD600 (Hand Held Type II noise meter).

5.2.3.1 Methodology

The noise meter was hand-held and positioned such that the microphone, equipped with a windshield, was pointing opposite to wind direction. The noise meter was set to automatically record a range of noise related parameters over a period less than 10minutes,Values were then calculated for L_{Aeq}, LA_{max}, LA_{min} (i.e. the average, maximum and minimum A-weighted Sound Pressure Level of the residual noise in dBA) for the monitoring period.

5.2.3.2 Allowable limits

- Allowable noise limits are governed by the Jordanian instructions for elimination of noise for the year 2003, which defines the maximum allowed noise limits for the different land-use types during day time and night time as listed in **Table 6**. These limits are applicable for ambient noise outside workplace, for noise limits within workplace; instructions issued by Ministry of Labour are adopted.
- The project area is categorized as industrial area; therefore the measured noise level will be compared with limits set for Industrial areas.

Table 6: Maximum Allowable Noise Limits

Area	Allowable Limits for Noise Levels (dBA)	
	Day	Night
Residential areas within cities	60	50
Residential areas within suburbs	55	45
Residential areas within villages	50	40
Residential areas with commercial activities, services, light handcrafts, and city centre	65	55
Industrial areas (Heavy Industry)	**75**	**65**
Places of education, worship, treatment and hospitals	45	35

5.2.3.3 Measured Noise Level

A short-term noise monitoring program was conducted at the project area, which aims at determining the existing noise level at the proposed project site in order to assess the expected impacts of the project activities on the surrounding area during construction and operation phases. One central monitoring location was chosen as illustrated in **Figure 7**.

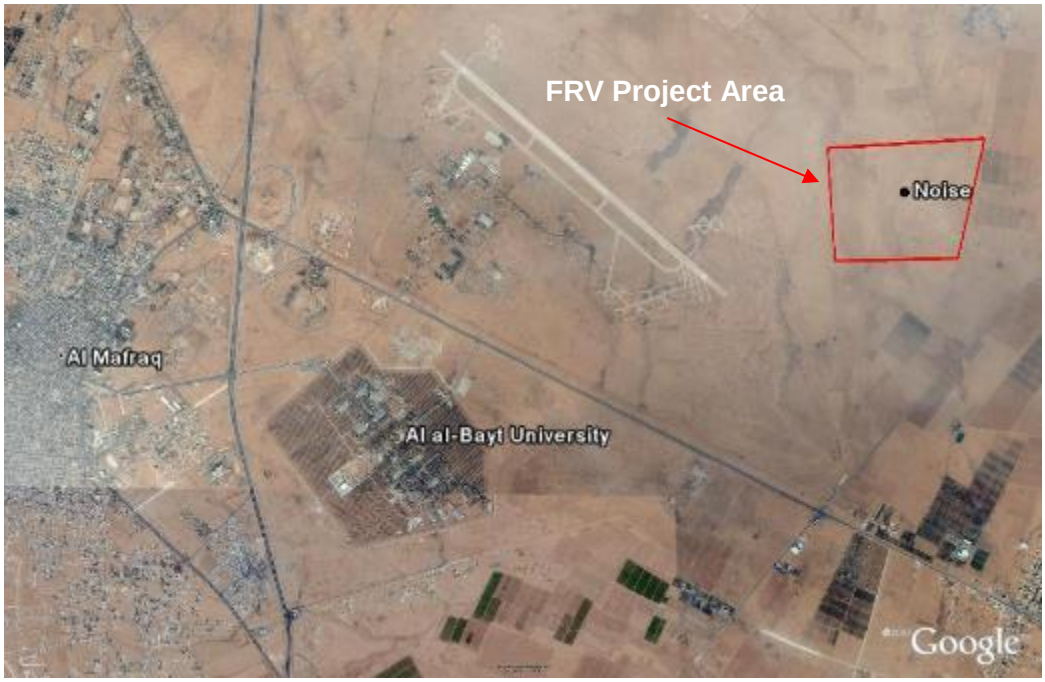


Figure 7: Noise Monitoring Location

The results of noise level monitoring are shown in **Figure 8** below. The measurements were carried out during day time. As can be seen from these data, LAavg is within the allowed limits, while maximum levels are not exceeding the standards. Any additional noise generated from the Project construction activities needs to be taken into account and appropriate mitigation of adverse health impacts applied, such as wearing protective ear muffs or plugs by workers during construction and operation. These will be discussed in further detail in the impact assessment and mitigation section.

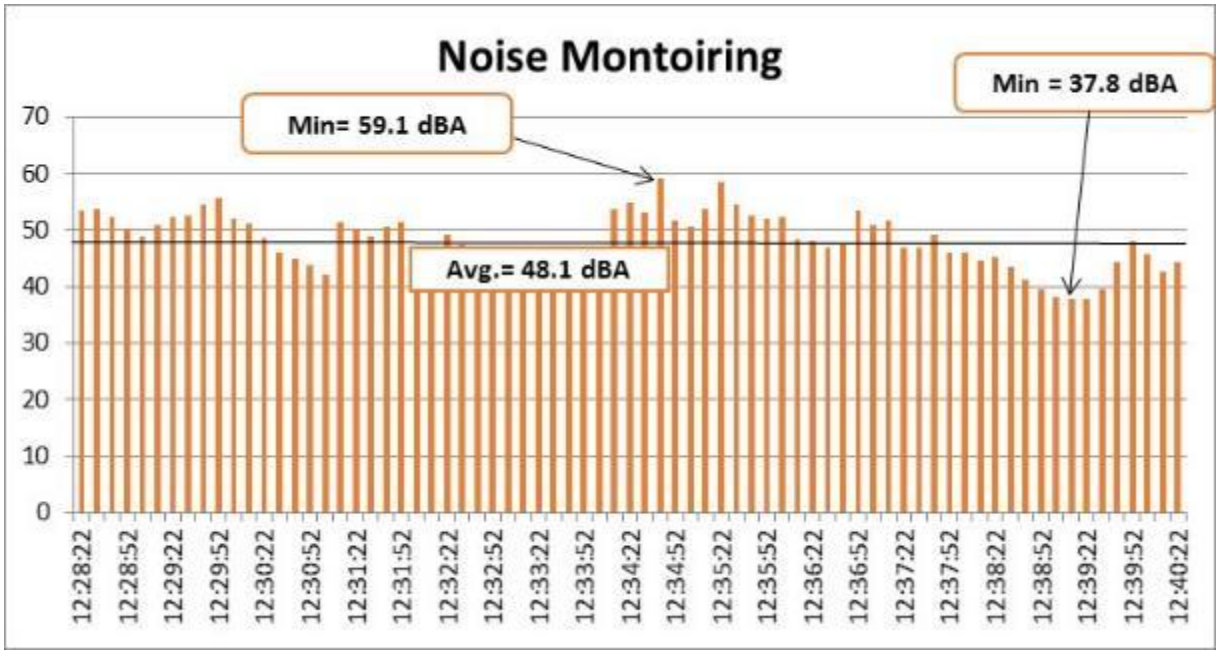


Figure 8: Results of Noise Monitoring

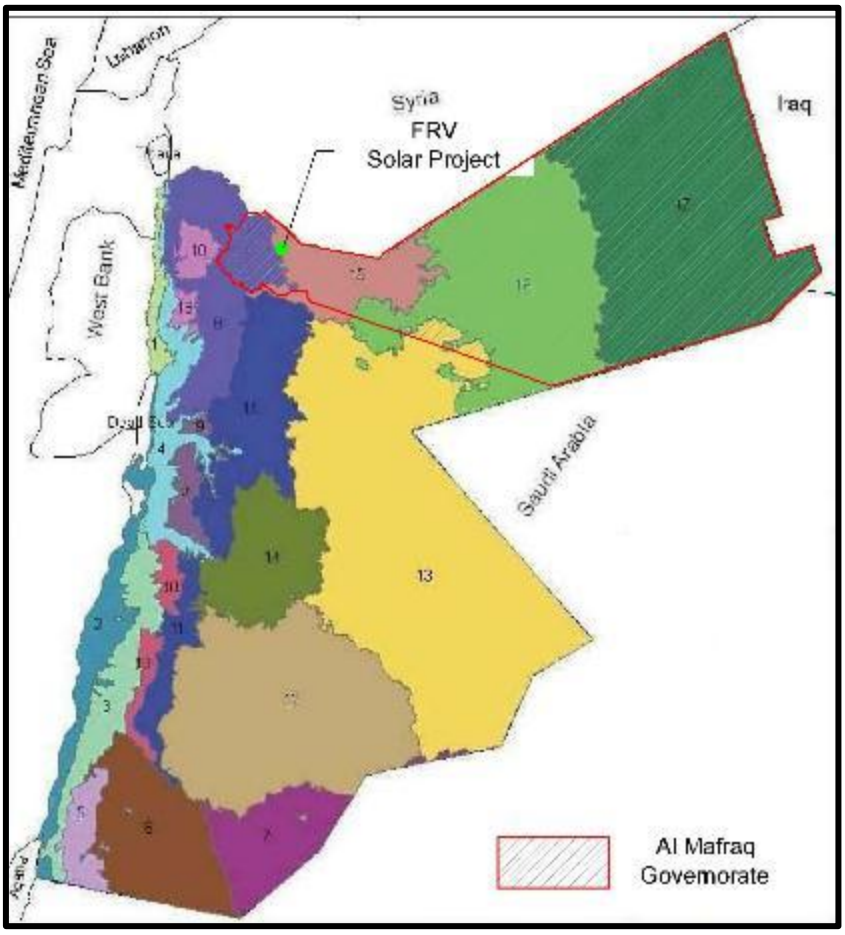
5.2.4 Topography, Morphology and Soil

Jordan is located about 80 km east of the Mediterranean Sea, bounded by Syria to the north, Saudi Arabia and the Gulf of Aqaba to the south (which is Jordan's only outlet to the sea), Iraq to the east and Palestine to the west. The area of landmass is approximately 88,778 km2, while the area of water bodies is approximately 482 km2 which includes the Dead Sea and the Gulf of Aqaba. Topography, morphology and soil are interrelated physical characteristics which are described in the following paragraphs (MoEnv, 2006).

Jordan is divided into three main topographic regions. These three regions, from east to west, are:

- **The Jordan Rift Valley:** A fault that extends from Lake Tiberias in the north to the Gulf of Aqaba in the south. The Jordan Valley, the Dead Sea and Wadi Araba are located in this zone (MoEnv, 2006).
- **The Mountainous Region** (where the project area falls), forms the eastern boundary of the Rift Valley and extends from Lake Tiberias to the Gulf of Aqaba. Mountains in this zone have elevations ranging from 1,200 to 1,500 meters above sea level. The region has a relatively mild climate with winter rains. The higher elevations receive occasional winter snows. Average annual precipitation in the zone varies from 600 mm in the north, to 100 - 300 mm in the south. Ninety percent of Jordan's population live in this zone (MoEnv, 2006).
- **The Eastern Desert** (also known as the Badia) lies east of the Mountainous Region and covers 80 percent of the land area of Jordan. This region is characterized by a dry, hot climate. Most of the zone is flat or hilly, but in the south lays the two highest mountains in Jordan, namely Rum Mountain (1,753 m) and Umm ad Dami (1,854 m) (MoEnv).

Furthermore, Jordan is split into 18 land regions as shown in **Figure 9** below, where each land region is characterized by altitude, physiography, dominant soil type, vegetation and land use. According to the figure, the project area falls within land region: namely the Northern Jordan Basalt Plateau (land region no. 15). The land region no.15 where the transitional xeric-aridic moisture regime is dominant while xeric regime exists in a few wadis and depressions. The major soil subgroups are xeric and xerochreptic calciorthids on the middle and upper slopes of the interfluves. Xerochreptic paleorthids are the second most common subgroup on the very gently sloping interfluves. Lithic subgroups are also common in this area on the crests and craters while camborthids occur in the valleys, basins and lower foot slopes (Jordan Soils and Land Management, 2006).



Source: MoEnv, 2006

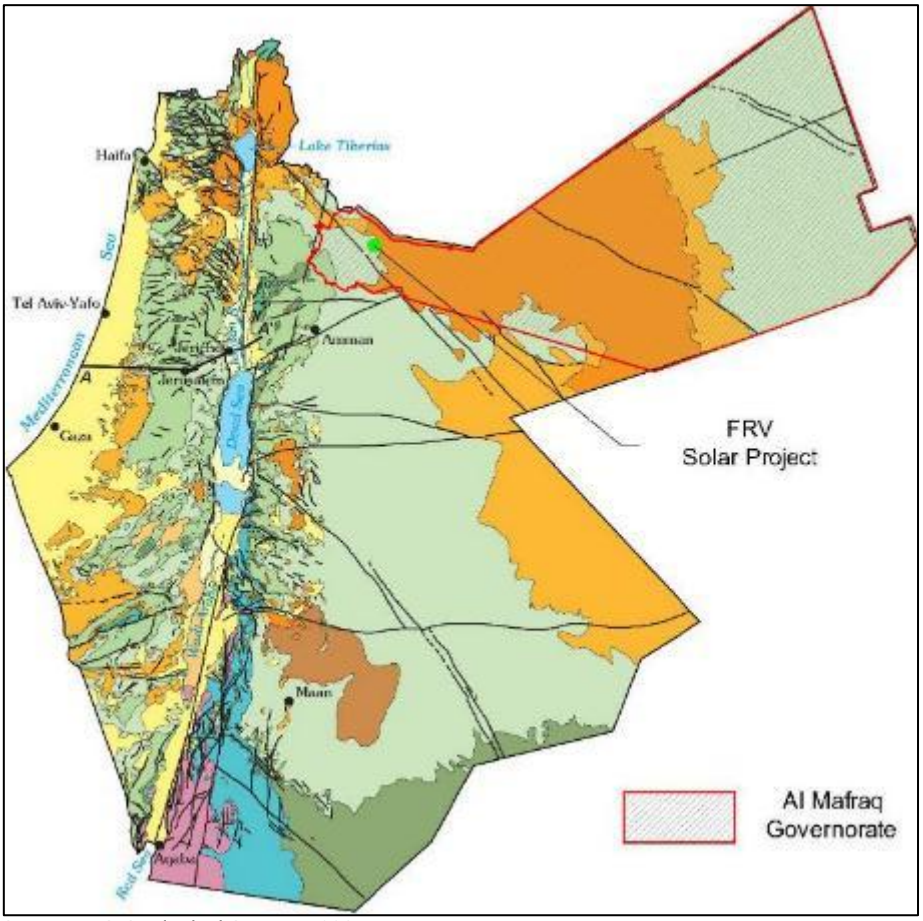
Figure 9: Land Regions Distribution in Jordan

5.2.5 Geomorphology and Geology

Jordan occupies the north-west part of the Arabian plate where most of the country is located within the stable shelf part of the plate (Petroleum Directorate, NRA, 2006). The geology in Jordan includes basalt, sandstone, limestone, chalk, marl and chert and various other Pleistocene and Holocene deposits of alluvial and Aeolian deposits.

The oldest rocks in Jordan are Precambrian in age and crop out around Aqaba and Wadi Arabah. Magnificent outcrops of the Palaeozoic sandstone in southern Jordan are present along the eastern shoulder of Wadi Arabah until the north-east tip of the Dead Sea.

The geologic map presented in **Figure 10** below shows the differing geologic features, landforms and hydrologic conditions from one part of the country to another. The detailed legend of the geologic map is also shown in **Figure 11** explaining the rock units, their age, lithology and water bearing properties.



Source: U.S Geological Survey, 1998

Figure 10: Geology of Jordan

As shown in **Figure 10** above, the project site belongs to the Ajloun and Balqa group within the B4 and B3 formations (Umm Rijam and Muwaqqar formations), which fall within the palaeocene and upper cretaceous systems. In terms of sedimentary rocks these formations consist of chalk, chert, limestone and marl, the B3 formation is sometimes bituminious. Limestone and chert layers are prolific aquifers in much of Jordan. Well yields are highly variable and are controlled largely by cavernous zones in the limestone that are affected by

the geologic structure. Flowing wells are common in areas of low elevation (U.S Geological Survey, 1998).

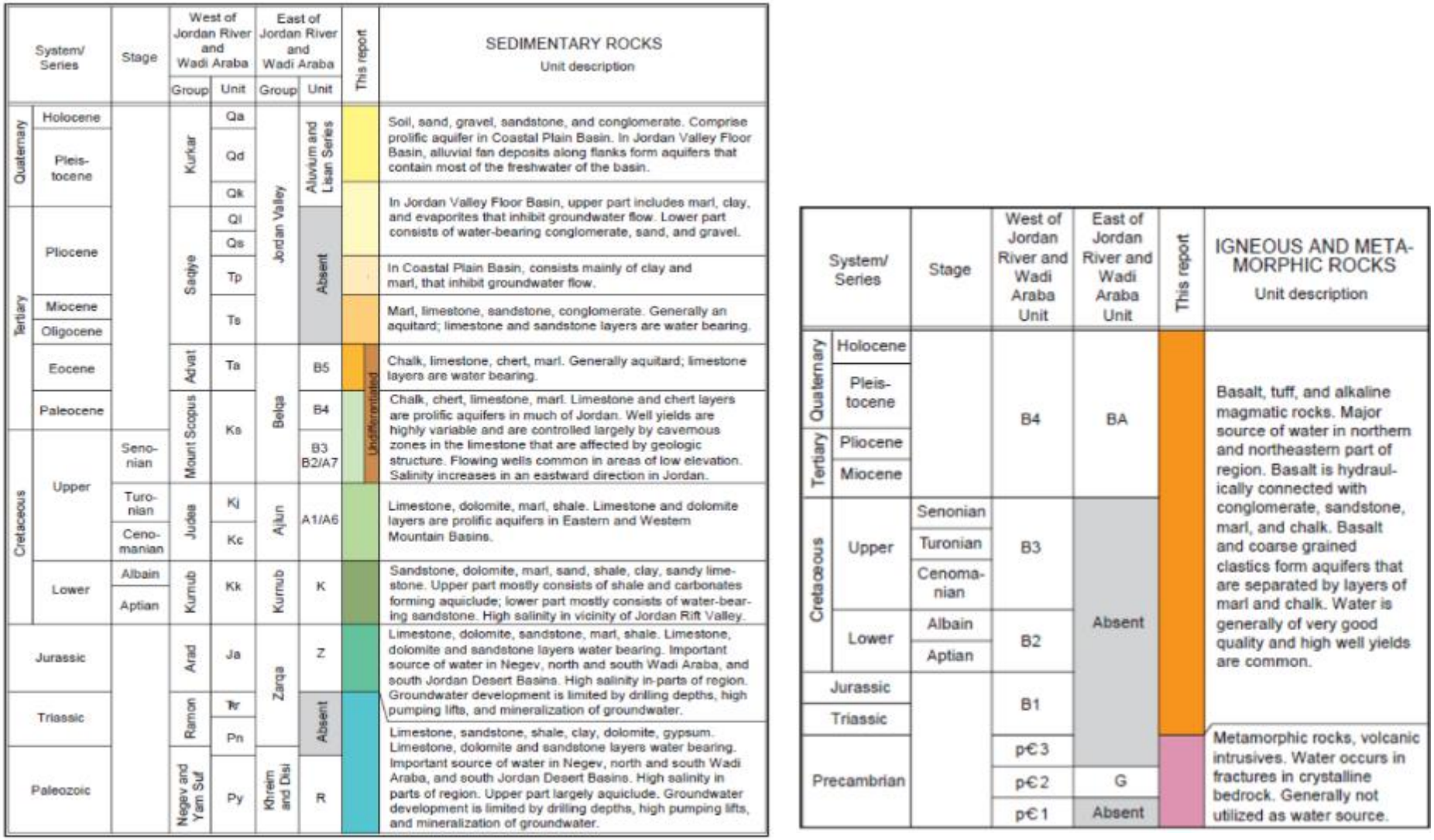


Figure 11: Generalized Geologic Units and Water-Bearing Properties

5.2.6 Tectonic Setting

The rate of current seismic activity in Jordan, including the project area, is minor with many of the strong seismic events located along the axis of the Dead Sea Rift.

The project site lies within the light magnitude of Richter's scale which is illustrated on the seismic hazard distribution map of Jordan shown in **Figure 12**. Therefore, if an earthquake was induced in that area, it is anticipated that the intensity will fall between the 4.0 to 4.9 magnitude (yellow colour) according to Richter's scale. The light magnitude is often felt with rattling and shaking noises, but usually causes no significant damages (Richter Scale Explained, 2011).

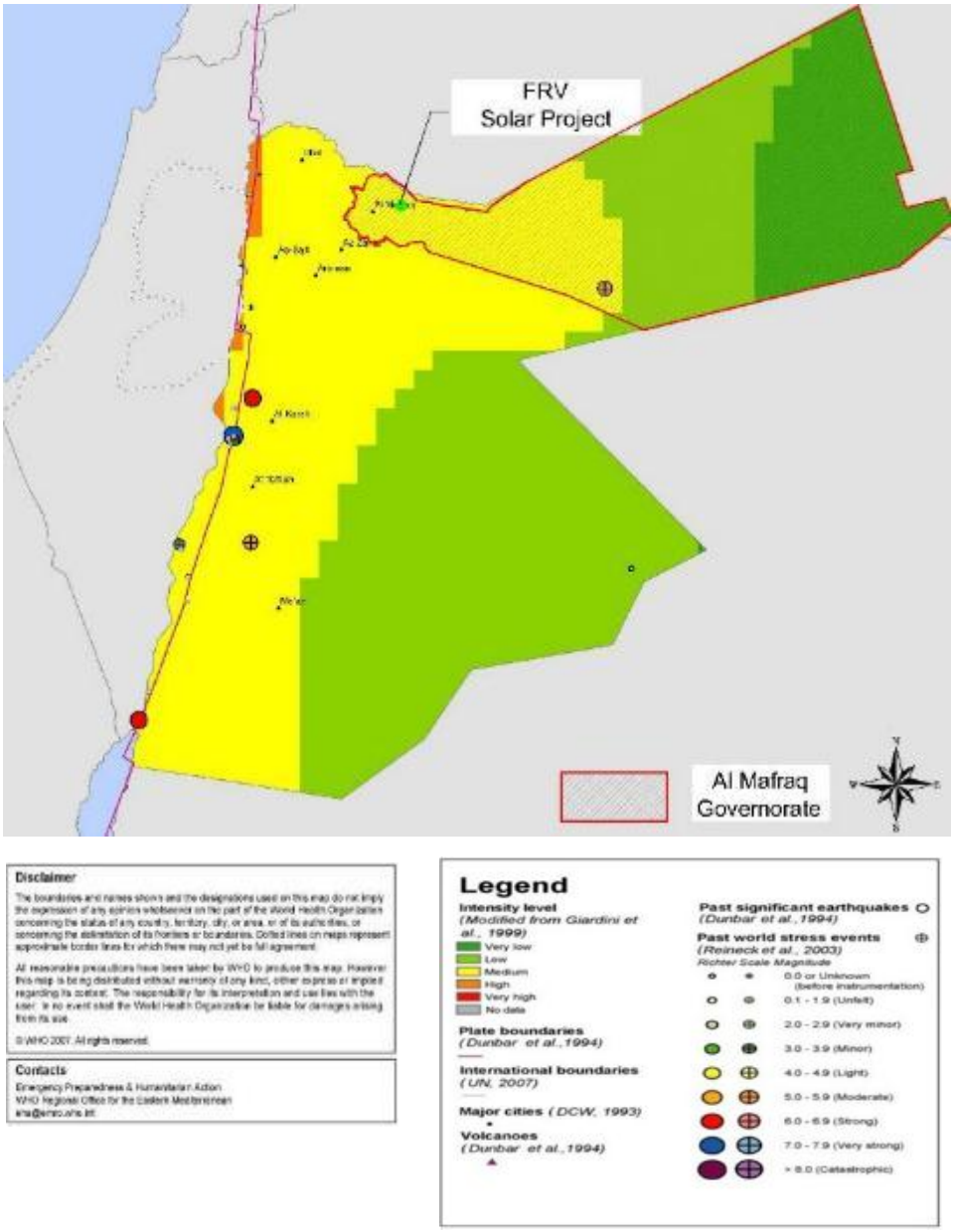


Figure 12: Seismic Hazard Distribution Map of Jordan

5.2.7 Water Resources

Jordan is classified as a country with scarce water resources. The available water resources per capita are falling due to population growth and are anticipated to fall from less than 160 m³/capita/year at present to about 90 m³/capita/year by 2025, putting Jordan in the category of absolute water shortage. Due to the limited water resources in Jordan, the demands and uses of water are exceeding renewable water supply, as a result of major contributing factors, such as the unsustainable use of groundwater through overdrawing of highland aquifers which leads to the gradual depletion of groundwater resources (MoEnv, 2006).

The water uses in Jordan are divided in four main uses, in the following each use with the percentage of usage from the total affordable quantity of water resources:

- Irrigation , 70%,
- Municipal , 24%
- Industrial, 5%
- Touristic, 1%.

In terms of renewable water resources; groundwater, base flow and flood flow are considered conventional resources while treated wastewater, brackish and desalinated water are considered non-conventional resources. Highly variable seasonal rainfall is the main source of water in the Country. Significant amounts of rainfall (i.e. above 200 mm/a) are limited to the highlands in the north-western part presenting the long-term average of annual precipitation. Around 5% of rainwater infiltrates into the ground, thereby replenishing groundwater aquifers. The amount transformed into direct flow is slightly smaller. The largest share of over 90% of annual rainfall is lost to evapo-transpiration.

Besides the indigenous water resources the country's renewable water resources are replenished through regional watercourses and trans-boundary groundwater flow. (GTZ, NWMP, National Water Master Plan, 2004). Water desalination, on the other hand, could be considered a future source of water supply.

Below is a description of surface and groundwater hydrology, existing water pollution discharges, and receiving water quality for water resources related to location of the project.

5.2.7.1 Surface Water

Surface water basins in Jordan are depicted in **Figure 13**. According to this figure, the project area is located within Zarqa basin, which is also referred to by Amman-Zarqa basin.

The Amman-Zarqa basin has a total catchment area of about 4,150 km2. An area of 3,725 km2 is located in Jordan (~90%), the remaining areas are in Syria (upper part of Wadi Dhuleil sub-catchment). However, the runoff contribution of the Syrian sub-catchment is negligible; most of the flood flow is generated further west close to the escarpment.

The Zarqa River is the main drainage course of the Amman-Zarqa basin which originates in Western Amman and flows from there in a wide arch first eastwards to the town of Zarqa,

then northwards, afterwards it is joined at Sukhneh by Wadi Dhuleil, its main tributary and flows finally westwards towards the Rift Valley. The stream flow of the Zarqa River is impounded by King Talal Dam at an elevation of 120 m and a storage capacity of 75 MCM and is thus able to manage base flows and even flood flows in most years.

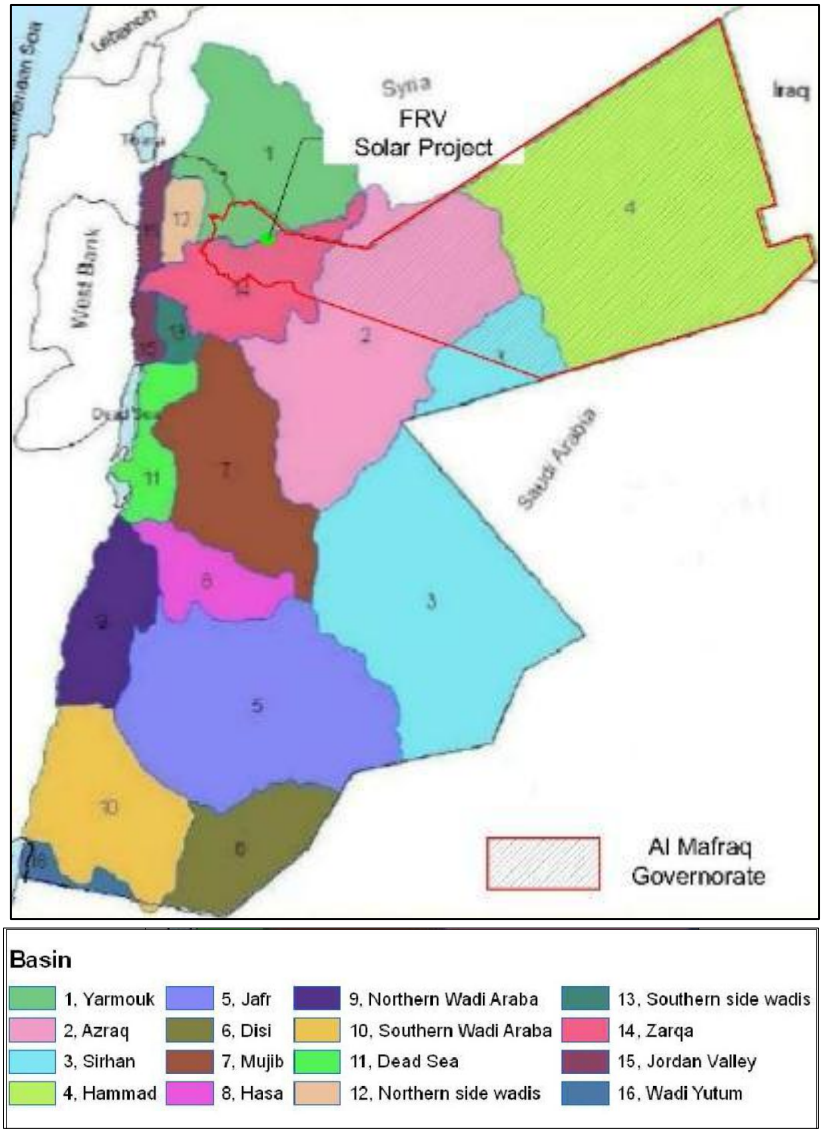


Figure 13: Surface Water Basins Distribution in Jordan

However, the project area is located in the upper reaches of the water divide area, which separates Amman, Zarqa and Yarmouk basins that have an extension to the Syrian lands all over the northern and north eastern part in Jordan. Furthermore, the project area is part of Wadi Al Baij catchment that discharges the runoff of the project area toward Zatari area.

Direct runoff from heavy rainfall is considered as the only source of water flowing in Wadis in the project area. According to the Engineering services study for the solar projects in King Hussein Bin Talal Development Area (KHBTDA) that prepared by Al Shamil Engineering Company in June 2014, it was concluded that the surface water flow is normal to occur in the area when the rainfall amount exceeds 8 mm during the rainy days, while the maximum runoff from the project area is calculated to be 0.025 MCM and the maximum flood flow for the catchment area of wadi Al- Zaatri is around 0.114 MCM.

It is worth noting that during the site survey, the study team observed ditches that collect water during the winter season. The **Figure 14** illustrate the surface water runoff crossing the project area and the ditches formed by this runoff during the winter season.

Figure 14: Water Ditches and Small Wadi crossing the project site

5.2.7.2 Groundwater

Groundwater is water that is stored underground in spaces of soil or rock. The water-bearing porous soil or rock strata yielding significant amounts of water to wells or springs are called 'aquifers'. The groundwater aquifers in Jordan are classified into three main complexes:

- **The Deep Aquifer Complex:** This is formed from sandstone and is found as one unit in the south and two units in the north separated by thick limestone and marl layers.
- **The Middle Aquifer Complex** (the upper and middle cretaceous complex): This consists of limestone, dolomite, marl stone and chert beds.
- **The Shallow Aquifer Complex:** This is the mostly exploited and consists of two main systems; the basalt aquifer system and the sedimentary rocks and alluvial deposits of Tertiary and Quaternary ages system.

In Jordan, groundwater is recharged either by the seepage of a small percentage of total rainfall into the ground, or through groundwater inflow from Syria (referred to as "transboundary flow", in which water resources are shared with another country). Other inflows are the result of return flows from irrigation, leaks from pipes, reservoirs, and wastewater treatment plants. Groundwater outflows are from abstraction by pumping wells, spring and base flow discharge (GTZ, NWMP-Water Resources in Jordan, 2004).

Twelve groundwater basins are identified having a total renewable annual supply "safe yield" of about 280 MCM. The distribution of the groundwater basins is shown in **Figure 15** below.

As illustrated in **Figure 15** below, the project area is located within Yarmouk basin which is considered the second in size among groundwater basins in Jordan. The Yarmouk Basin safe yield is estimated at about 40 MCM per annum. The pumping level reaches 59 MCM per annum. The water quantity and quality is categorized as being at the higher end of the scale of ground water resources in Jordan (MoEnv 2006).

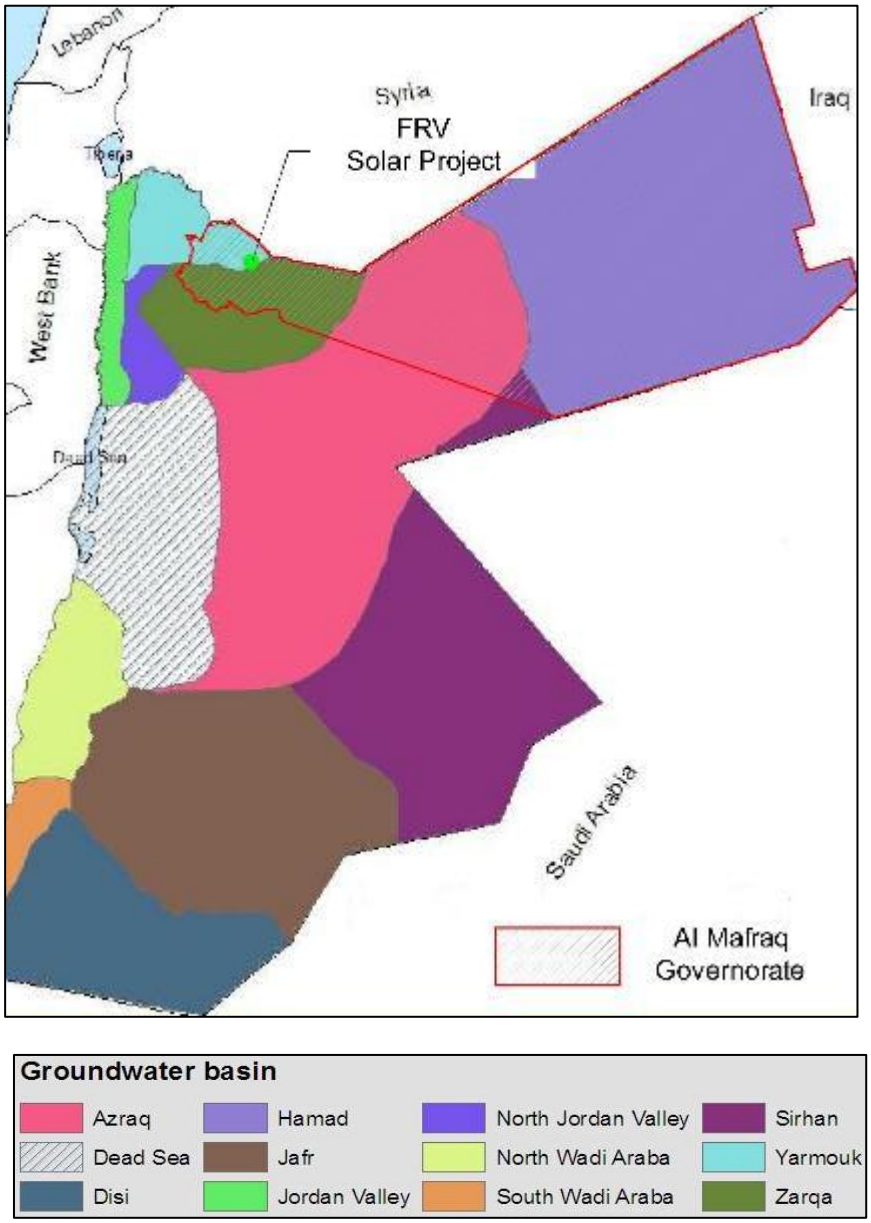


Figure 15: Groundwater Basins Distribution in Jordan

5.3 Biological Environment

5.3.1 Ecosystem

5.3.1.1 Desert Ecosystem

The project area is characterized by the Desert Ecosystem, which is one of the three ecosystems presented in Jordan. This ecosystem is the most dominant at the national level, where it comprises more that 70% of Jordan's area. It is gently undulating plateau with an elevation of 500m to 900m above sea level. Four broad habitats- types can be distinguished in this ecosystem where at the project location and surrounding two habitats types were found:

1- Hammada; smooth, gravel/chert plains, which stretches from Ras Al Naqab to the Iraqi border in the northeast.

2- Clay pans lying at the bottom of close drainage basins in the desert can become flooded after heavy rains, with the water persisting for several months rather than draining away.

This largely treeless ecosystem is dominated on its fringe, adjoining the Highlands ecosystem by Irano Turanian species of small shrubs and bushes such as Artemisia, Retama, Anabasis and Ziziphus. The majority of the ecosystem to the east of this highland fringe has even poorer plant cover dominated by Artemisia , Phlomis, Stipa, Astragalus and Trigonella. Deserts in Jordan mainly defined as Badia.

The Badia is the main rangeland of Jordan, thus the range quality is deteriorated due to very heavy grazing and widespread of ploughing for cultivation of rain fed barley, which has led to loss of natural plant cover and accelerated soil erosion and degradation through wind and water erosion.

5.3.1.2 Flora

Biogeographic Zone

Irano-Turanean zone:

The project area is located within the Irano-Turanean zone which is characterized by the presence of shrubs and bushes and the absence of tree vegetation, the leading plant species are the *Anabasis syriaca* and the *Artemisia herba- alba*. This zone, *phytogeographically*, is a narrow strip of variable width that surrounds all the Mediterranean ecozone except at the north. The mean annual rainfall is usually less than 150 mm. The vegetation is mainly of small shrubs and bushes i.e. *Anabasis syriaca, Artemisia herba-alba.*

The Irano-Turanian region is indistinguishable zoogeographically from other bioclimatic ecozones. In Jordan it is a transitional zone between the Mediterranean ecozones and the surrounding ecozones. This ecozone does not have its own entity since it does not possess specific fauna as other ecozones in Jordan. None of the species is restricted to this region, and all the species found here originally came from the surrounding ecozones. Moreover, the width of this region varies from year to year in relation to the amount of rain. Saint

Girons (1982) indicated that zoogeographically the Irano-Turanian zone in Palestine is of disputed validity.

This zone surrounds the Mediterranean region from all sides except the north and is characterized by being a timberless land since it has no forest cover.

Altitudes usually range from 500-700 m, and rainfall ranges from 150-300 mm. The mean annual minimal temperature ranges from 5-20*C, and the mean annual maximum temperature ranges from 15-25*C. Soil is mostly calcareous or transported by wind. Vegetation is mostly dominated by chamaephytes.

Vegetation Type

The project located at a transitional zone between two distinctive vegetation types, namely; Steppe Vegetation and Hamada vegetation. The natural vegetation at the project location is highly deteriorated due to two main reasons:

1- The project area has seasonal cultivation of fodder for livestock by herders from Mafraq area because although the project is within MDC area but there is no controls on access into the site (**Figure 16**).
2- Random overgrazing has been observed inside the project area, such activity creates sever damage to the natural vegetation cover such natural forage that already has a very low productivity (**Figure 17**).

Steppe Vegetation Type:

This vegetation is confined to the Irano – Turanian biogeographic zone and may intrude either into the Mediterranean or the Saharo- Arabian zone. The composition of this vegetation varies according to the soil and climatic differences depending on its location with respect to the Mediterranean zone. This might be due to the fact that the western steppes are more affected by the tropical conditions and vegetation in the Rift Valley, while the Eastern steppes are more affected by the Sahara conditions and vegetation.

The recoded species of this vegetation type are all common and do not have any conservation value. These common species are mainly restricted to the shallow wadis that are created by the seasonal rains and floods when occur (**Figure 18**). Below are the recorded flora species of this vegetation type within the project area and the surroundings:

Asphodelus aestivus *Urgiea maritime* *Anabasis syriaca*

Ferula communis *Hammada spp.* *Gypsophila Arabica*

Salsola spp. *Astragalus spinosus*

Figure 16: Seasonal Cultivation at the Project Area

Figure 17: Grazing Observed inside the project Area

Figure 18: Vegetation cover is more available at wadi bids

Hammada Vegetation

Large portions of the project area is predominantly occupied with the chert/gravel Hammada vegetation type. This is characterized by the extensive gravel plains, which are either devoid of vegetation or with annual grasses. The latter are intercepted frequently with large run-off hammada vegetation within wadi systems created in the area due to previous flash floods, where enough moisture is available to support green growth. Vegetation is more frequent at wadis and run-offs, and depends on several factors, such as amount of water, soil type and grazing. All recorded species of this vegetation type at the project area are common and have no conservation value. Below the recorded species within the project boundary:

Atriplex halimus *Anabasis artculata* *Achillea fragrantissima*

Salsola vermiculata *Zilla spinose* *Peganum harmalla,*

Astragalus spinosus *Saeda vera,*

5.3.1.3 Fauna

Zoo-geographic Zone:

The project is located within one of the three zoogeographic zones defined in Jordan; Saharo – Sindian Zone (also referred to as the Saharo-Arabian and Irano-Turanian phytogeographic region by Zohary 1973). This zone is located to the east of the mountain ranges, extending from south of Jordan to northeast of the country in Mafraq area. It is another sub region within the Palearctic and includes the Sahara Desert, The Arabian Desert. The majority of the project's mammals are belonging to this zone. The fauna of the project area are suffering from habitats destruction and high level of disturbance due to human activities including the illegal hunting.

5.3.1.4 Mammals

The mammals of the project area are mainly of nocturnal activities, nevertheless, the results of the baseline has shown very low abundance of mammals species which is highly related to the activities is taking place in the development area. Small mammals are relatively more abundant since their home range is much smaller than the large ones. Below are the recorded mammals' species in the project area:

Lesser Egyptian jerboa, *Jaculus;* Wagner's Gerbil, *Gerbillus dasyurus;* Fat Sand Jird, *Psammomys obesus;* Desert Hedgehog, *Paraechinus aethiopicus;* Arabian Cape Hare, *Lepus capensis arabicus;* Red Fox, *Vulpes*

5.3.1.5 Reptiles

The reptiles species occur in the area are mainly those related to desert and arid habitats, however, major habitats deterioration has reduced the diversity and abundance of these species in the project area as well as other similar arid habitats. Four species of reptiles were recorded at the project area:

Pale Agama, *Trapelus pallidus agnetae;* Short-snouted Lizard, *Mesalina brevirostris*; Large-headed Thin–toed Gecko, *Stenodactylus grandiceps;* Schokari Sand Racer, *Psammophis schokari*

5.3.1.6 Birds

Jordan has a wide diversity of bird habitat types due to its varied topography and climate and its bio-geographical location. More than 363 bird species have been recorded in Jordan, of which more than 141 species are breeding birds and this number might increase with the continuous research.

Jordan lies on the main route of bird's migration between Africa, Asia and Europe. Millions of birds are migrating over Jordan each year, among which the majority of the Jordanian avifauna is belonging. The huge number of migrant birds that visit Jordan twice a year has made the country of a great importance for the global avifauna.

The birds' diversity at the project area is relatively low and largely dependent on the microhabitats within the area, ranging from flat Hamada to flat shrubbery desert patches.

The project area occurs within the Saharo-Arabian bio-geographical zone, and is mainly comprised of chert Hammada habitats. Birds' species communities within this area are thus comprised of the arid and semi-arid dwellers showing many similarities between both breeders and migratory birds. Breeding birds are desert breeders and include several species of larks (Temminck's and Desert Larks) which are biome restricted species.

Migrants include several passerine species that rest in the wadi vegetation, as well as many raptors passing over during migration.

The project area is not located within or adjacent to any Bird Important Areas (IBAs), the nearest IBA is Irbid – Mafraq Plains where the project is 11km far from the border of the IBA (**Figure 19)**.

In order to define the impact of the project on the migratory soaring birds, Birdlife Sensitivity Map tool was applied to the project area with buffer zones of 2 km, 5 km and 10 km

distances, and it's found at all these scenarios' that the potential of impact is ZERO (**APPENDIX B**).

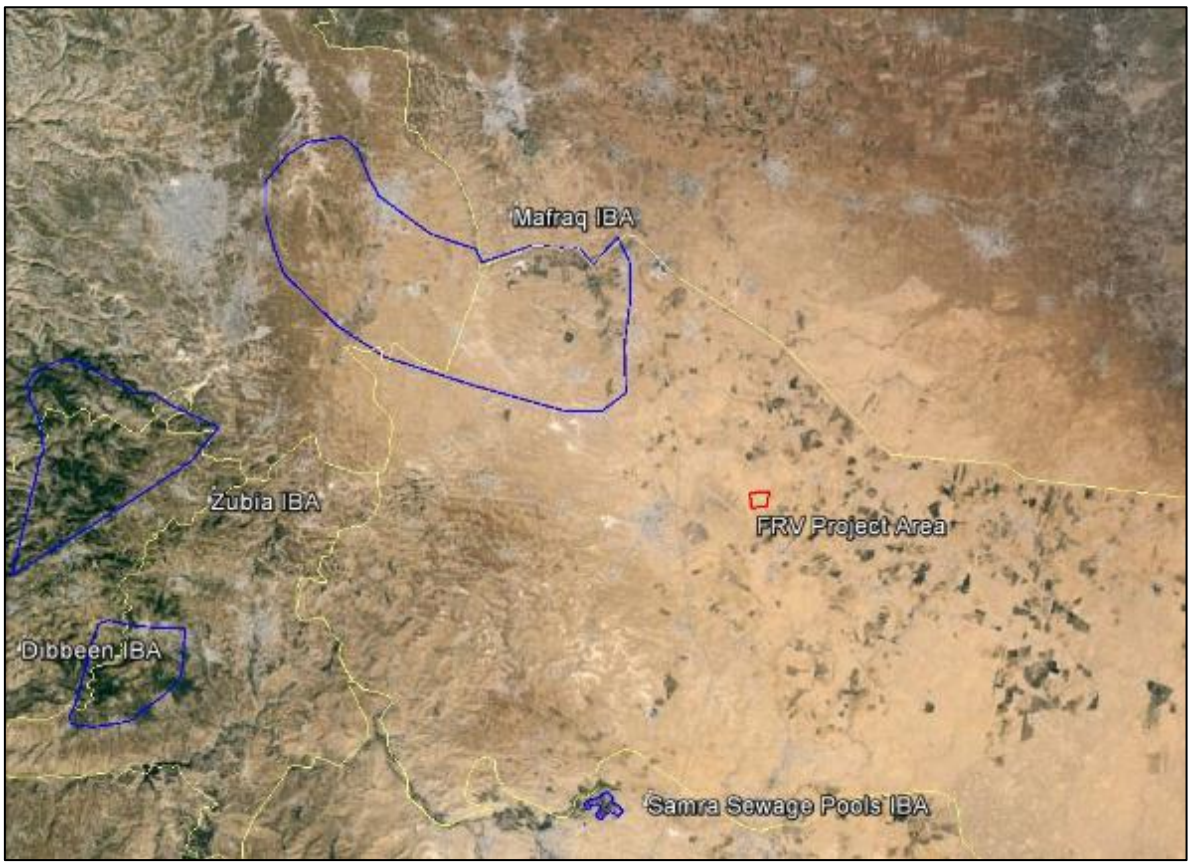


Figure 19: The location of the project location in relation to the surrounding IBAs

5.4 Socio – Economic Conditions

In general, Jordan is characterized by three major social environments, the urban life style, the rural life style, and Bedouin life style. The urban life style is represented by cities such as Amman, Mafraq, Irbid…etc. The rural life style is the dominant in the villages and small settlements scattered along the governorates where they rely on agricultural activities including seasonal cultivation of fodder for their livestock, and still the base and the governing reference for all social relations. Bedouin life style is mainly represented by nomads' movement on seasonal basis from one place to another in order to find proper water and feed resources for their livestock. The movement patterns rely on many different factors such as Water Resources, Biological Resources (Rangelands), Climate Conditions and Feed Resources (Cultivated Forage Lands).

This section gives an overview of the type and number of people who will be available within the project site and the surroundings, the surrounding land uses, existing infrastructure and utilities.

5.4.1 Population

The population at Mafraq Governorate in 2013 was estimated at 306,900, which comprises 4.7% of the total population in Jordan. The number of males during the same year was estimated at 159,100 while females were estimated at 147,800.

The area of Zarqa governorate is 26,551km^2, comprising 29.9% of the total area of Jordan, this would result in a population density of 11.6 capita/km^2 (DoS yearbook, 2013).

The age structure of Mafraq population shows that it is a young community having 39.9% of the community below the age of 15 years, and 69.2% of the community is below the age of 30 years. Only 3.6% is above age 65.

5.4.2 Land Use

The project area is located within MDC area as part of the KHBTDA and classified as industrial area. The plots allocated for solar project are currently empty of any use as shown in **Figure 20** below.

Figure 20: Photos from the project site

As shown in **Figure 21** below the nearest populated area to the project site is Al Zbaidiyah Village which is located around 1km north to the project site. Al Mafarq city is located around 5.75 km to the west while AL Ba'ej Village is located around 3km north east of the project site.

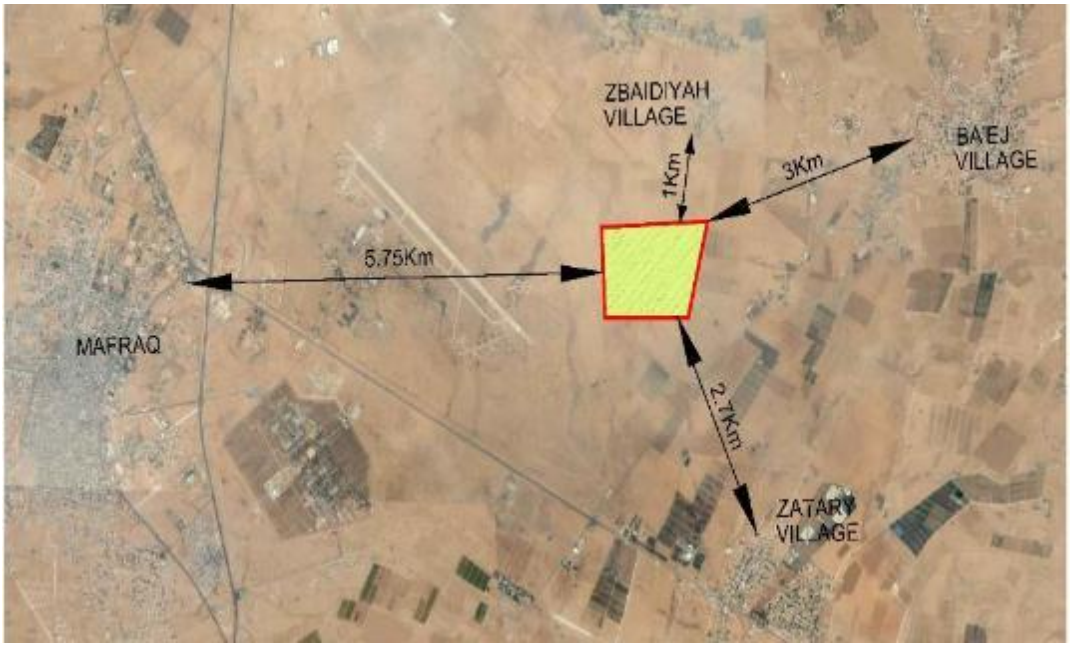


Figure 21: Project Site and Nearby Populated Areas

It is worth noting that during the site visits to the project area, the study team found one group of herders utilizing the project area and surroundings to feed their herds as shown in **Figure 22**. As confirmed by the MDC representative that such groups of herders utilize this area occasionally and escort their herds to move in the surroundings of the project area.

Figure 22: Group of herders utilize the project area

5.4.3 Infrastructure, Utilities, and Transport

The project site can be reached through the international highway connecting Mafraq with the Syrian borders. Currently MDC implements an infrastructure project for the MDC area, the project will provide infrastructure services such as roads, combined water and firefighting network wastewater. Moreover, the other services will be available within MDC area such as telecommunication and internet. **Figure 23** below shows photos for the current infrastructure project within MDC zone.

Figure 23: Infrastructure Project within MDC Area

5.5 Archaeological and Cultural Heritage Resources

No archaeological and/or cultural heritages sites are foreseen within the project area. However, the contractor shall be responsible to notify the supervisor of the Cultural resources Management Office of the Department of Antiquities in the case that antiquities are encountered in any area during construction and also specifications set in Article 15 of the Antiquities Law No. 21 (1988).

6 STAKEHOLDER IDENTIFICATION AND ENGAGEMENT

6.1 Introduction

Stakeholders are identified as any individual and/or group that could be affected by the proposed project activities and has interest in their outcome. According to this definition, the stakeholders may include property owners, business owners, central government and local officials, special interest groups, and non-government organization.

Stakeholders should play a vital role in providing advice to the project management, therefore, in compliance with local EIA regulations, and international standards, i.e. IFC/World Bank, stakeholder engagement has been an ongoing process throughout the ESIA process in order to ensure transparency with all stakeholders that may be affected by, or have influence on the project.

The stakeholder engagement activities carried out during this ESIA are as follows:

- Identification of project stakeholders and all parties affected or related to this project
- Conducting a scoping session and documenting its results in a scoping statement report as part of the Final ToR.

6.2 Stakeholder Engagement

Upon submission of the application and categorization of the Project, the ESIA Scoping Process was initiated for the purpose of providing the identified stakeholders with information pertaining to the proposed Project, outlining the ESIA preparation and review process, and obtaining stakeholders views on the key environmental and social issues that should be considered during the design and implementation of the Project. The Scoping Statement report that was submitted as part of the Final ToR to MoEnv has already identified the key environmental impacts likely to be associated with the project as well as a methodology and execution plan for assessment.

The scoping workshop for this project, organized MoEnv and AJ in collaboration with FRV, was held on November, 15th 2015 at the Geneva Hotel, Amman, Jordan. The scoping program focused on describing the project and the key potential impacts identified in the Terms of Reference (ToR). A scoping statement that summarizes the deliberations of the workshop, the participating stakeholders and the issues identified to be of potentially significant impacts was prepared and as part of the Final ToR that was submitted to MoEnv on November 22nd 2015 and approved on December 3rd 2015.

The list of invitees to the scoping session included concerned stakeholders from government agencies, institutions, organizations, municipalities, and non-governmental organizations (NGOs) including, but not limited to, the following:

Table 7: Stakeholder Categories

No.	Stakeholder Category	Examples
1	Government	Government Ministries, Ministry of Energy and Mineral Resources, Ministry of Environment, Ministry of Health, Ministry of Planning, Ministry of Agriculture, Ministry of Water and Irrigation, Ministry of Tourism & Antiquities, Ministry of Municipalities and Municipal Affairs.
2	Community	Community Leaders, women, children, tribal and unemployed groups
3	Shareholders	Shareholders and project staff
4	NGOs	Environmental, social, Education, Sustainable Development, Health, Ecotourism, Cultural, Archaeology BGOs (national and international with local representations. E.g. Royal Society for the Conservation of Nature (RSCN); Jordan Environment Society (JES); Friends of the Environment (FOE); IUCN, etc.
5	Media	Press, Broadcast, Radio, Key Journalists
6	Academic	Universities and Research Institutes

The detailed list of invited stakeholders is included within the scoping statement, and the list of stakeholders that attended the scoping session is presented in the scoping statement as well.

The main issues of concern can be summarized as follows:

- The positive impact on the local community and employment opportunity.
- Extend the project after decommissioning phase ;
- The flood Risk assessment for the project area;
- The project considered as a green project;

The overall aim of the scoping session was to take into consideration all issues of concern raised by stakeholders throughout different phases of the project. Thus, the above mentioned issues were evaluated and assessed, where relevant, to ensure that the impacts are not significant and no harmful effects will be caused during and after the project.

7 IDENTIFICATION OF ENVIRONMENTAL AND SOCIO-ECONOMIC ASPECTS AND RECEPTORS

Project environment covering physical, biological, Socio-economic and OHS aspects are identified for all proposed activities which has the potential to:

- Interact with the environment (physical, biological, socio-economic & OHS); and
- Breach the conditions of relevant national and international standards and guidelines.

The identified receptors are presented in table below.

Table 8: Identified Environmental and Socio-economic Receptors

Aspects/ Receptors	Details
1-Physical Environment	
Air Quality	The atmosphere at and around the Project Site.
Noise	The construction phase especially activity related to transportation and execution might have a potential impact upon.
Soil	The soils of the project area on which construction, operation and decommissioning activities will occur.
Hydrogeology	The hydrogeology (i.e., groundwater) in the area in and around where construction and operation activities will occur.
Hydrology	Storm water within the project area.
Landscape / Visual Impact /Topography	The geomorphologic land forms and terrain at the Project site.
2-Biological Environment	
Flora	Plant species that could potentially exist in the area in which the construction and operational activities will occur.
Fauna: (Birds, Reptiles and Mammals)	Fauna species that could potentially be affected by the project different activities in the area in which the construction and operational activities will occur.
3-Occupational Health and Safety	
Construction Team	Staff on project site which are subject to occupational hazards effects such as noise, dust, etc.
4-Socio-economic Environment	
Public Health & Safety – PHS	Land users nearby the project boundaries that could be subject to hazards/public health and safety effects potentially arising from the Project's activities.

Aspects/ Receptors	Details
Population	The project area is far from the populated areas. Hence, there is no population (people) utilising the project area.
Land Use & Land Ownership	The project area is owned by MDC and shall be leased by FRV for the project duration.
Workforce & Employment	New work opportunities are expected mainly construction phase and operation phase
Utilities and infrastructure	The utilities (e.g. power supply, water, telecommunications, sewage services) which the project construction and operation activities might have a potential impact upon.
Transport & Traffic	Road transport systems of the area in which the Project activities are to occur during the construction phase, and minor during operation phase.
Archaeology / Cultural Property	Archaeological sites and artefacts that have cultural significance found within or in the vicinity of the Project area.

7.1 Interaction of Identified Aspects and Receptors

Based on the review of environmental aspects, project activities, and the project's environmental receptors, a summary of potential interactions between the environmental aspects and receptors relevant to this project were identified. This will allow for a preliminary assessment of the key environmental issues related to physical, biological, OHS and socio-economic receptors, or 'key issues' associated with the Project to be completed.

The interaction of aspects and receptors identified in the ESIA process are presented in table below for all planned and unplanned activities in addition to take natural disasters into consideration:

Table 9: Environmental and Socio-Economic Aspect Matrix

Receptor / Activity		Physical						Biological			OHS	Socio-economic							Other
		Air Quality	Noise	Soil	Groundwater	Hydrology	Landscape / Topography	Flora (habitats)	Birds	Reptiles & Mammals		PHS	Population	Land Use	Workforce & Employment	Utilities & Infrastructure	Transport & Traffic	Cultural & Archaeology Heritage	Liability / Reputation
Planned Activities																			
Construction	Access road to site	●	●	●			●	●		●	●	●			●	●	●	●	●
	Accommodations	●	●	●			●	●		●	●		●		●	●	●		●
	Haulage	●	●	●		●		●	●	●	●	●			●	●	●		●
	Site survey	●	●					●							●		●		●
	Site soil Investigation	●	●	●	●	●		●			●				●			●	
	Clearing and grading	●	●	●		●	●	●	●	●	●	●			●	●		●	●
	Trenching & ditching	●	●	●			●	●		●	●	●			●	●		●	●
	Excavation & digging	●	●	●			●	●		●	●	●			●	●		●	●
	Earthworks	●	●	●			●	●		●	●	●			●				●
	Mobilization/demobilization of labour & equipment	●	●	●		●	●	●	●	●	●	●			●	●	●		●
	Structures construction	●	●	●		●	●	●	●	●	●	●		●	●			●	●
	Waste generated from construction activities			●		●	●	●		●	●	●	●	●	●				●
	Wastewater generated by site workers			●		●	●	●		●	●	●	●	●	●	●			●

Receptor / Activity		Physical						Biological			OHS	Socio-economic							Other
		Air Quality	Noise	Soil	Groundwater	Hydrology	Landscape / Topography	Flora (habitats)	Birds	Reptiles & Mammals		PHS	Population	Land Use	Workforce & Employment	Utilities & Infrastructure	Transport & Traffic	Cultural & Archaeology Heritage	Liability / Reputation
Operation	Wastewater discharge			●		●	●	●	●	●	●	●	●		●	●			●
	Municipal solid waste handling	●		●		●	●	●	●	●	●	●	●	●	●				●
	Hazardous/chemical waste storage and disposal	●		●		●	●	●	●	●	●	●	●	●	●	●			●
	Chemical / oil storage	●		●		●		●	●	●	●	●	●		●				●
	Vehicles operation	●	●								●	●			●		●		●
	Maintenance activities	●	●	●		●	●	●		●	●	●			●	●	●		●
Decommissioning	Equipment Dismantling		●	●			●	●		●	●	●	●		●		●		●
	Demolishing	●	●				●	●	●	●	●	●	●		●		●		●
	Fence Removal		●					●			●	●	●		●		●		●
	Excavation & backfilling	●	●	●		●	●	●	●	●	●	●	●		●	●	●		●
Unplanned Project Activities																			
Construction	Vehicle collision	●	●	●				●	●	●	●	●	●				●		●
	Spill of chemicals or liquid fuels	●		●		●	●	●	●	●	●	●	●						●
	Ignitions of flammable materials / accidental fires	●		●			●	●	●	●	●	●	●				●		●
Operation	Vehicle collision	●	●	●				●	●	●	●	●	●				●		●
	Spill of chemicals or liquid fuels	●		●		●	●	●	●	●	●	●	●						●

Receptor / Activity		Physical						Biological			OHS	Socio-economic							Other
		Air Quality	Noise	Soil	Groundwater	Hydrology	Landscape / Topography	Flora (habitats)	Birds	Reptiles & Mammals		PHS	Population	Land Use	Workforce & Employment	Utilities & Infrastructure	Transport & Traffic	Cultural & Archaeology Heritage	Liability / Reputation
	Ignitions of flammable materials / accidental fires	●		●			●	●	●	●	●	●	●				●		●
Natural Disasters																			
Construction	Earthquake "Seismic Activities"		●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	
	Flooding			●		●	●	●	●	●		●	●	●		●	●		
Operation	Earthquake "Seismic Activities"		●	●	●		●	●	●	●		●	●	●	●	●	●	●	
	Flooding			●		●	●	●	●	●		●	●	●		●	●		

8 ANALYSIS OF PROPOSED PROJECT ALTERNATIVES

The analysis of project alternatives is one of the main tenets of environmental impact policy and procedures world-wide. A thorough, unbiased and transparent assessment of alternatives from an environmental, social, technical and economic standpoint is one of the most important contributions an ESIA can make to improve decision making.

The analysis for this project contains options/alternatives which are the “No Project” versus “Project” alternative in addition to other energy resources alternatives; however, the project location is selected by MDC in Al Mafraq Governorate.

By considering these alternatives prior to the commencement of Project activities, environmental and social project benefits can be maximized and potential challenges can be identified and addressed.

Table 10 below presents the symbols that denote the various levels of environmental impact to aid in the comparison of alternatives. Each symbol indicates an overall evaluation of the specified environmental component and social aspect.

Table 10: Evaluation Symbols for Levels of Environmental and Social Impact

Symbol	Description
X	Denotes potential for impact, which is not considered significant
S-	Denotes Potential Significant Adverse Impact
S+	Denotes Potential Significant Beneficial Impact
*	Denotes no change to the existing situation

8.1 The ‘Project’ Vs the ’No Project’ Alternative

The “No Project” option considers the alternative of not conducting the project at all. It is normally evaluated to assess the impacts if the project does not go ahead. This alternative is evaluated against the implementation of solar energy project as one of the renewable energy resources in Jordan.

Table 11 presents the results of the evaluation. Going forward with the proposed project alternative is considered the best possible option as opposed to ‘No Project’ since the proposed project is considered a green and environmental solution for Solar Power in

Jordan as the solar energy considered as renewable clean technology with no emissions as well as the global and local trend for energy generation.

Table 11: Comparison of overall environmental and socio-economic impacts for the project Vs. 'no project' alternative

Environmental Components	Project Options	
	Proposed Project	No-Project Alternative
Terrestrial Ecology	S-	*
Air Quality	*	*
Noise Generation	*	*
Wastewater Generation	S-	*
Waste Generation / Disposal	S-	*
Soil & Groundwater	*	*
Health & Safety	s-	*
Socio-economic Impacts	S+	x
Traffic Disturbance	x	*
Land Use	S+	s-
Archaeology / Cultural Property	x	*
Energy Production	S+	s-
Employment and Job Opportunity	S+	s-

Notes:

X: Denotes potential for impact, which is not considered significant
S: Denotes Potential Significant Adverse Impact
S+: Denotes Significant Beneficial Impact
* : Denotes no change to the existing situation

8.2 Electricity Sources Alternatives

The energy demand in Jordan and in the world increasing rapidly, then in order to face this increasing Jordan government has been issued in December 2007 ''Updated Master Strategy of Energy Sector in Jordan for the period (2007-2020)'' which entitled as Energy Strategy 2020, The energy strategy expected that the demand increasing according to two scenarios: high and low scenario related to the increasing growth rate.

Figure 20 presents the demand scenarios in collaborate with the growth rate, in the following the description of these scenarios.

- The demand for primary energy for the year 2007 about 7858 thousand for the high demand scenario and 17108 thousand in the year 2020 i.e. an expected growth rate of 6.2% during the period (2007-2020);
- The demand for primary energy according to the low scenario in the year 2007 is about 7450 thousand to raise in the year 2020 to 13057 thousand at an annual growth rate of 4.5% for the period (2007-2020).

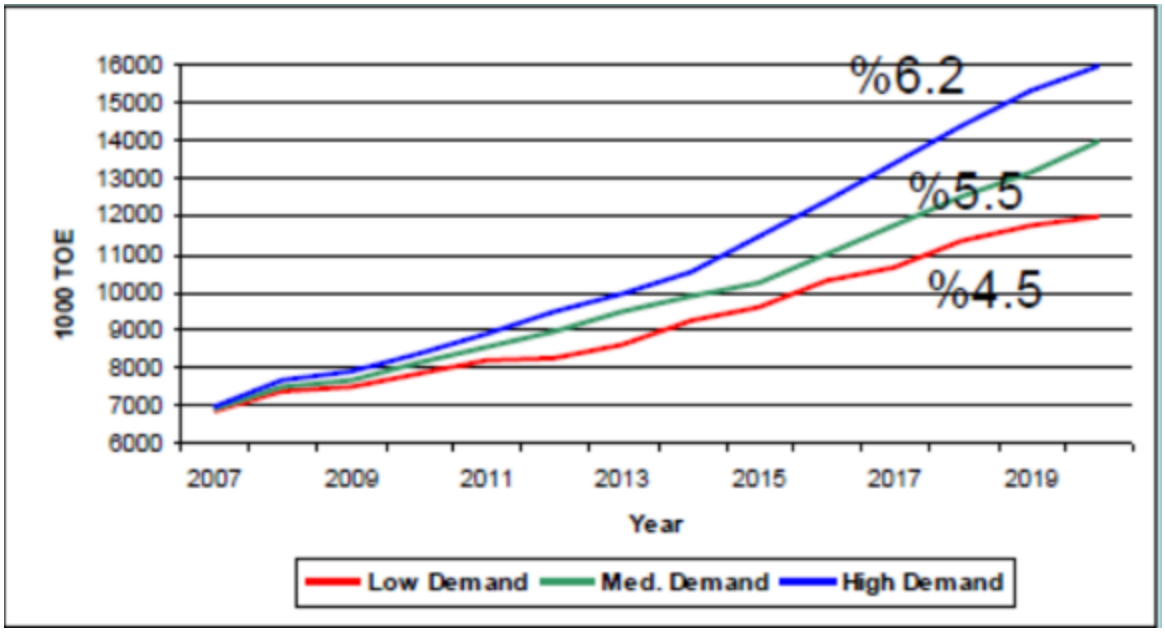
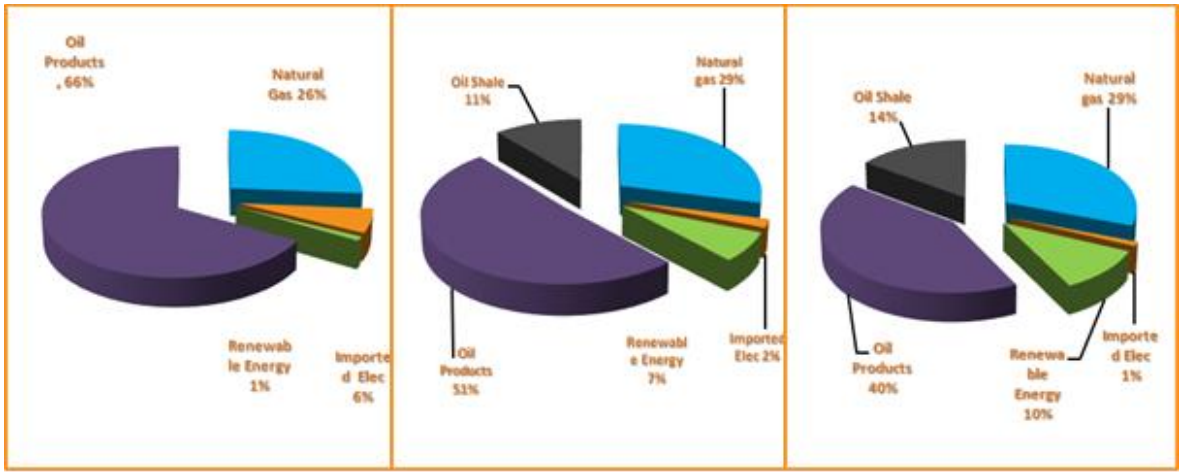


Figure 24: Energy demand increasing rates

The Energy strategy 2020 planning to increase the renewable energy as a clean technology for Solar Power to cover 10% of total demand, as well as increase the local energy resources share to 39% of the total demand as illustrated in **Figure 25** below

Figure 25: The Energy Strategy up to the Year 2020



As all above the demand increasing force the government to find additional energy resources and these resources could be conventional and renewable resources, so the using the solar energy is one of the preferable option with less impact than the conventional resources, furthermore, it is considered as green option for Jordan with high sunshine days and land availability, in the following the main reasons to use solar energy instead the conventional:

- Solar power is pollution-free during use;
- Production end-wastes and emissions are manageable using existing pollution controls;

- End-of-use recycling technologies are under development and policies are being produced that encourage recycling from producers;
- PV installations can operate for 100 years or even more [with little maintenance or intervention after their initial set-up;
- Grid-connected solar electricity can be used locally thus reducing transmission/distribution losses;
- Compared to fossil and nuclear energy sources, very little research money has been invested in the development of solar cells, so there is considerable room for improvement.; and
- High efficiency.

9 IMPACT ASSESSMENT

An impact assessment has been undertaken following the full characterization of the environmental, social and health baseline, and identification of all project aspects. The scope of the assessment covers all Project area and was undertaken in accordance with relevant MoEnv regulations and applicable local, national and international standards and guidelines.

9.1 Approach and Methodology

Initially, Project environmental, social and economic and health aspects were identified for the proposed activities. The activities were considered in terms of their potential to:

- Interact with the environment (physical, biological, socio-economic); and
- Breach the conditions of relevant national and international standards and guidelines or company policy.

The environmental, socio-economic and engineering information and data gathered, collated and reviewed during the baseline and aspect identification tasks were systematically developed to prepare matrices of key Project activities and environmental, social, health and economic receptors. This allowed for a preliminary assessment of the key environmental and socio-economic issues, or 'key issues' associated with the Project to be completed.

When assessing impacts the following were considered:

- Positive or negative impacts
- Impacts occurring directly or indirectly from Project activities
- Magnitude of impact
- Public health and safety risks
- Geographical extent of the effect
- Duration and frequency of the impact
- Sensitivities of the receiving environment over the entire project area
- Potential significance
- Residual impacts.

Figure 26 below illustrates the EIA process adopted during the EIA study phases.

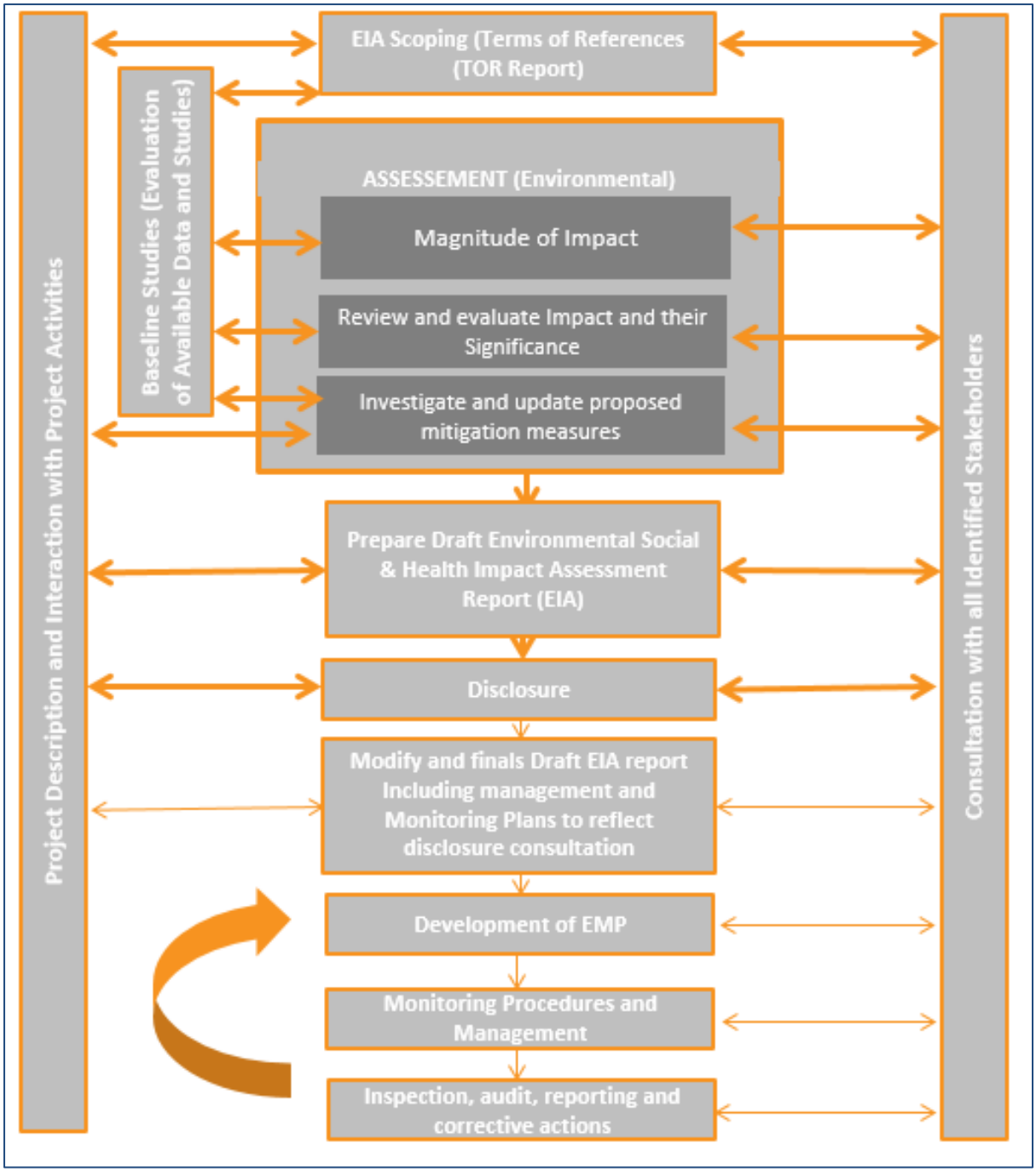


Figure 26: ESIA Process

As part of the assessment, the potential cumulative effects were considered, taking into account other developments (if any) in the local area.

Once all of the project environmental and socioeconomic impacts have been assessed, the significance of the impacts was ranked by considering the following elements:

- The consequence of identified events: the resulting effect (positive or negative) of an activity's interaction with legal, natural and/or socioeconomic environments; and
- Likelihood: the likelihood that an activity will occur.

Agreed criteria were defined for each level of consequence and each level of likelihood and the significance of the impact associated with each identified aspect is the product of the consequence and likelihood. It should be noted that the assessment has been conducted by considering the mitigation measures normally designed into / included in the project.

The following sections briefly describe the consequence, likelihood, and significance criteria.

9.1.1 Consequence

To assign a level of consequence to each environmental and social impact, criteria are defined for environmental and socio-economic consequence or severity. Legal issues are embedded in both criteria sets. The consequence categories and their ranking are presented in **Table 12**.

Table 12: Consequence Categories and Rankings

Consequence	Ranking	Description
Catastrophic	5	Massive effect – Persistent severe environmental damage or severe nuisance extending over a large area. In terms of commercial or recreational use or nature conservation, a major economic loss for the Company. Constant, high exceedance of statutory or prescribed limits, high profile community outrage.
Severe	4	Major effect – Severe environmental damage. The Company is required to take extensive measures to restore polluted or damaged environment to its original state. Extended breaches of statutory or prescribed limits, and serious community concern and complaints.
Critical	3	Localised effect – Limited discharges of known toxicity, considerable community concern and/or complaints. Repeated breaches of statuary or prescribed limit. Affecting neighbourhood. Spontaneous recovery of limited damage within one year.
Marginal	2	Minor effect – Contamination. Damage sufficiently large to damage the environment, some community concern raised. Single exceedance of statutory or prescribed criterion. No permanent effect on the environment.
Negligible	1	Slight effect – Local environmental damage. Within the fence and within systems. Negligible financial severity.
None	0	No impact
Positive	+	Beneficial impact – enhances the environment

It should be noted that it is often difficult to compare impacts consistently across different natural and socio-economic environments. When evaluating the environmental and socio-economic aspects, emphasis was placed on specific cause and effect relationships.

Scientific evidence as well as predictions based on observation of previous similar activities can and have been used in the impact assessment process. Where it has not been possible to fully quantify the effect that an activity may have on the environment or a component of the environment, or where there is a lack of scientific knowledge, qualitative judgment has been used. Such judgments is based on a full understanding of the project activities, and the team's knowledge of the environment, social structure and general health aspects of the region in which the project's activities will occur.

9.1.2 Likelihood

To assign likelihood to each activity, five categories are defined and ranked. The criteria for likelihood are shown in **Table 13**.

Table 13: Likelihood Categories and Rankings

Category	Ranking	Definition
Certain	5	The activity will occur under normal operating conditions
Very Likely	4	The activity is very likely to occur under normal operational conditions
Likely	3	The activity is likely to occur at some time under normal operating conditions
Unlikely	2	The activity is unlikely to but may occur at some time under normal operating conditions
Very Unlikely	1	The activity is very unlikely to occur under normal operating conditions but may occur in exceptional circumstances

9.1.3 Significance

The significance of the impact is expressed as the product of the consequence and likelihood of occurrence of the activity, expressed as follows:

Significance = Consequence x Likelihood

Figure 27 Illustrates all possible product results for the five consequence and likelihood categories.

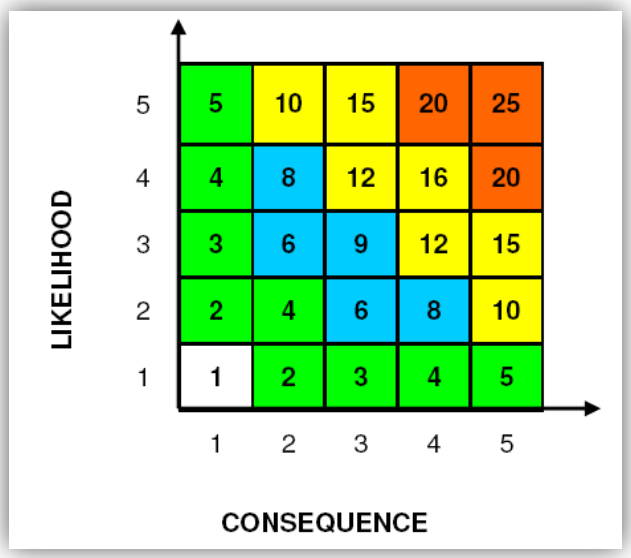


Figure 27: Product Results for Consequence & Likelihood Categories

Based on its consequence-likelihood score, each environmental aspect has been ranked into five categories by order of significance as illustrated in **Table 14**.

Table 14: Significance Categories

Ranking (Consequence X Likelihood)	Significance
>16	Critical
10-16	High
6-9	Medium
2-5	Low
<2	Negligible

To assist in determining and calculating the significance of an impact, impact assessment matrices has been developed based on the aspect identification exercise.

9.1.4 Residual Impact

Residual impacts are impacts that remain after mitigation measures, including those incorporated into the project's base case design in addition to those developed as part of the base design.

The residual impacts assessment identifies which project activities are likely to result in a semi-permanent to permanent change in the natural (i.e. physical, biological) and/or socio-economic environments. The significance of this change has also been assessed.

9.2 Potential Environmental and Social Impact Assessment

This section identifies and, where appropriate, quantifies the primary biophysical effects expected to result from construction, operation and retrofit/decommissioning of the PV Power Plant.

Every identified aspect was assessed in terms of its potential to cause an impact on natural and/or socio-economic receptors and was subsequently ranked in terms of consequence and likelihood, thus enabling the determination of the overall significance of the impact.

In general, PV power plants have recently proved to be sustainable and safe around the world, given that they do not cause the release of air pollutants or global warming emissions, and are considered economically viable.

This section will address the potential environmental and social impacts specific to this project.

The section is structured according to the main issues and effects resulting from the proposed project activities across the following project phases:

- **Construction Phase:** This involves all activities for the construction of the PV power plant.
- **Operation Phase:** This refers to the PV power plant operation processes.
- **Retrofit or Decommissioning Phase:** Following the operation phase, determination as to whether the facility can be retrofitted i.e. upgraded and addition of new technology will be determined. If retrofitting did not turn out to be feasible, then decommissioning activity will take place. Decommissioning activities are anticipated to be similar to construction; therefore, the potential impacts are anticipated to be relatively similar.

9.2.1 Physical Environment

9.2.1.1 Air Quality

Construction Phase

The main impacts associated with construction activities will be:

1) **Dust generation:** resulting from earthworks such as leveling, grading, excavation works and movement of vehicles across dirt/unpaved roads, especially during windy conditions. The contractor shall be committed to control emitted dust from such operations through the proposed dust emission control procedures described in the environmental and social management plan (ESMP) included in this report.

2) **Exhaust emissions:** Exhaust emissions of SO_2, NO_x, CO, CO_2, and PM_{10} will be attributed predominantly to the operation of the construction plant and road vehicles such as movement of trucks and vehicles during construction works. These emissions

will be limited to the project area and are anticipated to be generated in small concentrations and dispersed rapidly within the area leading to an impact of low significance. This means that these effects are localized and temporary which implies that any deterioration in air quality at project location is unlikely to be significant and is expected to be transient.

Based on the above, local degradation of the ambient air quality during construction is considered to be with a likelihood of **likely (3)** and **negligible (1)** Consequence with an overall **low (3)** Impact significance.

Operation Phase

No emissions are expected to be released during the operation phase, due to the fact that solar PV power plants do not release greenhouse gases or any toxic pollutants during their operation, as a result, no impacts on ambient air quality are anticipated during the operation phase.

It is worth mentioning that solar PV power plants have very low air emissions of air pollutants such as sulfur dioxide, nitrogen oxides, carbon monoxide, volatile organic compounds, and the greenhouse gas carbon dioxide during operations compared to fossil fuel power generation facilities, since solar power plants do not involve combustion processes. Therefore, this impact is considered **negligible (1).**

Decommissioning Phase

Similar to construction, the decommissioning phase is anticipated to generate dust and exhaust emissions. Decommissioning activities will involve site preparation, dismantling and disassembling of the components of the solar power plant facility, clearance of the site, and rehabilitation if needed.

Similarly, local degradation of air quality is expected on a limited and temporary level. As a result, the impact is considered **likely (3),** with a **negligible (1)** given the temporary nature of decommissioning, yielding an overall **low (3)** impact significance.

9.2.1.2 Green House Gas Emissions

Operation Phase

Life Cycle Assessments (LCA) and Green House Gas emission inventories are conducted to better understand a project's environmental burden from "cradle to grave' and also to aid in comparison between different energy technologies (for example, PV plant compared to traditional coal fired power plant). The LCA looks at the Green House Gas (GHG) emissions associated with every step of the PV project's lifecycle including the upstream (manufacturing) processes, operational processes during the life of the project and downstream processes including system decommissioning and disposal. This cradle-to-grave (and sometimes cradle-to-cradle when certain components are reused) approach is illustrated in the figure below generated by the International Energy Agency (IEA, 2011).

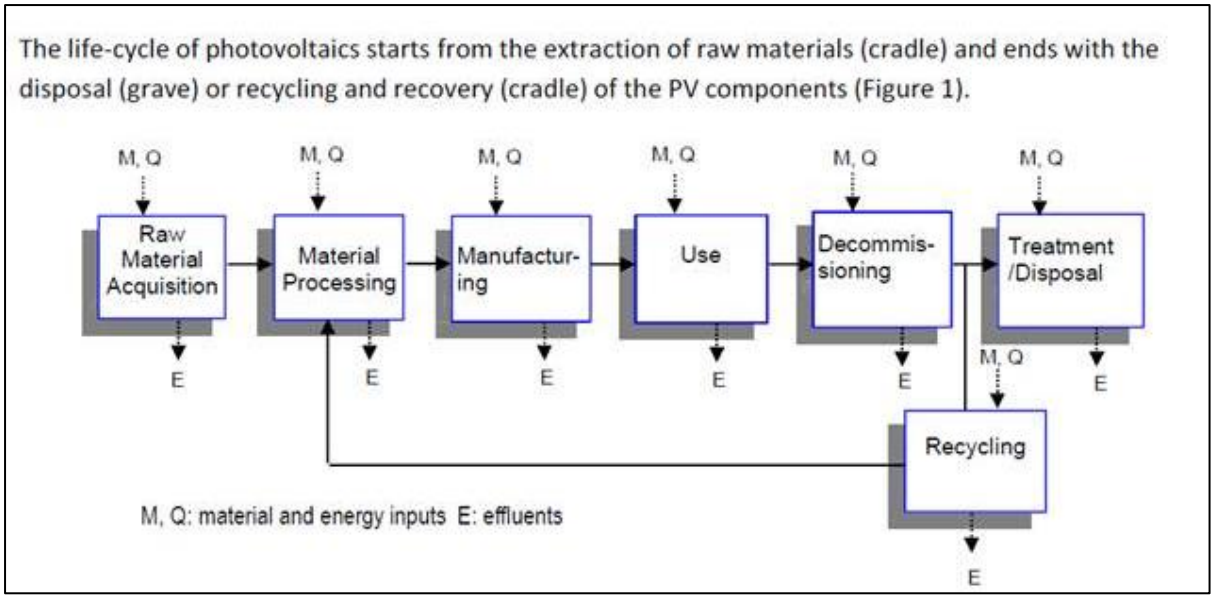


Figure 28: Material and energy inputs / outputs during the PV project lifecycle from cradle to grave (or cradle) (IEA.2011)

Based on a desktop review of relevant sources by renowned international organizations like the International Energy Agency (IEA, 2011) and the US based National Renewable Energy Laboratory (NREL, 2012), benchmarks for lifecycle GHG emissions for PV technology are presented in this section. In both cases, the lifecycle GHG emissions for PV projects have been generated based on the following information and assumptions:

- Analysis of the lifecycle emissions for the most widely used PV systems including Crystalline Silicone (c-Si) (both mono and multi-crystalline) and Thin Film (TF) (however for thin film there is less available robust data globally).
- The analysis includes all stages of the upstream process: material extraction, materiel production, module manufacture (input / output energy and materials during manufacturing of cell, wafer, module, and balance-of-system), System/plant component manufacture, installation/plant construction.
- This is followed by GHG analysis duration operation activities which include power generation and system/plant operation and maintenance
- Finally the LCA considers emissions during system/plant decommissioning, disposal and recycling –where applicable.
- The NREL has conducted a Harmonization Project (2012) based on the outcomes of hundreds of published LCA studies over the past 30 years, where the following parameters and assumptions were harmonized to provide accurate and transparent estimates for GHG emissions from PV systems. These are:
    - Solar Irradiation 1700-2400 kwh/m2/yr
    - System lifetime at 30 years
    - Crystalline Module Efficiency at 14% and 13.2% respectively for mono and multi-crystalline modules , respectively
    - Performance ration of 0.8 for ground-mounted systems

Based on the above, the GHG emissions from PV systems has been found to be about **40 g CO_2eq/kwh** compared to 1000 g CO_2eq/kwh for traditional coal fired electric power plants as illustrated below.

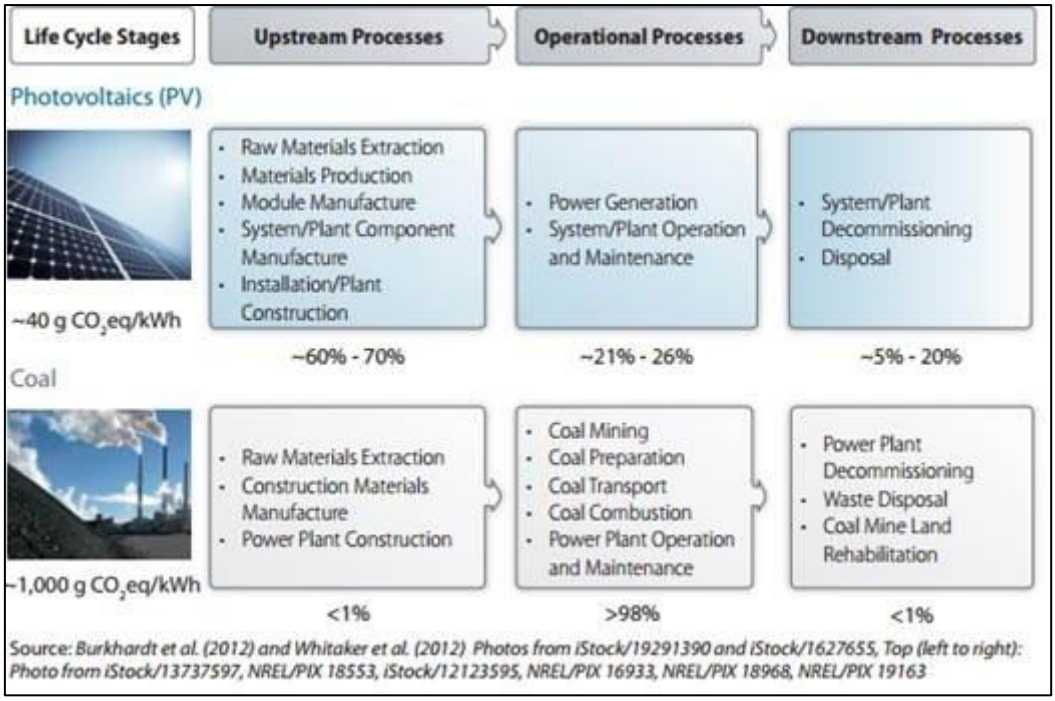


Figure 29: Lifecycle GHG emissions for PV systems compared to coal fired electric power plants

It is important to note that most of the emissions associated with PV systems are attributed to the material and energy intensive upstream process including extraction and manufacturing. Operational emissions account for 20% of the PV system's lifecycle GHG emissions however this number could even be lower for a country like Jordan where the solar irradiation would be higher than the assumed 1700 kwh/m^2/yr reaching up to 2300 kwh/m^2/yr in the project area near Mafraq as can be seen in the figure below.

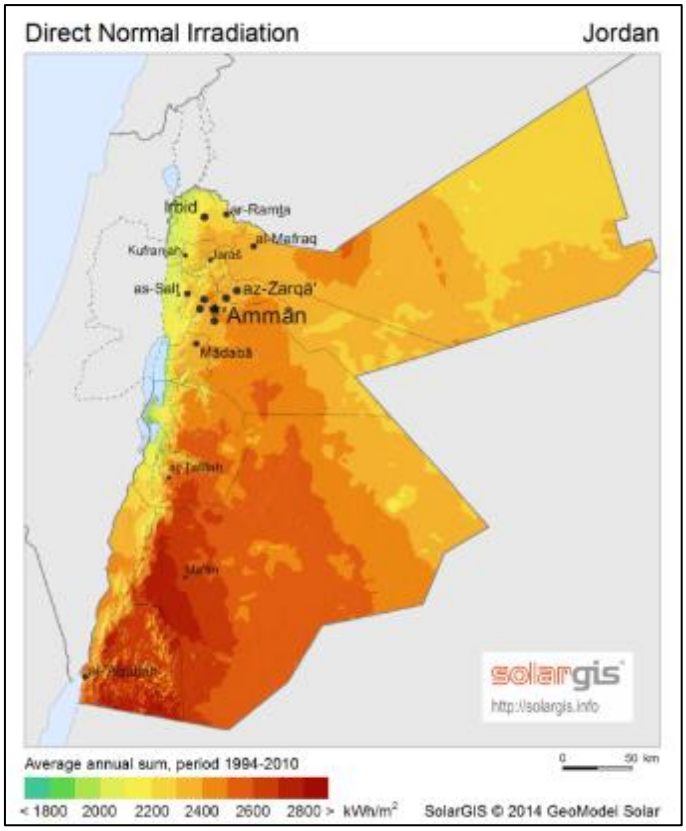


Figure 30: Jordan solar irradiation map in (kwh/m2/yr) (Source: solargis)

Similarly, the study prepared by the IEA (2011) reflects a similar but slightly lower range of GHG emissions for the key PV technologies at about 30 g CO_2eq/kwh, as illustrated below. However the variation may be attributed to the fact that the figure below is based on roof-mounted PV systems where the BOS (Balance of System including module support, cabling and power conditioning) may differ for ground mounted PV, which is the case for our project. In addition, these studies do not specifically differentiate between the GHG LCA for tracking vs non-tracking systems, where there may be a slightly higher operational GHG emissions for tracking systems as is the case for the project at hand.

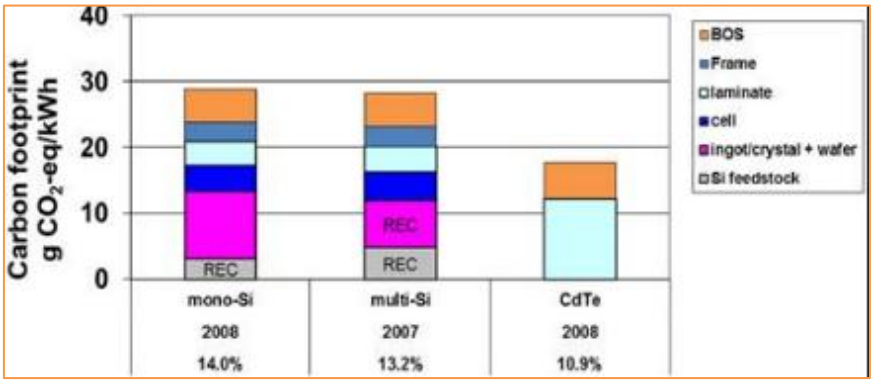


Figure 31: Carbon foot print of crystalline and thin-film roof mounted PV systems (IEA, 2011)

In addition, the IFC for its own investment purposes assumes the following conservative default emissions factors for the non-operational aspects of renewable energy projects which

included GHG emissions during production, transportation, installation, disposal and leakage beyond the project boundary). These are summarized in the table below:

Renewable Energy Type	tCO2e/MW
Wind	16.80
PV Solar	29.20
Hydro (Small/ Run-of-River)	24.18
Biomass	34.96

Figure 32: IFC Renewable Energy Emission Factors

Based on the above, for this 50 MW project, **1460 ton equivalent of CO_2 (tCO_2e)/yr** are expected from "other emissions" (as opposed to operational emissions) over the lifetime of the project (IFC, 2011).

Generally speaking, however, renewable energy systems including PV power plants are considered to be climate change mitigation projects in the sense that their deployment results in an overall reduction of GHG emissions, as they tend to replace more carbon-intensive technologies like the coal or heavy-fuel fired electric power plants. This is the case in Jordan where grid-connected PV systems result in offsetting electrical power that is otherwise produced by fuel powered electric power plant. The latest Carbon Emissions Estimation Tool (CEET) issued by the IFC in 2014 indicates the following emission factor for a kwh of electricity produced the grid in Jordan:

637.42 g CO_2eq/kwh, compared to the 40 g CO_2eq/kwh associated with the PV lifecycle GHG emission mentioned above roughly shows the reduction potential of such projects.

This mitigation dimension of PV projects is captured by parameters like the Energy Payback Time (EPBT), which is defined by the IEA as "the period for a renewable energy system to generate he same amount of energy (in terms of primary energy equivalent) that was used to produce the system itself", which is captured by the following equation

$$\text{Energy Payback Time (EPBT)} = (E_{mat}+E_{manuf}+E_{trans}+E_{inst}+E_{EOL}) / ((E_{agen} / \eta_G) - E_{aoper})$$

where,

E_{mat} : Primary energy demand to produce materials comprising PV system

E_{manuf} : Primary energy demand to manufacture PV system

E_{trans} : Primary energy demand to transport materials used during the life cycle

E_{inst} : Primary energy demand to install the system

E_{EOL} : Primary energy demand for end-of-life management

E_{agen} : Annual electricity generation

E_{aoper} : Annual energy demand for operation and maintenance in primary energy terms

η_G : Grid efficiency, the average primary energy to electricity conversion efficiency at the demand side

Applying the above equation to the common PV systems, the IEA study indicates an average EPBT of around 1.5 years for these projects. This number is likely to be lower for this project considering that higher efficiency modules that will be used. Therefore, the impact likelihood is very unlikely (1), with a negligible (1) consequence, yielding an overall **negligible (<2)** impact significance.

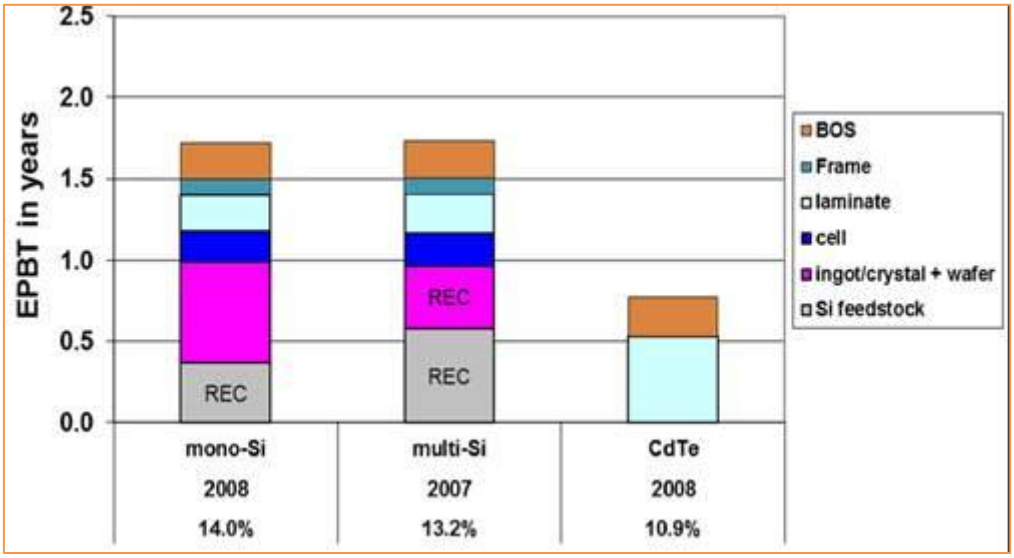


Figure 33: Energy payback time (EPBT) for PV technologies (Source: IEA,2011)

9.2.1.3 Noise

Construction Phase

Construction activities for the PV power plant will contribute to noise impacts. There are several noise generating activities such as earthworks, haulage activities, excavation, backfilling, and installation of PV panels, and other equipment within the facility in addition to noise sources generated from machinery and equipment on site.

The closest communities/activities to the project area are shown in Figure 17 of the baseline section above. And the closest community/village is 1 km away from the project site.

Hence, it can be considered that the only people who could potentially be impacted by the noise are the employees working within the project site; these increased noise levels are considered occupational noises that require occupational health and safety measures. In addition to this, some reptiles and mammals, within the project area can potentially be driven away from the site due to the sound levels. Furthermore, the project area is considered to be in an industrial area dedicated to solar projects given that it falls within KHBTDA as classified by Mafraq Development Corporation.

However, these noise impacts are not considered to significantly harm animals nor cause impacts on a population level.

Since the activities will occur under normal operating conditions and are expected to have only localized and temporary effects within the project area, the impact likelihood is **very likely (4)** with a **negligible (1)** consequence, thus the impact significance is **low (4**).

Operation Phase

The PV power plant as a facility is not considered to exhibit any significant noisy operations, although the facility's inverters and transformers may produce some sound, but this is not considered a serious issue, since they will not generate any noise. In addition, there will be no close by sensitive receptors such as labor camps or residential dwellings within the project site.

In addition, noise generated from inverters is only heard when distance is close (i.e. within 1-2 m, however, as distance increases, noise will be greatly reduced, not to mention that they do not generate noise during night time.

As a result, the impact is very unlikely (1), with a negligible (1) consequence, thus, the overall significance is **negligible (<2).** Therefore, no mitigation measures are needed.

Decommissioning Phase

The decommissioning activities of dismantling the PV power plant and removing the ancillary facilities are associated with potential increased noise levels.

However, as the only receptors will be the workers at the site and within the proposed facilities within the vicinity of the PV power plant, these increased noise levels are considered occupational noises that require occupational health and safety measures. For any potential receptors other than the workers, the impact likelihood is **likely (3),** with a **negligible (1)** consequence, thus it is of **low (3)** significance since it is considered to be temporary.

9.2.1.4 Soil

Construction Phase

Construction activities are not expected to result in significant soil loss; however excavation, leveling and other earthworks may disturb the soil due to the removal of top soil, which could trigger soil erosion process.

The other source of impact to soil is waste generation from construction material, accidental leakage of fuel, oil, or chemicals stored within a bunded area causing direct contamination to soil which may degrade lower layers of soil depending on the amount of spills.

Assuming that spill response plans shall be in place by the contractor, it is anticipated that impacts to soil resulting from these activities will be **likely (3),** with a **marginal (2)** consequence, yielding a **medium (6**) impact significance.

Operation Phase

Soil impacts during operation phase are limited to accidental spillage of lubricant, fuel and other chemicals that may potentially cause soil degradation. However, since the project area is classified as an industrial area by Mafraq Development Area, it does not have significant agricultural potential.

Through implanting spill response procedures, and proper storage and handling of any chemicals on site, the impact probability will be reduced.

Therefore, this impact is **unlikely (2**), with a **marginal (2)** consequence, yielding an overall **low (2)** impact significance.

Decommissioning Phase

During the decommissioning phase, the decommissioning activities are anticipated to have an impact of medium significance to soil. This is due to possible accidental leakage of fuel, oil, or chemicals during demolition activities. Therefore, proper environmental protection measures should be followed to prevent or control the occurrence of such incidences.

The impact likelihood is **likely (3),** with a **marginal (2**) consequence, the impact assessment is considered to be **medium (6).**

9.2.1.5 Visual Amenity

Construction Phase

The construction activities that are likely to create a visual intrusion and a disruption to aesthetics include: materials lay down, excavation, backfilling, and spoil.

The project site consists of areas that are sparsely vegetated or have no vegetative covers, and hence no trees or bushes will need to be removed as part of construction. Also, there are no close communities that would be within the visual radius of the project, the closest community is Zbaidiyah village located 1 km away. Therefore visual intrusions are anticipated to be limited to employees. Hence, the visual effects of the construction will be of low significance within the project area and largely limited to effect only employees living in the company's temporary camp facilities during construction (if any).

The impact likelihood is **likely (3),** with a **negligible (1)** consequence, the impact assessment is considered to be **low (3).**

Operation Phase

The presence of a large area of PV panels is not expected to constitute a risk for glare since the project developer i.e. FRV has obtained an approval from the nearby military air force airport, and the airport itself plans to install PV panels for internal use. Also no nearby residential dwellings are present. The potential visual disturbance to birds is not expected given the fact the closes IBA (Mafraq IBA) is located are far from the project area (around 11 km away), and as a result, there is no migratory bird flyway over the project area.

The project area is not anticipated that visual impacts are generated due to the PV system design, which is designed to include dark, light-absorbing materials and covered with a multi-layer anti-reflection coating for glass surfaces, which reduces the sun's reflection from PV panels. This technology minimizes glare, traps more light, which gives the PV system a characteristic of being primarily absorptive, making them suitable to be installed at airports.

It is essential to point out that the intensity of light reflected from a PV module surface depends on factors such as the amount of sunlight reaching the surface and will therefore

vary based on, among others, geographic location, time of year, cloud cover, and PV module orientation.

Based on the above assessment, visual impacts from the PV power plant is considered **unlikely (2)** given that PV panels have minimal reflectivity, with a **marginal (2)** consequence, thus an overall impact significance of **low (4).**

Decommissioning Phase

During the dismantling of the PV power plant, removal of ancillary facilities, and the rehabilitation of the project area (if needed), visual intrusions will be likely but their consequence will be negligible due to fact that such impact would be temporary (over a short period). Moreover, the actual dismantling of the PV power plant will reduce or remove the visual impacts witnessed during the operation phase.

Therefore, the impact likelihood is **very unlikely (1)** given that there will be remediation procedures on site, with a **negligible (1)** consequence, yielding an overall **negligible (<2)** impact.

9.2.1.6 Waste Management

Construction Phase

Improper management of non-hazardous and hazardous waste generated during construction may lead to impacts on soil, water, visual environment, in addition to health and safety of workers.

Non-hazardous waste includes paper, wood, plastic, scrap metals, glass and mud. Hazardous waste includes absorbent material, batteries, tires, metal drums, empty chemical containers, waste oil from machinery lubricants, etc.

All waste generated at the construction site will segregated, handled, stored and managed as per Contractor's Waste Management procedures. Domestic wastewater generated at site will be collected in septic tanks. These shall be transported to the nearest approved municipal wastewater treatment facility, and solid waste shall be disposed of in a secured area for trash.

The impact likelihood is **likely (3)** and consequence is **marginal (2),** therefore, the impact significance is assessed as **medium (6).**

Operation Phase

Waste generated during operation phase will be limited to wastewater from maintenance and cleaning activities in addition to domestic waste (due to workers domestic activities).

Also domestic wastewater generated at site will be collected in septic tanks. These shall be transported to the nearest approved municipal wastewater treatment facility.

Waste generation during the operation phase is considered part of daily operations, therefore, it is not considered to have any significant impacts to the environment or health of

personnel present on site given that the number of personnel on site during operations will be around 8 persons.

Therefore, the impact likelihood is assessed as **very unlikely (1),** with a **negligible (1)** consequence, yielding a **negligible (<2)** impact significance.

Decommissioning Phase

Waste generated during decommissioning limited to non-hazardous and inert wastes such as scrap metals, paper, wood, plastic, given that the contractor will adhere his waste management procedures.

Similar to the construction phase, potential generation of hazardous waste includes absorbent material, batteries, tires, metal drums, empty chemical containers, waste oil from machinery lubricants, etc.

It is not expected that hazardous wastes will be generated from dismantling the PV power plant since the project developer i.e. FRV is expected to evaluate the PV panels to determine whether it is suitable to extend their life, or return them the manufacturer for recycling or to be used in another project depending on their efficiency and feasibility.

Therefore, the impact of waste generation is considered **unlikely (2)**, with a consequence of **marginal (2)** during to this temporary phase, given that specific waste management procedures will be implemented on site, yielding an overall impact significance of **low (4).**

9.2.1.7 Water Resources

Surface Water

All Phases

As discussed in the baseline section, direct runoff from heavy rainfall is considered as the only source of water flowing in Wadis in the project area. According to the Engineering services study for the solar projects in King Hussein Bin Talal Development Area (KHBTDA), June 2014, the surface water flow is normal to occur in the KHBTDA area when the rainfall amount exceeding 8 mm during rainy days, while the maximum runoff in the KHBTDA area is calculated to be 0.025 MCM and the maximum flood flow for the catchment area of wadi Al- Zaatri is around 0.114 MCM.

In order to quantify the potential impact from surface water runoff and potential flood risk, it is recommended to conduct further hydrological analysis for the project area.

As a result the impact is considered **unlikely (2)** with a **critical (3)** consequence, yielding a **medium (6)** impact significance.

Groundwater

All Phases

The project activities during three phases: construction, operation, and decommissioning are not expected to impact the ground water since the water table level is deep.

The hydrological analysis conducted for the KHBTDA area concluded that no ground water exists in the area down to the depth of 400 m. For this reason KHBTDA is supplied by its water needs for the time being from the groundwater which occurs in Amman-Zarqa basin, which is located to the east of KHBTDA.

As a result, no groundwater contamination is expected from project activities.

The impact likelihood is assessed as **very unlikely (1),** with a **negligible (1)** consequence, yielding a **negligible (1)** impact significance.

9.2.1.8 Biological Environment

Construction Phase

The activities anticipated during the construction phase will include earthworks, excavations, grading, site leveling, asphalting, paving and the operation of construction machinery and equipment. However, according to the baseline description, the project area does not encompass natural systems, which means that no significant flora and fauna are present.

As a result, construction activities are not anticipated to pose any risks on the ecology of the vicinity of the project site.

However, it may cause temporary disturbance to resident birds with ground nests due to noise, dust and particulate emissions, and possible illegal hunting by construction workers. Moreover, reptiles present within the project site may temporarily move to adjacent locations during construction activities, however are expected to return back as construction is completed.

Due to the absence of terrestrial habitats within the Project area, no significant impact terrestrial ecology is expected, therefore it is assessed as **unlikely (2),** with a **marginal (2)** consequence, therefore, the impact significance is **low (4).**

Operation Phase

As discussed above, and given that the project area does not encompass any natural systems and is sparsely vegetated supporting low population sizes of desert dwellers.

The anticipated impacts on terrestrial ecology is considered low, however, activities such as vehicular movement, may cause disturbance to resident birds and their ground nests.

However this is considered minimal, as a result the impact likelihood is **unlikely (2)** with a **negligible (1)** consequence yielding **low (2)** impact significance.

Decommissioning Phase

The activities associated with decommissioning will involve dismantling of the PV power plant and removal its facilities.

This is a temporary phase that could result in some additional noise and dust disturbances. These activities are not anticipated to harm any flora elements due to absence or scarcity of vegetative cover within and around project area, provided dust suppression measures and other procedures are followed. On the other hand, decommissioning activities may cause disturbance to bird species similar to what was discussed during construction.

The impact likelihood is **unlikely (2)** with a marginal **consequence (2),** thus the impact significance is considered to be **low (4).**

9.2.1.9 Health and Safety

Construction Phase

The construction activities include site preparation, infrastructure utilities installation, building structures. As a result, will be potential impacts on workers' health and safety due to exposure to risks through construction activities that lead to accidents causing injuries and death. The most frequent risks causes of accidental death and injury are:

Safety risks such as: tripping; falling due to working at heights; potential fire due to hot work, smoking, failure in electrical installations; electric shocks.

Health risks: Injuries such as: lifting, lowering, pushing, pulling and carrying; temporary or hearing loss which usually comes from noise generated from machinery used for excavation or piling work and from compressors and concrete mixers etc.; heat stress and working during high temperatures; dermatitis that can arise from contact with substances that cause dermatitis such as wet cement, asphalt, solvents used in paints, glues or other surface coatings…etc.

Therefore, the Contractor, under the supervision of FRV, will be committed to ensure all health and safety measures are in place to prevent accidents and\or reduce the consequences of non-conformance events. The contractor shall ensure all prospect risks during construction phase are assessed and all prevention and mitigation measures are in place accordingly. The contractor shall ensure all workers during construction comply with safety producers through training, awareness and supervising. Moreover, the contactor shall provide all appropriate resources (Personal Protective Equipment) onsite to ensure providing first aid for personnel in case of occurrence emergencies.

It is worth noting that the Jordanian Labor Law No. 8 for the year 1996 and its amendments mentions that when an employee is stricken with one of the occupational diseases, disabilities or death due to working practices and a medical authority report is submitted stating the condition, the employer is then obliged to pay the compensation payment according to the law. Moreover, the provisions of the 'General Safety Code of Construction Projects Implementation', as part of the Jordanian National Building Law must be observed carefully by the assigned contractor, in addition to the fire protection code. The occurrence of occupational health and safety impacts such as death and serious injuries is considered irreversible and highly significant since human receptors are adversely affected.

Given the health and safety system and precautions that are expected to be applied by the contractor, the impact is considered to be **likely (3)** with a **critical (3)** consequence, yielding a **medium (9)** impact significance.

Operation Phase

During the operation phase, the risks will be quite limited due to nature of operation activities; the activities will be limited to guarding and on call and\or onsite technical support (Maintenance and cleaning). There will be potential impacts on personnel' health and safety during operation phase due to exposure to risks such as: Slipping and tripping, falling during working at height, handling wastewater, Fire…etc. As a result, the impact is considered **unlikely (2)** with a **marginal (2)** consequence, yielding a **low (4)** impact significance.

Therefore, the project developer shall ensure all risks from operation activities to be assessed and to establish specific work procedures for tasks during operation phase including all safety prevention and mitigation measures to avoid non-conformance events.

Decommissioning Phase

The decommissioning activities will include equipment dismantling and demolishing facilities at project site. As all project components will be recycled after decommissioning, the prospect risks from decommissioning phase will be limited to dismantling and demolishing activities including moving all recyclable components to their final destination. There will be potential impacts on workers' health and safety due to exposure to risks through decommissioning activities as following:

Safety risks such as: tripping; falling due to working at heights; potential fire due to hot work, smoking, failure in electrical installations; electric shocks.

Health risks: Injuries such as: lifting, lowering, pushing, pulling and carrying; temporary or hearing loss which usually comes from noise generated from machinery used for excavation or piling work and from compressors and concrete mixers etc.; heat stress and working during high temperatures; dermatitis that can arise from contact with substances that cause dermatitis such as wet cement, asphalt, solvents used in paints, glues or other surface coatings…etc.

As a result, the impact likelihood is **likely** (**3**) with **marginal** (**2**) Consequence, as a result, the impact is found to be **medium** (**6**) significance.

Therefore, FRV will be committed to ensure all health and safety measures are in place to prevent accidents and\or reduce the consequences of non-conformance events. The developer shall ensure all prospect risks during decommissioning phase are assessed and all prevention and mitigations measures are in place accordingly.

9.2.1.10 Socio-economics

Construction Phase

Employment Opportunities

Positive benefits of the project may arise from short-term job opportunities during construction which may reach up to 120 jobs. It is important that jobs to be targeted to the local people within Mafraq Governorate where feasible in order to maximize this impact. The impact is assessed as **positive (+).**

Traffic

During the Construction Phase traffic is expected to increase to a certain degree due to the nature of activities that will take place such as the transport of equipment and materials to and from the site through the surrounding road network. Additional traffic load will be evident at certain times during the day, especially if there are slow moving heavy vehicles transporting material to and from the site.

Vehicle traffic can cause congestion on road networks around and within the site and thereby leading to potential accidents.

The above potential traffic impacts can possibly occur during the duration of construction, especially during working hours. However, this is considered a short-term impact. This impact is likely to happen but is not anticipated to cause any permanent effect on the receiving environment. Hence, the impact is **likely (3),** with a **marginal (2)** consequence, as a result, the impact is found to be of **medium (6)** significance.

Potential Implications on Local Community Groups

The project area is located within the KHBTDA managed by Mafraq Development Corporation (MDC), as a result it is government owned land and will be rented to investing companies to provide renewable energy projects, in this case FRV. As mentioned in the baseline section, the study team identified some herders within the project area and surroundings.

The potential impacts that are expected to be caused by the project on the herders are discussed below through the Involuntary Resettlement Categories discussed under IFC PS5 (Land Acquisition and Involuntary Resettlement). The potential impacts can be grouped into two main categories:

Category 1: Physical Displacement

This impact is not expected as there are no permanent resident herders within the project site over the year. The herders come to the project site and surroundings to utilize the cultivated forage lands for the duration between May to August.

Category 2: Economic Displacement

- **Loss of Assets:** As mentioned in the baseline section, cultivated forage lands are considered as the only available asset within project site. However, based on the

interview with the MDC representative, it was confirmed that the herders utilize the cultivated areas occasionally for seasonal grazing. Also, similar lands suitable for such seasonal cultivation for grazing is available outside the boundary of the KHBTDA. Therefore, it is not expected to have the impact of loss of assets as a result of the project.

- **Loss of access to assets:** The plot allocated for the project will span over limited number of land parcels. Therefore, the project will not cause any restrictions to move within or reach nearby lands. So the expected impact of loss access to assets caused by the project is not expected.

- **Loss of income sources or means of livelihood:** This is not expected to have any impacts from the project on the herders within project site and surroundings as there are no economic income obtained by them from the project land.

Also, the closest community/village to the project area is Zbaidiyah village and is located 1 km away; therefore the project is not expected to cause any serious impacts to such communities.

As a result, the impacts are considered **unlikely (2)** with a **negligible (1)** consequence, yielding a **low (2)** impact.

Operation Phase

Employment Opportunities

The long-term operation of the PV power plant will provide specialized employment and training for a small local workforce (approximately 8 people) to be hired as part of FRV's operator's team. However, these opportunities are assumed to be limited in number and require people with certain technical qualifications. The impact significance is assessed as **positive (+).**

Traffic

Impacts from traffic are not expected to occur during the operation phase due to minimal number of personnel present within the project site. Therefore, increased traffic load is not considered a significant impact. As a result, the impact is **very unlikely (1),** with a **marginal (2)** consequence, yielding an overall **low (3)** impact significance.

Economy and Society

Solar projects in Jordan are expected to improve Jordan's economy as more investors are attracted to Mafraq to establish clean energy projects, this will consequently provide electricity for the sectored communities within the northern parts of Jordan.

The solar projects will also lead to upgrading the economic status of the local community in addition to potential increase in land prices and improvement in welfare conditions in the long run. This project is anticipated to have benefits to society since it will contribute to skill

transfer, and will provide a clean and pollution free energy, as a result, improved public health.

Therefore, this impact is considered to be **Positive (+).**

Decommissioning

Employment Opportunities

Short-term job opportunities may be arise during decommissioning, however, this can negatively impact permanent personnel at the PV power plant since the facility will cease its operations, therefore permanent staff may lose their jobs.

Although this impact is **very unlikely (1)** given that fact that an upgrade is expected for the facility during its post –design life**,** however, the consequence is considered **critical (3)** to permanent personnel if the facility underwent decommissioning, yielding a **low (3)** impact significance.

Traffic

The anticipated impacts during decommissioning are similar to those for the construction phase, where the heavy machinery that transports disassembled parts of the project PV power plant facility might be of more significance than normal vehicles and pickups.

Proper management actions with adequate mitigations can reduce significantly such anticipated impacts.

The impact likelihood is **likely (3),** with a **marginal (2)** consequence, thus the significance of the impact is considered to be **Medium (6).**

9.2.1.11 Archaeology and Cultural Resources

Construction & Decommissioning Phases

The field visits conducted at the project site and published studies determined that there are no evident archaeological and cultural heritage sites within the project area.

Although it is very unlikely that undiscovered archaeological remains are present, the consequence of finding such remains will be minor if construction was coupled with effective monitoring and early coordination with the Jordanian Department of Antiquities. It is concluded that there is no anticipated impact from construction or decommissioning on these receptors; therefore the impact assessment process for this receptor has yielded the low significance.

The chance find site impact likelihood is **very unlikely (1),** with a **Critical (3)** consequence if archaeological remains happen to be discovered, therefore, the overall impact assessment is considered to be **low (3).**

10 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The project developer i.e. FRV is committed to achieving and maintaining environmental standards, such that Jordanian environmental regulations and IFC performance standards are met, and potential adverse environmental impacts resulting from the project activities are minimized as practicably as possible. This will be achieved through appropriate project planning and methods of Project operation.

Implementation of on-going environmental monitoring programs will enable the assessment and modification, if required, of the Environmental Management program.

10.1 Objectives

This Environmental and Social Management Plan (ESMP) aims at ensuring the application of the mitigation and monitoring measures needed to reduce and control the various environmental and social impacts associated with the implementation of the proposed project.

The key objectives of the ESMP are summarized below:

- Minimizing any adverse environmental, social and health impacts resulting from the project activities;
- Conducting all project activities in accordance with relevant Jordanian Legislation and applicable IFC guidelines.
- Implementation of on-going environmental monitoring programs;
- Periodic review of the Environmental Management programs to allow for iterative improvement;
- Ensure that all stakeholder concerns are addressed.

Overall, this ESMP aims at ensuring the application of the mitigation and monitoring measures needed to reduce and control the various environmental and social impacts associated with the implementation of the proposed project as presented in **Tables 15** and **16**.

10.2 Mitigation and Monitoring

Further to the impacts assessed in the previous chapter, this section presents more detailed mitigation measures and monitoring requirements (included in the following tables) that correspond to the impacts examined in the previous section, thus exploring them in more detail.

Mitigation measures aim to offset any negative impacts that may result from the project, and monitoring is the process of measuring the success of mitigation measures in order to assess their effectiveness. Reporting is the process of measuring actual performance or how well the mitigation measures have been implemented, including the format, timing and responsibility for reporting of the monitoring results.

Although the ESIA process did not reveal any high significant impacts (highest was found to be medium), this section provides measures that further reduce those impacts considered to be medium as well as those considered to be low.

Table 15: Environmental and Social Management Plan during Construction Phase

Aspect	Key Potential Impact	Mitigation Measures	Monitoring Requirements	Frequency	Reporting	Performance Indicator	Responsibility
Physical Environment							
Air Quality	Dust generation due to construction activities	• Setting an appropriate site speed limit to reduce dust generation from vehicles travelling over unmade surfaces. • During construction dust generated on unpaved roadways and work areas should be controlled by the application of water on an "as needs" basis. • Unnecessary handling of dusty materials will be avoided such as minimising drop heights when loaders dump soils into trucks. • Train workers to handle construction materials and debris during construction to reduce fugitive emissions. • Cover trucks when transferring fine and dusty materials outside the project location	Visual monitoring of dust emissions during earthworks and construction activities	Daily	Contractor shall prepare and submit a report to FRV in case of compliants	No visible dust plumes originating from construction sites.	Contractor
	Exhaust emissions due to operation of construction plant and machinery	• Ensure adequate maintenance and inspection of vehicles to minimize exhaust emissions. Not running engines for longer than is necessary.	Visual monitoring of exhaust emissions during earthworks and construction activities	Daily	N/A	Regular vehicle maintenance records	Contractor
Noise	Increased noise levels during to constrcution &machinery	• The contractor shall use heavy equipment, machinery, and fuels in compliance with national regulations. The contractor shall perform regular maintenance on all equipment, vehicle and machinery to prevent noise emissions. • The contractor shall limit idling of engines when not in use	Noise measurements to be undertaken during construction activities, at the site in	Every 6 months, and after receiving any com-plaints from workers or	To FRV in case of any exceedance	Compliance with MoEnv and National guideline limits for environm	Contractor

Aspect	Key Potential Impact	Mitigation Measures	Monitoring Requirements	Frequency	Reporting	Performance Indicator	Responsibility
		to reduce its contribution to noise emissions.	order to demonstrate compliance with the National environmental noise guidelines using a portable noise meter.	third parties.		ental noise at sensitive receptors:	
Soil	Soil disturbance due to removal of top soil, potential accidental spillage	• A spill prevention and response plan shall be prepared by the contractor in order to control any inadvertent leakage or spillage. Spill response measures shall be implemented (as necessary) to contain and clean up any contaminated soil. • Construction of bunds around relevant work and storage areas. Bunds in areas of hazardous chemical storage (including temporary storage) should be lined to contain accidental spillage and minimize the potential for migration to the underlying soil. • Any spilled chemical shall be immediately collected and disposed of in accordance with Spill Prevention and Response Plan and MSDS. • Contractor shall ensure that a spill kit and adequate PPE is available at the site for emergency cleanup activities in case of chemical/oil spillage. • To control soil erosion surface run-off should be collected from all paved working areas into retention ditches to restrict concentration of flows	Visual Inspection of storage area, and machinery through conducting regular audits of on-site activities and incident reporting forms. All site workers to be trained in spill response procedures.	Weekly	All unplanned incidents/accidents must be recorded by the contractor.	Number of spills or incidents to be recorded during on-site audits. Training records of personnel trained in spill response procedures must be filed	Contractor
Visual	Visual impacts	• The contractor shall ensure general cleanliness and good	Visual	Daily	N/A	Good	Contractor

Aspect	Key Potential Impact	Mitigation Measures	Monitoring Requirements	Frequency	Reporting	Performance Indicator	Responsibility
Amenity	from construction activities such as materials lay down, excavation, backfilling	housekeeping practice at the project site at all times.	inspection of general housekeeping and cleanliness at site in addi-tion to waste manage-ment on site.			housekee p-ing and tidiness of work areas within the project site. The fill material is maintaine d in a clean and tidy manner.	
Waste Generatio n	Improper management and handling of hazardous and non-hazardous waste during construction.	• The contractor shall segregate storage for different types of wastes, such as hazardous, non-hazardous recyclable construction material, plastic, paper, etc. to facilitate proper disposal. • The contractor shall provide a separate storage area for hazardous materials. The hazardous materials/products must be labeled with proper identification of its hazardous properties. • Chemical waste shall be stored in accordance with the provisions of Material Safety Data Sheets (MSDS). The contractor shall keep MSDS onsite. • Contractor shall provide trash bins within each construction site so as to prevent littering in the project area and surrounding areas. • The contractor shall establish regular intervals for waste	Visual monitoring of site cleanliness and proper storage and handling of hazardous waste and sewage. Inspect that segregated waste disposal or	Daily	Contractor shall prepare and submit monthly report to Project Developer.	Complian ce with waste manage ment procedur es. Current and complete records of regular waste pickup	Contractor

Aspect	Key Potential Impact	Mitigation Measures	Monitoring Requirements	Frequency	Reporting	Performance Indicator	Responsibility
		collection and disposal as per contractor's waste management procedures. • The sanitary and organic wastes shall be collected in a septic tankto be installed on siteand disposedoffregularly.	storage areas are clearly marked.			and disposal.	
Water Resources	Potential surface water runoff / potential flood risks.	To minimize risks from high rainfall and potential flooding the following measures might be necessary: • Study the existing wadi path within the plot and the surface water runoff from road culvert(s) (if any) in order to construct the suitable hydraulic structure within the plot such as channels and/ or culverts to reach the adjacent wadi in order to assess the floor risk. • Installation of application structures and road protection such as gabions, stone ''rip-rap'' or benching.	Follow-up with Ministry of Water and Irrigation and MDC (if needed)	During rainy seasons	To FRV in case of high precipitation events.	N/A	Contractor in collaboration with FRV
Biological Environment							
Ecology	Potential disturbance to resident birds	• Minimize open spaces on site that migratory birds may land in. • Minimize human and vehicular contact with fauna, including their burrows / nests and feeding grounds. • Waste shall be stored on site within closed container, especially food remnants to avoid attracting birds on site.	Visual inspection within project site.	During migration season (in spring and autumn)	N/A	N/A	Contractor
Health and Safety							
Health and Safety risks	Potential of exposure to safety events such as tripping,	• All construction equipment used for the execution of the project works shall be fit for purpose and carry valid inspection certificates and insurance requirements. • Risk assessment shall be prepared and communicated prior to commencement of work for all types of work	Visual inspection by user before each activity Routine	Prior activity Monthly	Contrctors shall prepare and submit monthly	Total Recordable Incidence Rate(TRIR)	Contractor and FRV

Aspect	Key Potential Impact	Mitigation Measures	Monitoring Requirements	Frequency	Reporting	Performance Indicator	Responsibility
	working at height activities, fire from hot works, smoking, failure in electrical installations, mobile plant and vehicles, and electrical shocks	activities on site. • Provide walkways that are clearly designated as a walkway; all walkways shall be provided with good conditions underfoot; signposted and with adequate lighting. • Signpost any slippery areas, ensure proper footwear with a good grip is worn for personnel working within slippery areas. • As far as reasonably practical, use cordless tools that may not need to use cables. Where cables for temporary lighting or mains-powered tools will be used, all cables shall be run through designated corridors. • Avoid work at height where it reasonably practicable to do so, e.g. by assembly at ground level. • Prevent any person falling a distance liable to cause personal injury e.g. by using a scaffold platform with double guard-rail and toe boards; • Arrest a fall with equipment to minimise the distance and consequences of a fall, e.g. safety nets, where work at height cannot be avoided or the fall prevented. • Carry out fire risk assessment for the construction areas, identify sources of fuel and ignition and establish general fire precautions including, means of escape, warning and fighting fire. • Set up a system to alert workers on site. This may be temporary or permanent mains operated fire alarm. • Fire extinguishers should be located at identified fire points around the site. The extinguishers shall be appropriate to the nature of the potential fire.	Inspection of Equipment and tools used during working at height activities Maintain proper housekeeping for the project site Routine Facilities' and site Inspection Vehicles and mobile plants inspection Preventive maintenance and patrol inspections for all vehicles and mobile plant Monitor work areas and	Continuously Monthly Pre-Use Monthly Continuously	report to FRV	Lost Time Incidence Frequency Fatal Accident Rate Number of safety training performed Number of non-conformance events. Reports.	

Aspect	Key Potential Impact	Mitigation Measures	Monitoring Requirements	Frequency	Reporting	Performance Indicator	Responsibility
		• Establish and communicate emergency response plan (ERP) with all parties, the ERP to consider such things as specific foreseeable emergency situations, organizational roles and authorities, responsibilities and expertise, emergency response and evacuation procedure, in addition to training for personnel and drills to test the plan • Ensure all plant machines and vehicles are regularly inspected, serviced and maintained; ensure all staff assigned is trained and competent to operate plant machines and vehicles. • Ensure all routes are suitable and wide enough for the vehicles, routes should be planned by minimise bends/junctions, steep gradients and the need for reversing, clearly designate areas for pedestrian walkways and crossing points. • Ensure clear signages are in place, such as Warning of speed limits, obstructions, allowable widths/heights...etc. • Electrical equipment must be safe and properly maintained; works shall not be carried out on live systems. • Only competent authorised persons shall carry out maintenance on electrical equipment, adequate Personal Protective Equipment (PPE) for electrical works must be provided to all personnel involved in the tasks. • Lock-Out / Tag-Out (LOTO) system shall be implemented during any electrical works. • Adequate number of staff and first aiders shall be on site in accordance with Jordanian Labour Law requirements. • First aid kit with adhesive bandages, antibiotic ointment, antiseptic wipes, aspirin, non-latex gloves, scissors,	activities to identify fire and explosions hazards. Fire Emergency Response Drills Inspection for fire extinguishers, testing for fire detection system, and other fire fighting equipment. Maintenance for fire extinguishers, testing for fire detection system, and other fire	Based on Fire risk assessment Monthly Semi-annually			

Aspect	Key Potential Impact	Mitigation Measures	Monitoring Requirements	Frequency	Reporting	Performance Indicator	Responsibility
		thermometer, etc. shall be made available by the contractor on site. • Emergency evacuation response shall be prepared by the contractor and relevant staff shall be trained through mock-up drills.	fighting equipment.				
	Exposure to health events during construction activities such as manual handling, hand-arm vibration, temporary or permanent hearing loss, heat stress, and dermatitis	• Ensure that operations, which involve manual handling, are eliminated so far as reasonably practicable, provide mechanical aids such as forklifts, trolleys, cranes, hoists etc. • Ensure all equipment are suitable for jobs (safety, size, power, efficiency, ergonomics, cost, user acceptability etc), provide the lowest vibration tools that are suitable and can do the works. • Ensure all tools and other work equipment are serviced and maintained in accordance with maintenance schedules and manufacturer's instructions. • Regular noise exposure assessments and noise level surveys of noisy areas, processes and equipment shall be carried out in order to form basis for remedial actions when necessary. • As far as reasonably practical, all steps to reduce noise exposure levels of employees by means other than that of personal protective equipment shall be taken, such as reducing exposure times, enclosures, silencers, machine covers…etc. • Provide suitable and effective hearing protection to employees working in high noise levels. • Designate and clearly mark hearing protection zones, which may include particular areas, operations or pieces of	Monitor the health of workers Monitor work areas and operations to identify noise hazards. Inspection for use hear protection equipment Fit Testing Maintenance & Care for Hear protection equipment.	Continuously Continuously Prior Use Annually Monthly	Contrctors shall prepare and submit monthly report to the developer	Total Recordable Incidence Rate(TRIR) Lost Time Incidence Frequency Fatal Accident Rate Medical Treatment Case (MTC) No. Restricted Work Day Cases (RWDC) No.	Contractor and FRV

Aspect	Key Potential Impact	Mitigation Measures	Monitoring Requirements	Frequency	Reporting	Performance Indicator	Responsibility
		equipment. All personnel entering these zones shall be required to wear hearing protection inside these areas. • Awareness training sessions should be established and provided to all personnel involved during the construction phase in order to highlight the heat related illnesses of working in hot conditions such as heat cramps, heat exhaustion, heat stroke, dehydration. • Ensure adequate quantities of drinking water are available at different locations within the site, • Ensure proper planning of works to consider the time of peak temperatures during the day, provide rest brakes during the peak times. • Provision of sun shades at different locations within the site. • Eliminate the risk of exposure whenever possible, provide proper PPE wherever necessary and to ensure that there are satisfactory washing and changing facilities. • Ensure that all workers exposed to a risk are aware of the possible dangers. They should be given thorough training in how to protect themselves and there should be effective supervision to ensure that the correct methods are being used.				Restricted Work Days (RWD) HSE Training Hours Number of non-conformance events. Reports	
Socio-economics							

Aspect	Key Potential Impact	Mitigation Measures	Monitoring Requirements	Frequency	Reporting	Performance Indicator	Responsibility
Traffic	Additional traffic load due to transport of equipment and materials to and from the site through the surrounding road network	• The contractor to ensure that all trucks and vehicles accessing the facility are operated by licensed operators. • Pedestrians Safety: All project vehicles and trucks shall comply with the proposed speed limits • Ensure adequate maintenance and inspection of vehicles • Presence of flagman at the entrance and exit of the project site in order to control vehciles and truck movement.	Maintain an open dialogue with the MDC. Monitor vehicle movement to and from the Project area.	Continuously	All incidents to be reported to project management contractor and to traffic department.	No complains or concerns from traditional users of the area's roads routes are received during the construction activities. No incidents or accidents (collisions) are recorded	Contractor

Aspect	Key Potential Impact	Mitigation Measures	Monitoring Requirements	Frequency	Reporting	Performance Indicator	Responsibility
Potential Effects on local communities	Potential impacts to herders	• Preparation of a community grievance mechanism and a Stakeholder Engagement Plan prior to construction in complicance with IFC guidelines.	Ensure to establish specific monitoring procedure for stakeholder consultation and records of grievances where needed.	All throughout the project phases	To IFC	Compliance with IFC guidelines and implementation of grievance mechanism and SEP.	FRV; which will communicate it to the Contractor
Archaeological Resources & Cultural Heritage							
Archaeology & Cultural Resources	Only potential concern can be impacts on possible unseen archaeological sites/remains (chance finds)	• All construction works shall be ceased if any historical or archaeological sites are chance found during construction. • In the event potential archarological and/or cultural resources are discovered during construction activities, the Ministry of Tourism and Antiquities – Mafraq Directorate shall be invited for consultations and assessment of the finding. • Work shall be resumed only after archaeological experts from Ministry of Tourism and Antiquities and official authorities such as the Department of Antiquities (DoA) are consulted and appropriate mitigation measures are implemented.	• Minimum of one site inspection immediately after chance find. • Informing personnel present on site of chance find procedures in case any archaeolog	One site inspection after chance find	To Department of Antiquities (DoA) in case of chance finds.	N/A	Contractor / Department of Antiquities (DoA)

Aspect	Key Potential Impact	Mitigation Measures	Monitoring Requirements	Frequency	Reporting	Performance Indicator	Responsibility
			ical or cultural resources were encountered				

Table 16: Environmental and Social Management Plan during Operation Phase

Aspect	Key Potential Impact	Mitigation Measures	Monitoring Requirements	Frequency	Reporting	Performance Indicator	Responsibility
Physical Environment							
Soil	Potential spillage of stored oil and chemicals	• Specific procedures shall be developed for the removal of waste or spilled fuel, oil and contaminated soil at approved disposal facilities. • Proper storage for chemicals and fuel within confined areas on site and adopting proper safety measures when handling those chemicals to prevent their leakage and infiltration into the soil.	Inspect the presence of any disturbed areas in and around the project site for erosion Visual inspection of oil storage tanks, waste storage area and fuel storage area for spills and leaks	Post rainfall event Weekly	To developer's top management	Maintain readily available records of all workers training on spill response procedures.	FRV
Visual Amenity	Potential glare from PV panels	The used technology has Anti- Reflective coating that significantly reduce the refelectivity of the PV Pannels	N/A	N/A	N/A	N/A	FRV
Terrestrial Ecology							
Terrestrial Ecology	Potential disturbance and harm to birds	• Minimize human and vehicular contact with resident birds including their burrows / nests and feeding grounds. • Groundnests found on site shall be translocated outside the industrial park's boundary. • Waste shall be stored on site within closed container, especially food remnants to avoid attracting birds on site.	Visual inspection within project site.	Weekly	To developer's top management	No reported harm to birds.	FRV

Aspect	Key Potential Impact	Mitigation Measures	Monitoring Requirements	Frequency	Reporting	Performance Indicator	Responsibility
Health and Safety							
Safety risks	Potential of exposure to safety events during operation activities such as slipping and tripping, working at height activities, and fire	• Provide walkways that are clearly designated as a walkway; all walkways shall be provided with good conditions underfoot; signposted and with adequate lighting. • Ensure all works and storage areas are tidy, all material deliveries shall be planned to minimize accumulated materials at project site. • Signpost any slippery areas, provide proper footwear during working within slippery areas. • Avoid work at height where it reasonably practicable to do so, e.g. by assembly at ground level. • Prevent any person falling a distance liable to cause personal injury e.g. by using a scaffold platform with double guard-rail and toe boards. • Carry out fire risk assessment during operation to identify sources of fuel and ignition and establish general fire precautions including, means of escape, warning and fighting fire. • Set up a system to alert workers on site. This may be temporary or permanent mains operated fire alarm. • Fire extinguishers should be located at identified fire points around the site. The	Routine Inspection of Equipment and tools used during working at height activities Maintain proper housekeeping for the project site Routine Facilities' and site Inspection. Monitor work areas and activities to identify fire and explosions hazards. Fire Emergency Response Drills Inspection for fire extinguishers,	Monthly Continuously Monthly Continuously Based on fire Assessmnet Monthly	Prepare regular report to developer's top management	Total Recordable Incidence Rate(TRIR) Lost Time Incidence Frequency Number of safety training performed Number of non-conformance events. Reports.	FRV

Aspect	Key Potential Impact	Mitigation Measures	Monitoring Requirements	Frequency	Reporting	Performance Indicator	Responsibility
		extinguishers shall be appropriate to the nature of the potential fire. • Establish and communicate emergency response plan with all parties, the ERP to consider such things as specific foreseeable emergency situations, organizational roles and authorities, responsibilities and expertise, emergency response and evacuation procedure, in addition to training for personnel and drills to test the plan • Adequate first aiders shall be on site in accordance with Jordanian Labour Law requirements. • First aid kit with adhesive bandages, antibiotic ointment, antiseptic wipes, aspirin, non-latex gloves, scissors, thermometer, etc. shall be made available by the contractor on site. • Emergency evacuation response shall be prepared by the contractor and relevant staff shall be trained through mock-up drills.	testing for fire detection system, and other fire fighting equipment. Maintenance for fire extinguishers, testing for fire detection system, and other fire fighting equipment.	Semi-Annually			
Socio-economics							
Traffic	Potential minimal increase of traffic load	Implementation of a regulated entrance and exit into the facility.	Monitoring of access roads around site Record complaints received from	Daily	All incidents reported to the proper authority and to MDC.	Number of complaints from road users. Number of traffic	FRV

Aspect	Key Potential Impact	Mitigation Measures	Monitoring Requirements	Frequency	Reporting	Performance Indicator	Responsibility
			locals or authorities.			incidents due to vehicle movement.	

10.3 Decommissioning

The solar power plant facility is considered a large scale long-term investment that will contribute to economic benefits to the country through provision of power supply, designed in accordance with best practice, taking into account all relevant national and internal codes and legislation.

The design life of the facility will be approximately 20 years. Therefore, the post-design life is expected to involve rehabilitation, upgrading and modernization of the facility, with a possible expansion (retrofitting and addition of new technology).

As a result, impacts from decommissioning are not expected to arise in the near future unless retrofitting and upgrade of the facility was not feasible. However, this, ESIA Study has considered potential decommissioning impacts in case there was a need for the facility to be dismantled and end operations.

As can be noted from the impact assessment **section 9**, no impacts with high significance are anticipated to take place during decommissioning of the project since all facilities will be removed, solar power plant decommissioned, and PV panels will be dismantled and sent for recycling.

The main mitigation and monitoring measures to minimize or reduce the environmental and social impacts during decommissioning are anticipated to be similar to those identified for the construction phase.

Therefore, to avoid repetition, please refer to **Table15** for detailed mitigation measures that overlap with decommissioning as well.

11 REFERENCES

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APPENDIX A: AIR QUALITY MONITORING RESULTS

APPENDIX B: SOARING BIRDS SENSITIVITY MAP TOOL