Environmental and Social Screening

Solar Photovoltaic Power Generation Sites, Lebanon

July 18, 2024

CONTENTS

FIGURES

TABLES

Acronyms and Abbreviations	
EIA	Environmental Impact Assessment
EHSG	World Bank Group Environmental, Health, and Safety Guideline
E&S	Environmental and social
ESF	World Bank Environmental and Social Framework
EIA	Environmental Impact Assessment
ESS	World Bank Environmental and Social Standard
ESIA	Environmental and Social Impact Assessment
GIIP	Good International Industry Practice
GW	Gigawatt
GWh (GWH)	Gigawatt hour
IBA	BirdLife International Important Bird Area
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
km	Kilometer
masl	Meters above sea level
MOEW	Ministry of Energy and Water
MOE	Ministry of Environment
MW	Megawatt
MWh	Megawatt hour
SEP	Stakeholder Engagement Plan
SPA	Special Protection Area
SPP	Solar power plant
UNFCCC	United Nations Framework Convention on Climate Change

1. Introduction

1.1 Background

The World Bank is considering a project to assist Lebanon's electricity sector to overcome many of the challenges it faces. Under the *Lebanon Renewable Energy and System Reinforcement Project* (World Bank, P108501), the World Bank would provide financing to help scale up renewable energy in the electricity supply mix, strengthen the electricity transmission network and its management, improve operating efficiency of Electricité du Liban (EDL), and rehabilitate critical assets at hydropower plants.

One of the overall project's components would be financing the construction of a number of solar photovoltaic (PV) power plants (SPPs) ("the Project"). To support the Project, Electricité du Liban (EDL), Lebanon's national electricity producer and grid operator, appointed an international Consultant to screen selected sites to identify if there were environmental and/or social constraints that might affect the selection of these sites for SPPs.

1.2 Scope of Work

- The primary objective of the assignment is to:
  - Conduct desktop research and visit four prospective sites in order to understand environmental and conditions that could be a factor in selecting the location of individual SPPs.
  - Identify constraints that the environmental and social conditions at these locations could impose on SPP development in order to avoid or reduce impacts to acceptable levels in particular issues that could prevent or delay development due to the likelihood of unacceptable environmental or social impacts or the need for extensive studies in order to make that determination.

U.S.-based Environmental Solutions ER2M LLC was engaged to undertake the assignment and complete the work, with the following tasks. The Consultant team also included Lebanon-based Sustainable Environmental Solutions LLC. Tasks included

- *Task 1. Site Visit and Draft Screening Report.* The task included conducting desktop research, visiting four prospective SPP sites to observe conditions, and participating in meetings in Beirut and locally, including ministries with Government ministries and local authorities. The purpose of the site visit is to observe conditions in and around the identified locations, and (if needed) visit transmission line routes that may be required to connect those projects to the grid.
- *Task 2. Prepare Screening Report*. The task required preparation of this screening report, which includes the results of background research and site visits, stakeholder interviews, and identification of potential environmental and social risks and impacts. The report also identify high-level mitigation measures that may be necessary in order to develop SPPS at these locations. It was intended to observe the corridors in which transmission lines would evacuate electricity from the site to existing lines, but the connections points had not been identified at the time for the site visits so this could not be completed.

2. Site Visit

A site visit was conducted during the period of May 12 to May 25, 2024. The work was completed by the individuals in identified in Table 2-1.

Table 2-1. Consultant's Environmental and Social Screening Team

Team Member	*Project Role*
Mr Jack Mozingo	Project Director and ESHS expert
Dr Ivan Maximov	Project Manager and ESHS specialist, Audit t team leader
Mr Ali Jan	Social and resettlement specialist
Dr Lara Awad	Local biodiversity specialist
Mrs Sara Hteit	Local environmental specialist (Sustainable Environmental Solutions, Beirut)
Mrs Amal Sultan	Local social and stakeholder engagement specialist (Sustainable Environmental Solutions, Beirut)

The activities undertaken during the site visit included:

- Meetings at EDL Headquarters in Beirut to acquire project information. Participants in eh meetings included the General Director of EDL, the EDL Director General assistant for World Bank and EBRD project, EDL Head of technical department in the regional distribution directorate, EDL Regional representative (Hermel-Baalbek), and GIS and Renewable Energy Consultant, CNRS Consultancy.
- Site visits to four prospective SPP locations, including sites near Hermel, Qaa, Ras Baalbek, Harbata, Magneh, and Taraiya.
- Meetings with the Mayors of Qaa, Raas Baalbek, Hermel and Maqneh Municipalities.
- Meeting with the Ministry of Energy and Water in Beirut.
- Meeting with representatives of the World Bank in Beirut, including the Infrastructure Program Lead/Senior Energy Specialist and environmental and social specialists.

3. Electricité du Liban

Projects will be developed by or on behalf of Electricité du Liban (EDL), which is a State company that was founded by Decree No. 16878, dated July 10, 1964. The company is responsible for the generation, transmission, and distribution of electricity energy in Lebanon. Currently, EDL controls over 90 percent of the Lebanese electricity sector, including ownership of the Kadisha concession in North Lebanon. In 2016 (the most recent data provided to the team), EDL produced more than 13,000,000 gigawatt-hours through seven major thermal power plants. EDL's network also includes 66kV, 150kV, 220kV, and 400kV high-voltage transmission lines as well as 68 major power substations that convert power from high to medium voltage. The network comprises more than 1,540 km of transmission lines, including 1,362km of overhead lines and 178km of underground cables. EDL's distribution network includes substations and transformers to further reduce voltage and distribution lines to connect the substations to subscribers.

The EDL Headquarters (HQ) are located in Beirut. The total staff employed at EDL (as of 2024) is 1,227 specialists. The organizational structure of the Company is presented in Table 4-1 below.

Table 3-1. Main EDL Directorates

Chairman – General Director	Engineer Kamal Fouad Hayek
Board of Directors Members	• Eng. Tarek Abdalla • Eng. Housein Salloum • Eng. Samer Slim • Mr. Karim Saba • Eng. Habib Srour
Administrative Affaires Directorate	Hoda Bekhaazi Kfoury
Financial Affairs Directorate	Hoda Bekhaazi Kfoury
General control	Ail Izzedein
Transmission Directorate	Rabih Daw
Equipment Directorate	Fadi Bou Khzam
Common affaires Directorate	Wassef Hneineh
Generation Directorate	Bshara Atieh
Studies Directorate	Hazem Achour
Distribution Directorate (Beirut and Mount Lebanon)	Ibrahim Moussa
Distribution Directorate (regions)	Ghassan Darwish
Head of handing-over committee	Neaman Rhaiem
Head of medium voltage consumers department	Boulos Daw

EDL has no corporate Environmental and Social Management System (ESMS) and no Environmental Policy or Occupational Health and Safety Policy. There are also no environmental or occupational health and safety specialists at the corporate level.

EDL does have a specific human resources (HR) Policy, but does have an internal manual that includes applicable requirements for employment and labor management. It is important to note that EDL staff are divided into two major categories – permanent employees, who are considered Government employees, and contract staff. This is the result of a long-standing hiring freeze that has resulted in EDL having to appoint contract employees rather than hiring new permanent workers.

Currently EDL employs 1,227 permanent staff, whereas the number of contract employees is reportedly somewhat more than that. There is an HR manager in charge of all HR matters across the company, at both corporate and operating project (site) levels. Recruitment and employment (including of contract employees) is managed by a civil service board. EDL reports that all employees have a standard employment contract as per the requirements of the Lebanese Labor Code—all employees are reportedly 18 years of age or older.

4. Proposed Projects

In 2024, EDL, with the assistance from the National Council for Scientific Research – Lebanon (CNRS-L) and the World Bank, initiated preliminary technical screening research for further feasibility-level studies of areas and sites identified as potentially favorable for development of industrial scale SPPs in Lebanon. CNRS-L has completed its first screening exercise, based on spatial and technical constraints analysis, and identified several prospective areas for solar power developments.

Input parameters to the constraints analysis included/excluded:

- Solar resource availability/Solar irradiance (W/m2).
- Distance to the EDL national grid of 80 kilometers(km).
- Distance to access road(s) of no more than 80 km.
- Distance to EDL substation of no more than 80 km.
- Population density ofno more than 200 residents per square kilometers.
- Land use type: only areas classified as shrublands, grasslands, bare rock, and bare soil lands were included, with all residential areas, industrial areas, and areas under water excluded.
- Slope steeper than 10 degrees were excluded.
- Only south facing slopes were considered .
- Maximum elevation was set to 1,500 meters above sea level.
- Natural protected areas and parks were set into exclusion zones
- Land ownership – only state-owned lands, with all private lands excluded from consideration.

The outcome of the spatial and technical constraints analysis and modeling (that is, the technical screening) produced the results as shown in Figure 4-1 and Figure 4-2. There were a few clusters of potentially favorable areas for construction of SPPs and sites were selected within these clusters. They were all located in the northern Bekaa Valley):

- **Hermel, Qaa and Ras Baalbek sites**, situated in Baalbek-Hermel Governorate, Baalbek and Hermel Districts of Lebanon (the largest cluster in arial extent). Total cumulative est. capacity of 1,200MW
- **Harbata-Toufiqiyeh site**, situated in Baalbek-Hermel Governorate, Baalbek District of the country. Total est. capacity of 25MW.
- **Maqneh site,** situated in Baalbek-Hermel Governorate, Baalbek District of the country. Total est. capacity of 25MW.
- **Taraiya site,** situated in Baalbek-Hermel Governorate, Baalbek District of the country. Total est. capacity of 35MW.

Figure 4-3 shows the locations of these four sites in the context of the favorable areas, and all four were visited for the purposes of environmental and social screening.

Overall potential solar generation capacity is estimated to be in the range of 1,200-1,300MW. At present, it is anticipated that SPP development will begin with a small-scale (25-35MW installed capacity) pilot SPP at one of the pre-selected locations, then expanded further in the future as new private investors join the Project.

Actual development of SPPs on any of the sites would involve many or all of the activities in

Table 4-1, together with their commensurate impacts.

Figure 4-1. General Geographic Areas Found to be Technically Suitable for SPP Development

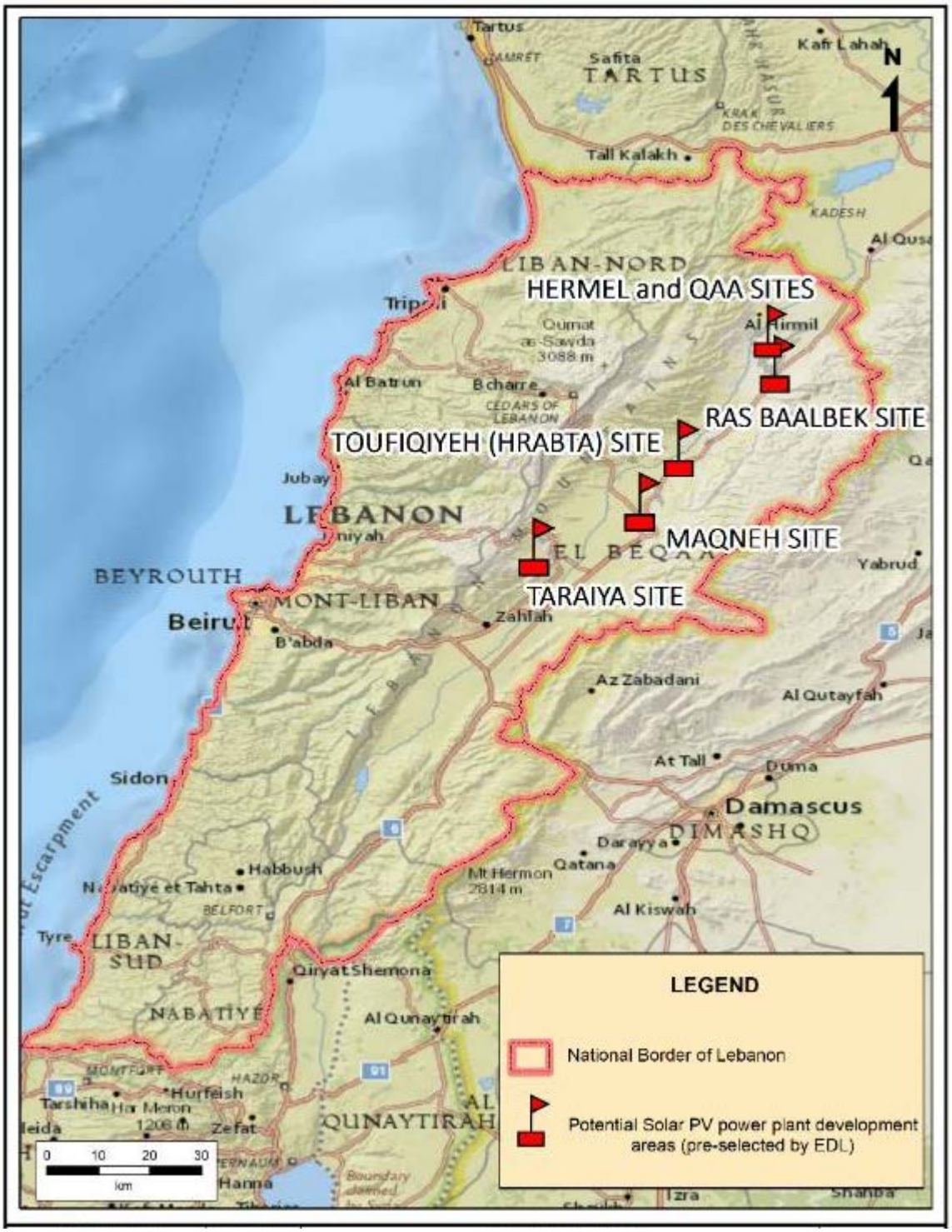


Figure 4-2. Areas Technically Suitable for SPP Development in Hermel and Baalbek Districts of the Baalbek-Hermel Governorate

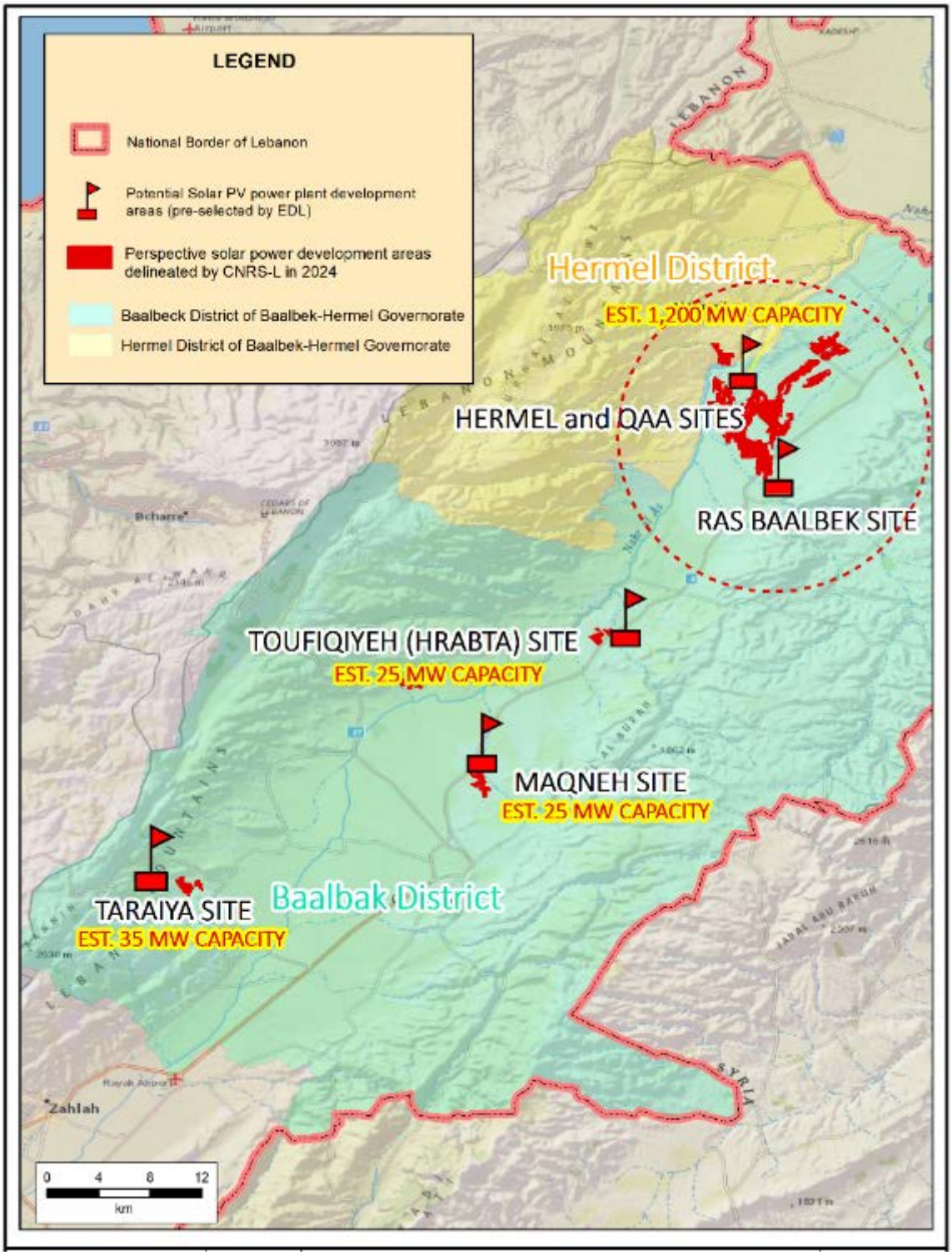


Figure 4-3. Potential SPP Sites Selected for Environmental and Social Screening

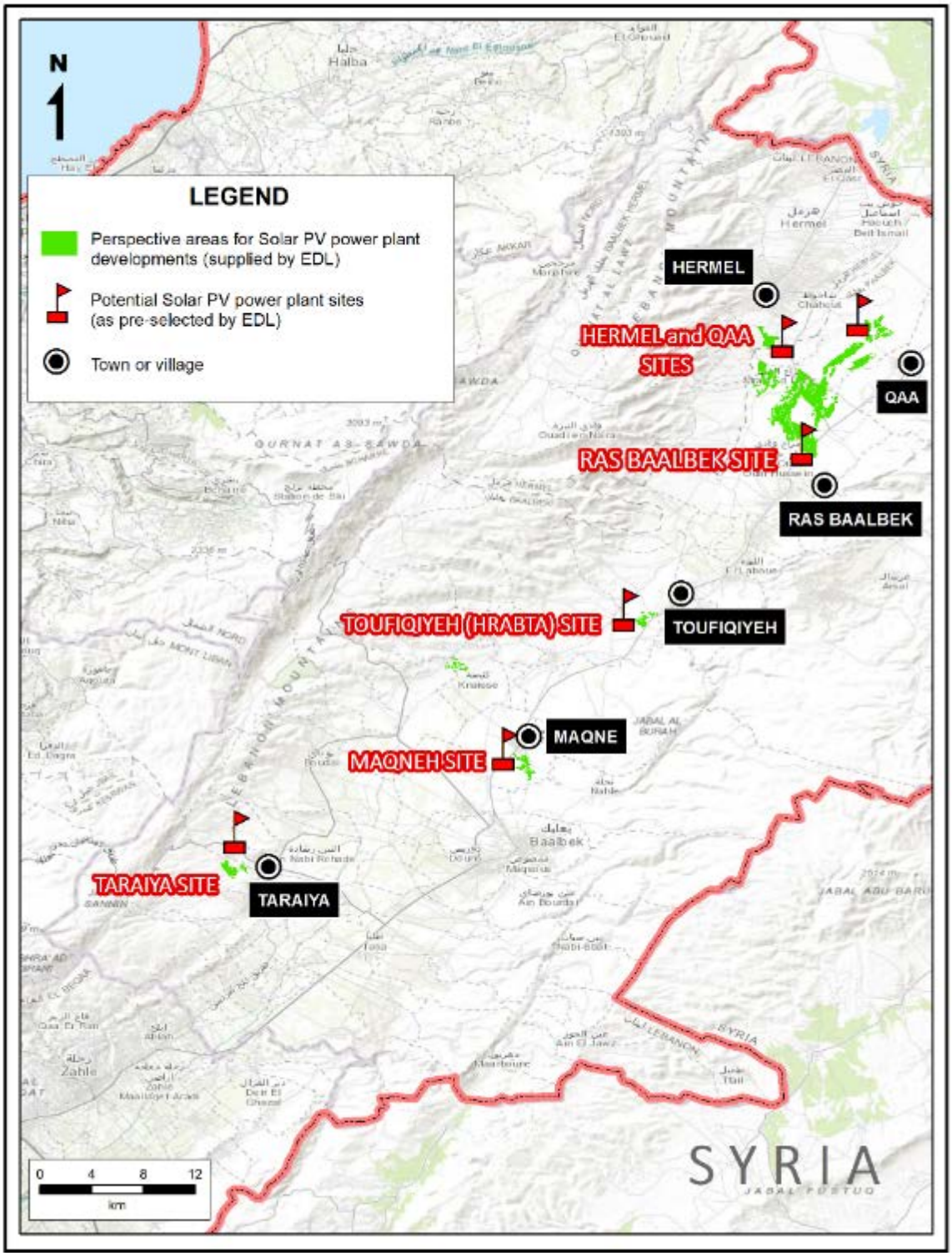

N
LEGEND
Perspective areas for Solar PV power plant developments (supplied by EDL)
Potential Solar PV power plant sites (as pre-selected by EDL)
Town or village
HERMEL
HERMEL and QAA SITES
QAA
RAS BAALBEK SITE
RAS BAALBEK
TOUFIQIYEH (HRABTA) SITE
TOUFIQIYEH
MAQNE
MAQNEH SITE
TARAIYA SITE
TARAIYA
SYRIA
0 4 8 12
km

Table 4-1. Activities Involved in Preparing, Operating, and Closing SPPs

Phase/Category	*Activities*
Project Preparation (EDL)	
Design	• Site and remote studies, site measurements • Preparation of design documents • Cost estimating
Contracting	• Development of procurement documents • Solicitation of bidders • Evaluation of proposals • Selection and appointment of Contractor
Construction (Contractor)	
Recruitment and hiring (contractor)	• Identification of positions, skills/qualifications • Advertisement/announcement (internal and/or external) • Appointments
Pre-mobilization	• Transport of equipment, supplies, workers to the site • Land clearing (removal of vegetation) • Installation of access roads • Development of site infrastructure: access and site roads, laydown areas, parking, buildings, fencing, lighting, etc. • Materials and waste management • Security
Mobilization	• ESHS management planning (EDL approval) • Detailed design (EDL approval) • Hiring
Construction	• Transport of equipment, supplies, workers to and from the site (no accommodations expected) • Heavy equipment movement/use • Materials and waste transport, storage, use, disposal • Drilling/digging for foundations • Cement works for foundations • Installation of PV panels • Installation of internal cabling and substation • Transmission lines to grid • Vegetation placement/care • Security
Demobilization	• Rehabilitation of disturbed areas on- and off-site • Transport of equipment, supplies, workers from the site
Operation (EDL?)	
Operations	• Traffic: Transport of workers to and from the site • Security and (likely) night-time lighting • Maintenance: - Panel cleaning - Panel replacement - Materials and waste management (fuel waste, etc.) - Possible drilling/digging - Vegetation care

5. Institutional and Regulatory Framework

5.1 National Institutional Framework

A number of institutional stakeholders would or could be involved in development of SPPs, including those shown in Table 5-1).

At a regional level, the concerned Governorate (Baalbek-Hermel), the concerned Municipalities (Qaa, Ras Baalbek, Harbata and Maqneh), Electricité du Liban (EDL), and LCEC have direct responsibilities relating to the environment protection and management.

Table 5-1. Institutional responsibilities

Institution	*Mission/Responsibility*
Ministry of Environment (MoE)	• Responsible for monitoring and control of environmental protection, prevention of pollution, protection of wildlife, and preservation of environmental balance. • Set environmental standards, specifications and guidelines for sectors that might have an impact on the environment and for the management of natural resources and amenities. • Responsible for policy planning and setting laws and regulations required to protect public health and the environment and then to strictly enforce them. • Advocate and develop measures for the reduction of intentional and unintentional discharge to the environment. • Define the environmental policy and ensure that it is appropriate to the nature, scale and environmental impacts of the activities. • Coordinate and encourage environmental awareness programs. • Responsible for approving EIA studies (should they are required).
Ministry of Energy and Water (MoEW)	• Establishes plans for the provision of energy for the industrial sector • Designs, builds, puts into operation and maintains power generation and supply facilities • Monitors surface and underground water quality, also estimates water needs and uses in all the regions, and identifies the conditions and systems needed for surface and underground water exploitation.
Ministry of Labor	• Responsible for labor and employment issues. Labour inspections are the responsibility of the Department of Labour Inspection, Prevention and Safety (DLIPS) under the Labour Relations Authority of the Ministry of Labour
Ministry of Interior and Municipalities (MoIM)	• Provide technical assistance and support to municipal federations. • Supervise municipal federations units and ensure conformity with administrative and financial regulations. • Provide technical assistance and support to municipal federations.
Local municipalities, Coalition of municipalities and Governorates	• Involved in the permitting procedure for new establishments • Involved in ensuring the well-being of the populations in its territory • Involved in environmental protection • Controls/owns/administers land areas of prospective SPPs

5.2 National Legal and Regulatory Framework

5.2.1 Energy Efficiency and Renewable Energy Regulations

In 2009, at the 15th session of the Conference of Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) in Copenhagen, the Lebanese government committed to developing renewable energy capacity to reach 12 percent of total capacity. The *2010 Policy Paper*

for the electricity sector (MoEW/LCEC, 2011) further emphasized the importance of electricity committed to the "…launching, supporting, and reinforcing of all public, private, and individual initiatives to adopt the utilization of renewable energies to reach 12% of electric and thermal supply…" by 2020.

The Draft Energy Conservation Law in 2010 provides for enhancing energy efficiency (EE) and renewable energy (RE) initiatives. Among other things, this draft law would institutionalize the Lebanese Center for Energy Conservation (LCEC) and provide it with the necessary authority to oversee renewable energy projects and initiatives. This draft law has not yet been ratified by the Lebanese Parliament.

The National Renewable Energy Action Plan (2016-2020) was developed by LCEC and published in November 2016, set clear quantitative targets for different renewable energy technologies and the legal framework required to achieve 12 percent renewable energy by 2020, with projections for 2025 and 2030. Concurrently, the Ministry of Environment conducted a Strategic Environmental Assessment (SEA) for the renewable energy sector in 2015. Lebanon's Nationally Determined Contribution (NDC) subsequently set renewable energy targets at 15 percent unconditionally and 20 percent conditionally by 2030 (NDC, 2015). A 2019 Policy Paper for the Electricity Sector further raised this target to 30 percent of electricity from renewable sources by 2030 (MoE/UNDP, 2019b). In 2020, the Ministry of Energy and Water (MoEW) and LCEC, in collaboration with IRENA, launched the Renewable Energy Roadmap (REmap). This roadmap detailed specific capacity targets for each RE technology, aiming for 1,000MW of wind, 601MW of hydropower, 2,500MW of centralized solar PV, 500MW of decentralized solar PV, and 13MW of biogas (MoEW / LCEC / IRENA, 2020). This initiative supported Lebanon's updated RE targets of 18%-30% as part of the 2020 NDC update under the Paris Agreement.

5.2.2 EIA Requirements

The Environmental Impact Assessment (EIA) Decree 8633 was endorsed and issued by the Lebanese Government dated August 7, 2012, followed by Decision 261/1 dated June 25, 2015. The EIA Decree sets the necessary principles and measures to assess the environmental impact of projects, covers the objectives of the regulation, definitions, as well as various stages of the national EIA process including screening, scoping, implementation, and review of the EIA report, in addition to the period of validity, and the appeal process.

In accordance with the EIA Decree 8633, there are three categories of environmental appraisals that may apply to any proposed industrial development, depending on the type and scale of the project and potential adverse E&S impacts:

- Full-scale EIA for a greenfield industrial development with moderate to major impacts expected, including EIA scoping, detailed impact evaluation and development of mitigation measures.
- Environmental Examination (IEE) for other types of projects (brownfield, expansion, extension projects) and for some projects to confirm whether full-scale EIA is needed.
- No EIA option if the screening and/or IEE confirms minor or negligible E&S risks or impacts as a result of project implementation.

Since the SPPs have not been identified or proposed, the Ministry has not been required to make a formal determination as to whether an IEE or EIA is required for one or all of the SPPs.

5.2.3 Principal National Laws and Regulations Applicable to the Project

Table 5-2 lists the national legislative acts, decrees, and decisions that may be applicable to development and/or operation of the SPPs, some of which would be of relatively minor importance.

Table 5-2. Relevant National Legislation

Law/Decree or Decision	*Date of Issue*	*Subject*	*Applicability*
Labor			
Labor Law	1946	The Lebanese Labor Code	Applicable
Law 207	2000	Amendment of Articles in Labor Law	Applicable
Law No. 215	205	Criminalizes sexual harassment in the workplace	Applicable
Decree 8987	2012	Prohibition of employment of minors under the age of 18 in work that may harm their health, safety or morals	Applicable
Decree 3791	2016	Minimum Wage	Applicable
Environment			
Law 64	1988	Protection of the environment from toxic and dangerous substances	Applicable
Law 444	July 2002	Code of the environment indicating the necessity to conduct EIA and IEE for development projects.	Applicable (subject to confirmation by MOE)
Law 77	2018	Water Law	Applicable
Law 78	2018	Air Quality Law	Applicable
Law 80	2018	Integrated Solid Waste Management	Applicable
Decree 2761	1933	The prohibition of wastewater discharge into water streams	Applicable
Decree 10276	1962	Protection of Surface and Groundwater Resources	Applicable
Decree 8735	1974	Conservation of Public Hygiene (solid waste)	Applicable
Decree 8633	March 2012	The EIA decree. It sets the requirements and procedures for the preparation of an EIA report.	Applicable (subject to confirmation by MOE)
Decree 5606	2019	Management of hazardous waste	Applicable
MoE Decision 52/1	1996	Standards and specific levels for limiting air, water, soil and noise pollution	Applicable
MoE Decision 8/1	2001	Revised standards for air emissions, liquid effluents and wastewater treatment plants	Applicable
MoE Decision 16/1	August 2003	Sets new guidelines for solid waste management sector.	Applicable
MoE Decision 16/1	2022	Emission limit values for air emissions (updating air quality	Applicable

Law/Decree or Decision	*Date of Issue*	*Subject*	*Applicability*
		standards specified in Decision 8/1)	
Circular 11/1	2013	Regulates the operation of generators, sets air pollution control requirements and emissions limits	Applicable
Land			
Decree 3339	1930	Land Property Code	Applicable
Law 58	1991	Expropriation Law	Potentially applicable
Health and Safety			
Decree 11802	January 2004	Occupational health and safety	Applicable
Cultural and Municipal			
Ministerial decree	2008	Cultural Policy Law	Applicable
Law 37	2016	Regulating the archaeological field intervention mechanism	Applicable
Decision 17	April 2003	Classifies lands into zones and describes the type of investments allowed in each zone. Also sets construction allowances in each zone	Applicable
Decision 24	August 2006		
Note: for most laws and decrees, only the year of initial passage or issuance is provided, with subsequent amendments not shown. All subsequent decrees issued under the laws, similar, are not shown.			

5.2.4 Potentially Applicable Environmental Standards

5.2.4.1 *EIA*

It is expected that the decision to develop each of the SPPs would trigger at least an IEE and possibly a full-scale EIA. The SPPs would be greenfield developments with potential adverse environmental and social impacts that would mitigation measures to be implemented. Most impacts would occur during construction, with very limited impacts during operation.

5.2.4.2 *Air Quality*

The permissible limits for ambient air quality exposure in Phases 1 and 2 (Decision No. 16/1) are presented in the table below (applicable to point and non-point air emission sources): Emissions to air would occur incidentally during construction, with almost none in operation.

Table 5-3. Ambient Air Quality Standards (Law 78, MOE Decision No. 16/1)

Parameter	*Emission limit value*	*Remark*
Dust	150 mg/Nm3	<0.2kg/hr for 24 hrs
	20 mg/Nm3	>0.2kg/hr for 24 hrs
Carbon Monoxide (CO)	250 mg/Nm3	24 hrs
Total Organic Compounds (TOC)	50 mg/Nm3	>0.5 kg/hr for 24 hrs
Dioxins and Furans	0.1 mg/Nm3	24 hrs
Gaseous Organic Group I	20 mg/Nm3	>0.1 kg/hr for 24 hrs

Parameter	*Emission limit value*	*Remark*
Gaseous Organic Group II	100 mg/Nm3	>0.5 kg/hr for 24 hrs
Inorganic gasses I	0.5 mg/Nm3	>2.5 g/hr for 24 hrs
Inorganic gasses II	3 mg/Nm3	>15 g/hr for 24 hrs
Inorganic gasses III	30 mg/Nm3	> 0.15 kg/hr for 24 hrs

5.2.4.3 *Wastewater*

Provisions regarding any effluent discharges into receiving natural water bodies are outlined in Table 6-4. There would be some limited water usage and possible discharge during operation.

Table 5-4. Effluent Discharge Limits (Law 77, Decision No 8/1 of January 2001)

Substance	*Maximum Allowable Limits for Receiving Water Bodies*		
	Sewerage system	*Surface water*	*Sea*
Color	none	none	none
pH	6-9	6-9	6-9
Temperature	35°C	30°C	35°C
BOD (5 day, 20ºC)	125 mg/l	25 mg/l	25 mg/l
COD (dichromate)	500 mg/l	125 mg/l	125 mg/l
Total Phosphorus	10 mg/l	10 mg/l	10 mg/l
Total Nitrogen*	60 mg/l	30 mg/l	30 mg/l
Suspended solids	600 mg/l	60 mg/l	60 mg/l
AOX	5	5	5
Detergents	-	3 mg/l	3 mg/l
Coliform Bacteria 370 C in 100 ml**	-	2,000	2,000
Salmonellae	Absence	Absence	Absence
Hydrocarbons	20 mg/l	20 mg/l	20 mg/l
Phenol Index	5 mg/l	0.3 mg/l	0.3 mg/l
Oil and grease	50 mg/l	30 mg/l	30 mg/l
Total Organic Carbon (TOC)	750 mg/l	75 mg/l	75 mg/l
Ammonia (NH_4^+)	-	10 mg/l	10 mg/l
Silver (Ag)	0.1 mg/l	0.1mg/l	0.1 mg/l
Aluminum (Al)	10 mg/l	10 mg/l	10 mg/l
Arsenic (As)	0.1 mg/l	0.1 mg/l	0.1 mg/l
Barium (Ba)	2 mg/l	2 mg/l	2 mg/l
Cadmium (Cd)	0.2 mg/l	0.2 mg/l	0.2 mg/l
Cobalt (Co)	1 mg/l	0.5 mg/l	0.5 mg/l
Chromium total (Cr)	2 mg/l	2 mg/l	2 mg/l
Hexavalent Chromium (Cr^{VI+})	0.2 mg/l	0.2 mg/l	0.2 mg/l
Copper total (Cu)	1 mg/l	0.5 mg/l	1.5 mg/l
Iron total (Fe)	5 mg/l	5 mg/l	5 mg/l

Substance	*Maximum Allowable Limits for Receiving Water Bodies*		
	Sewerage system	*Surface water*	*Sea*
Mercury total (Hg)	0.05 mg/l	0.05 mg/l	0.05 mg/l
Manganese (Mn)	1 mg/l	1 mg/l	1 mg/l
Nickel total (Ni)	2 mg/l	0.5 mg/l	0.5 mg/l
Lead total (Pb)	1 mg/l	0.5 mg/l	0.5 mg/l
Antimony (Sb)	0.3mg/l	0.3mg/l	0.3mg/l
Tin total (Sn)	2 mg/l	2 mg/l	2 mg/l
Zinc total (Zn)	10 mg/l	5 mg/l	5 mg/l
Active (Cl_2)	-	1 mg/l	1 mg/l
Cyanides (CN^-)	1 mg/l	0.1mg/l	0.1mg/l
Fluorides (F)	15 mg/l	25 mg/l	25 mg/l
Nitrate (NO_3^-)	-	90 mg/l	90 mg/l
Phosphate (PO_4^{3-})	-	5 mg/l	5 mg/l
Sulphate (SO_4^{2-})	1,000 mg/l	1,000 mg/l	1,000 mg/l
Sulfide (S^{2-})	1 mg/l	1 mg/l	1 mg/l

5.2.4.4 *Noise*

Noise exposure limits are specified in Ministerial Decision No. 52/1 of July 1996 and provided in Table 6-5. The national and IFC limits for exposure to noise are specified in Tables 6-5 and 6-6. Construction of SPP would generate noise in the immediate vicinity, there would be very limited noise generated during operation.

Table 5-5. Limits for Noise (Decision No. 52/1 of July 1996)

Region Type	*Limit for Noise Level dB(A) (Lebanese standards)*			IFC Guidelines *LAeq (dBA)*	
	Day time (7 a.m. - 6 p.m.)	*Evening time (6 p.m. - 10 p.m.)*	*Night Time (10p.m. - 7a.m.)*	*Daytime*	*Nighttime*
Residential areas having some construction sites or commercial activities or that are located near a road	50-60	45-55	40-50	55	45
Urban residential areas	45-55	40-50	35-45	55	45
Industrial areas	60-70	55-65	50-60	70	70
Rural residential areas	35 – 45	30 – 40	25 – 35		

Table 5-6. National Exposure Limits for Occupational Noise

Duration (Hours)	*Maximum allowed sound level, dBA*
8	90
4	95

Duration (Hours)	*Maximum allowed sound level, dBA*
2	100
1	105
½	110
¼	115

5.3 World Bank Environmental and Social Standards

5.3.1 Environmental and Social Framework

The World Bank or other international development financial institutions may provide financing to EDL for development of SPPs. All projects financed by the World Bank are required to meet the Bank's environmental and social standards, which are set forth in the 2018 Environmental and Social Framework (ESF). The ESF includes the Environmental and Social Policy for Investment Project Financing, which describes the requirements the Bank itself must follow for projects, and 10 Environmental and Social Standards (ESSs), which establish requirements for Borrowers such as EDL, to identify, assess, and control environmental and social risks and impacts of Bank-supported projects. ESSs that would apply to development of the SPPs are identified in Table 5-7

Table 5-7. Applicability of ESSs to Development of SPPs

ESS No.	*Title*	*Scope*	*Applicability to SPP(s)s*
1	Assessment and Management of Environmental and Social Risks and Impacts	Identification, control, and monitoring of risks, impacts, and mitigation	Applicable. Requirements will apply for assessment, mitigation, monitoring
2	Labor and Working Conditions	Labor relations, rules of employment, occupational health and safety, worker grievance mechanism	Applicable. Mitigation will be required
3	Resource Efficiency and Pollution Prevention and Management	Conservation of resources and control/prevention of wastes and pollution.	Applicable. Mitigation will be required
4	Community Health and Safety	Avoidance and control of risks and impacts on communities	Applicable. Some mitigation required to minimize impacts
5	ESS5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	Rules for mitigating physical and/or economic displacement of affected people	Not applicable unless EDL determines additional land is needed and the land is used by others
6:	Biodiversity Conservation and Sustainable Management of Living Natural Resources	protection and conservation of biodiversity and habitats	Applicable. Development would affect local flora and fauna
7	Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities	Rules for managing relations with and impact son indigenous peoples	Not applicable. No indigenous peoples could be affected.
8	Cultural Heritage	Protection of tangible and intangible cultural heritage.	Potentially applicable. Tangible heritage could be present on the sites
9	Financial Intermediaries	Application of standards to institutions receiving financial	Not applicable: EDL is not an FI

ESS No.	*Title*	*Scope*	*Applicability to SPP(s)s*
		support from the Bank.	
10	Stakeholder Engagement and Information Disclosure	Identification and engagement of affected and interested parties, information disclosure, grievance redress mechanism for external stakeholders.	Applicable

The Bank classifies all projects into one of four risk classifications:

- **High Risk** (Medium-or long-term effects that impact local or regional areas (outside of site boundaries) that cannot be remediated using good practices)
- **Substantial Risk** (Short-or medium-term effects that impact local or regional areas (outside of site boundaries) but can be remediated using good international practices).
- **Moderate Risk** (Local and short-term effects that are contained on site and can be remediated and managed using Developer/Operator's standard management plans and codes of practice).
- **Low Risk** (Minimal or non-detectable effects that are contained on site and can be managed using Developer/Operator's standard management plans and codes of practice).

In determining the appropriate risk classification, the Bank takes into account relevant issues, such as the type, location, sensitivity, and scale of the project; the nature and magnitude of the potential environmental and social risks and impacts; and the capacity and commitment of the Borrower (including any other entity responsible for the implementation of the project) to manage the environmental and social risks and impacts in a manner consistent with the ESSs.

The World Bank's preliminary assessment was that the overall project's environmental risk would be Substantial, based on potential risks from air and noise emissions, solid and liquid waste generation, use of chemicals, risks to aquatic species migration patterns, occupational health and safety risks (falls, material handling, electrocution, hit by moving objects, and other risks. Social risk was deemed Moderate, with potential adverse impacts as well as significant benefit due to improvements in the electricity supply. The risk of sexual exploitation, abuse, and sexual harassment was also considered to be Moderate, based on potential labor influx and potential use of child labor.

Based on the screening reported here, it is considered that development of the SPPs would present Moderate Risk to environmental resources and people. The actual rating will be determined based on World Bank consideration of all factors included in all components of the overall project.

5.3.2 World Bank Group Environmental, Health, and Safety Guidelines

The World Bank's Environmental and Social Standard 1 also requires projects to be developed using good international industry practice (GIIP), which include a number of Environmental, Health, and Safety Guidelines (EHSGs) promulgated by the World Bank Group. EHSGs that would apply to development of the SPPs include:

- General EHS Guidelines (April 30, 2007) includes guidelines for environmental controls during facility operation (air and water emissions, hazardous materials management,

noise, contaminated land, etc.) and occupational and community health and safety during operation. This guideline also covers the same topics for construction.

- EHS Guidelines for Electric Power Transmission and Distribution (April 20, 2007) cover many of the same topics (environmental controls, occupational and community health and safety) during construction and operation, with a focus on activities involved in constructing and operating electricity transmission and distribution lines.

Other good international industry practice for development of SPPS include the IFC Guidelines on Utility Scale Solar Power Plants (2015), which includes guidelines for the development, construction, operation and financing of utility-scale solar power plants (based on ESG performance of actual completed projects completed in different countries, including India, Philippines, India, China, Jordan, Mexico, South Africa, Honduras, and Chile).

6. Overview of Environmental and Social Conditions

This chapter provides an overview of the environmental and social settings of the study areas visited during the site visit, which are located nearest to Qaa-Hermel, Ras Baalbek, Toufiqiyeh-Harbata, Maqneh and Taraiya residential areas. The descriptions are essential for assessing the existing environmentally and socially significant factors necessary to screen the potential impacts of the project.

6.1 Locations

The **Hermel-Qaa-Ras Baalbek cluster of potential development sites** is located in the Northern Bekaa Valley on the northern border of the Baalbek Caza within the Baalbek-Hermel Governorate. It is bordered by Syria and Hermel to the north and east, by Ras Baalbek to the south and town of El-Qaa to the east. This is the largest area in size for potentially favorable spots for constructing SPPs, with about 25 to 30 square kilometers that could possibly accommodate up to about 1,200MW of total electricity generation capacity. The elevation of the area ranges from 552 meters at its lowest point to 1,621 meters at its peak. The coordinates are 34°21'8.79"N, 36°27'46.78"E (Figure 6-1).

The **Harbata-Toufiqiyeh** site is situated in the Baalbek Caza within the Baalbek-Hermel Governorate and lies at an elevation of 1,081 meters above sea level. The town is bordered by the Baalbek-Homs international road to the east, Oyoun Orghosh to the west, Nabha and Qlayleh to the south, and Zboud to the north. The area found potentially suitable for SPP development occupies an area of approximately 650,000 square meters of rocky land owned by the municipality. The overall generation potential capacity is estimated to be about 25MW. The coordinates for this site are 34° 9'50.43"N, 36°17'46.80"E (

Figure 6-2).

The **Maqneh** site is situated in the Baalbek Caza within the Baalbek-Hermel Governorate, at an elevation of 1,077 meters. The town of Maqneh is bordered by Deir El Ahmar to the north, Younine to the east, city of Baalbek to the south, and Btedaai to the west. The area also is about 650,000 square meters, with a total estimated generation capacity of 25MW. The geographic coordinates of the site are 34° 4'14.23"N, 36°12'31.96"E (Figure 7-3).

Finally, the **Taraiya site** is in the Baalbek Caza within the Baalbek-Hermel Governorate, at an elevation of 1,260 meters. The town of Taraiya is bordered by the town of Hadath to the north. The area that is potentially technically suitable for developing SPPs with total generation capacity of 25MW is approximately 550,000 square meters, with coordinates at 33° 59'38"N, 36°00'22"E (Figure 6-4).

Figure 6-1. Area Technically Suitable for Solar Development near Hermel, Qaa, and Ras Baalbek

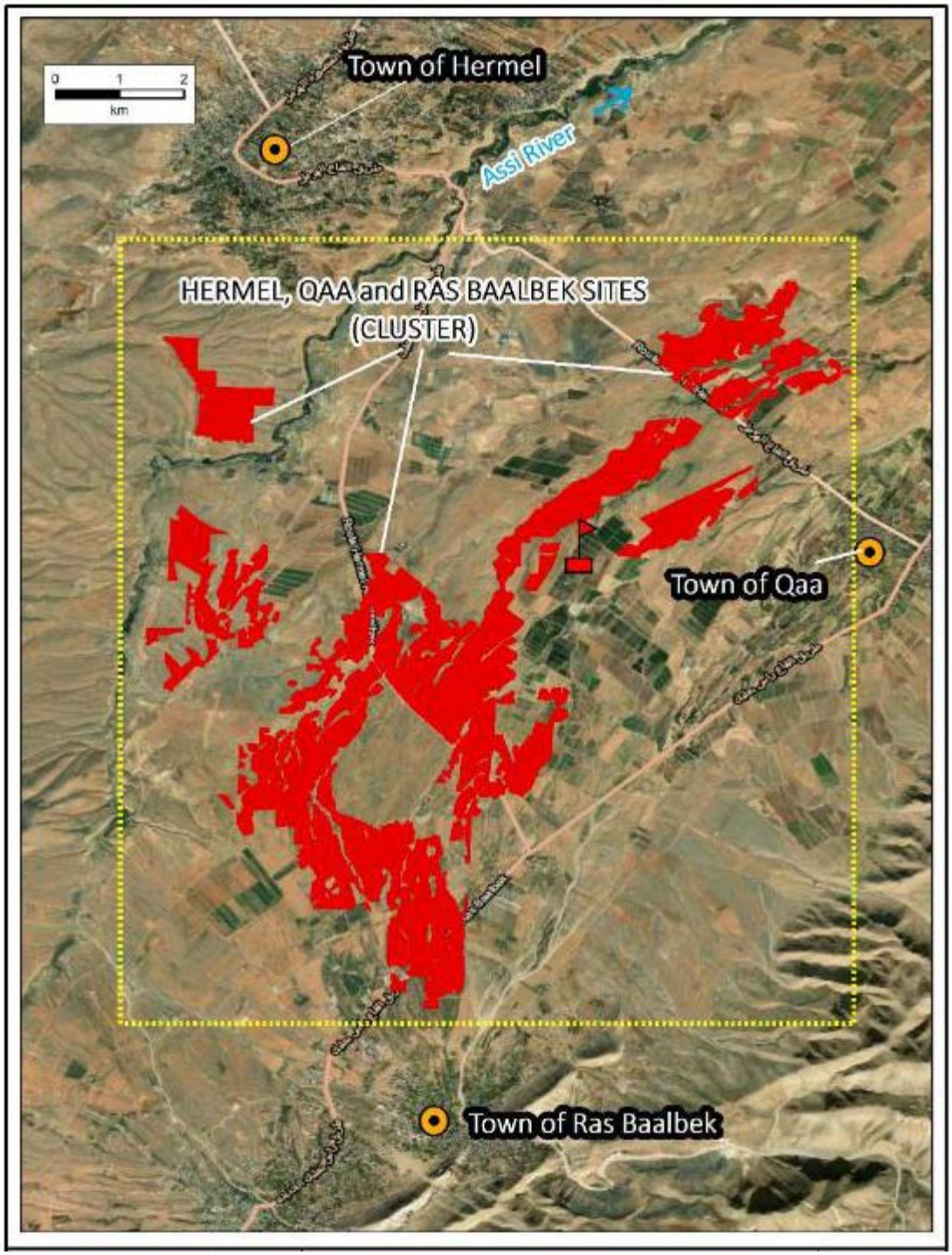

0 1 2
km
Town of Hermel
Assi River
HERMEL, QAA and RAS BAALBEK SITES
(CLUSTER)
Town of Qaa
Town of Ras Baalbek

Figure 6-2. Areas Technically Suitable for Solar Development near Harbata-Toufiqiyeh

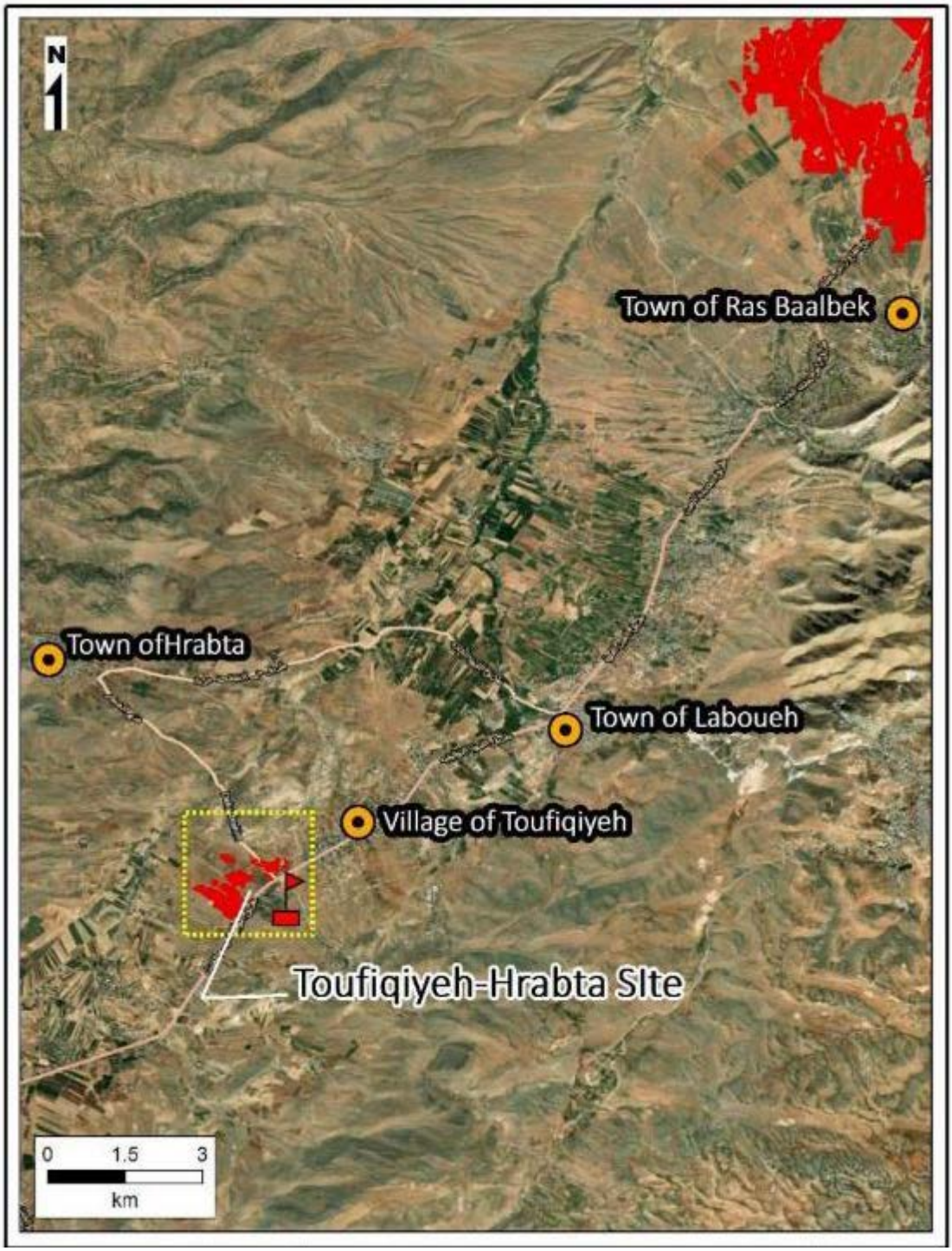


Figure 6-3. Areas Potentially Suitable for Solar Development near Maqneh

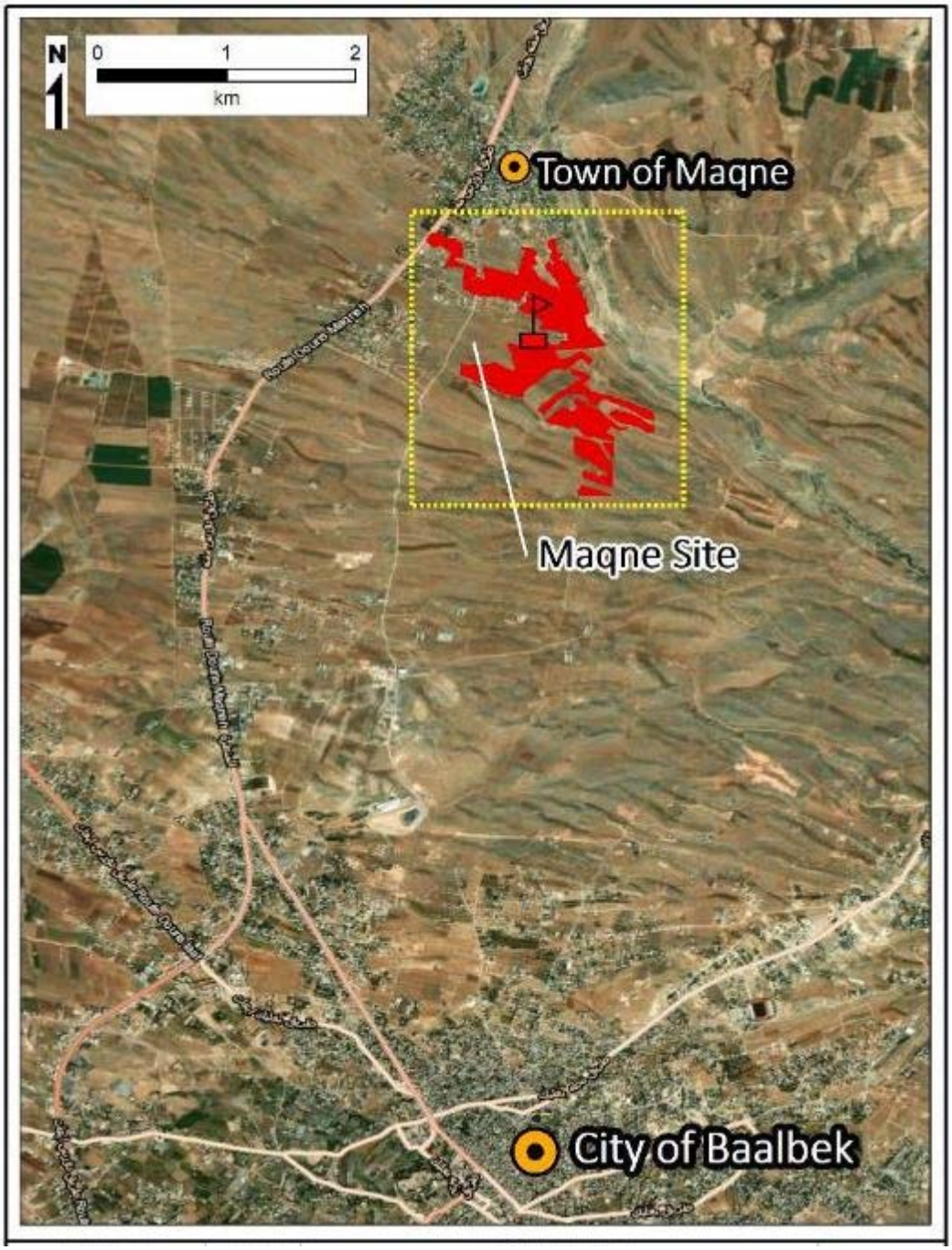
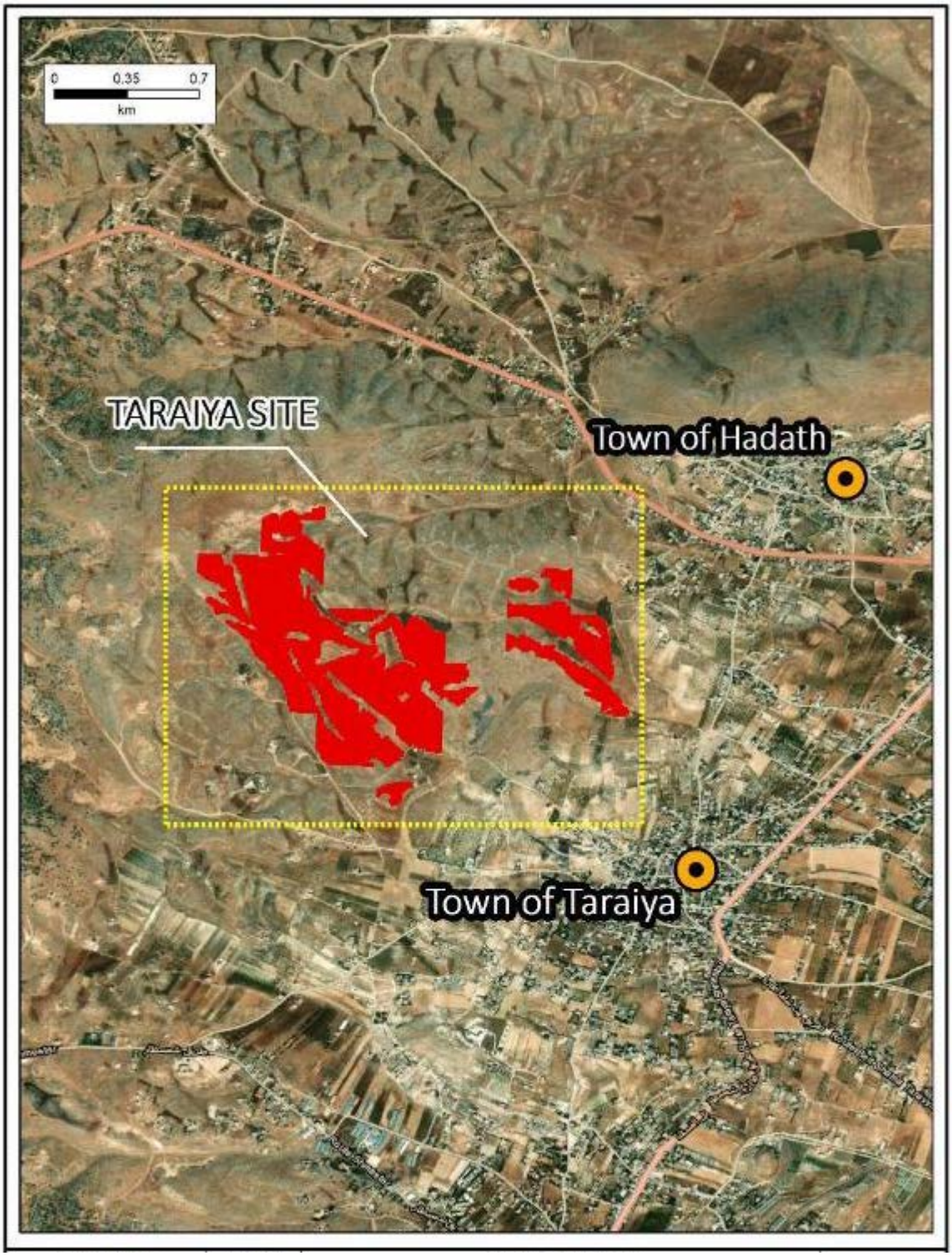


Figure 6-4. Areas Potentially Suitable for Solar Development Near Taraiya



6.2 Climate and Air Quality

6.2.1 Climate

Lebanon's Mediterranean climate can be subdivided into three broad climatic trends: the coastal, the mountainous and the inland (MoPWT, UNDP & GEF, 2005). All areas potentially suitable for solar development fall in the inland zone, where the climate is mild and moderate, with winters that are cold and wet and summers that are hot and dry. Projections indicate that the Mediterranean region,

particularly the Middle East and North Africa (MENA), will experience a significant decrease in precipitation.

6.2.2 Air Quality

All areas are situated within predominantly agricultural areas without significant heavy industry, so there are no major point sources of air pollutant emissions. It appears there is some limited presence of smaller industrial facilities across the areas of concern, but again no major sources of air emissions. Vehicular emissions, particularly along the international roads, and point and non-point source emissions from agricultural activities stand out as primary contributors to atmospheric pollution within the region. However, ambient air quality is generally good and within national standards.

6.3 Topography and Landscape

All the prospective areas for solar development are broadly characterized by gently rolling terrain with slopes less than 5 percent (one of the criteria for technical inclusion). The landscape in the region is predominantly arid/semi-arid semi-desert steppe-like lands covered with grass, shrubs and occasional trees/orchards (photographs 1 through 5).

Photograph 1. Typical Landscape at Potential Site Near Qaa

Photograph 2. Typical Landscape Near Ras Baalbek

Photographs 3. Typical Landscapes Near Harbata-Toufiqiyeh

Photograph 4..Typical Landscape Near Maqneh

Photographs 5. Typical Landscape Near Taraiya

6.4 Regional Geology

The geology at all four site locations is presented by the formations of the Upper Cretaceous and mid-Cenozoic periods. These formations are characterized by high porosity, ranging from 20% to 40%, due to their chalk and marly limestone composition. The mid-Cenozoic era encompasses the Neogene period, subdivided into the Miocene and Pliocene epochs. The Cenozoic formations feature a mix of siliciclastic and carbonate deposits with moderate porosity. Additionally, Miocene basalts are present, typically exhibiting lower porosity unless fractured.

6.5 Seismicity

Ras Baalbek, Qaa, Hermel Sites. Qaa is located in a seismically active region, influenced by its proximity to both major and minor faults within the Dead Sea Transform Fault system. The Yammouneh and Serghaya faults are the primary sources of seismic activity, with Qaa situated approximately 15 to 20 kilometers east of the Yammouneh Fault and 30 to 35 kilometers north of the Serghaya Fault. The presence of nearby minor faults further contributes to the seismic risk, with historical seismicity indicating a range of low magnitude events in the region.

Ras Baalbak is situated approximately 650 meters southeast of the Marah Baqdach A1 strike-slip fault and there may be nearby or underlying blind faults. The project site is located about 1.5 kilometers east of the Bekaa Syncline. The geological composition of the area generally consists of moderately stable ground, characterized by consolidated alluvial deposits and detrital sediments. Historical seismic activity in the region includes earthquakes with magnitudes ranging from 2.5 to 2.9, suggesting a relatively low seismic risk.

Harbata-Toufiqiyeh Site. Harbata is located at the beginning of a minor fault, beneath the Ain Aata-Lebweh Fault, and in proximity to the major Serghaya Fault. The Rachaya and Serghaya faults

represent the easternmost branches of the Dead Sea Transform Fault within the Lebanese restraining bend. The overall seismic risk is considered to be low in this specific area.

Maqneh and Taraiya Site. As for Maqneh, it lies approximately 10 to 15 kilometers east of the Yammouneh Fault and 25 to 30 kilometers west of the Serghaya Fault. These major faults are known for their left-lateral strike-slip motion which are known as sources of seismic activity. Additionally, the presence of numerous minor faults in the vicinity contributes to localized seismic events. Overall, the seismic risk can be concluded as low.

6.6 Hydrography and Surface Water Quality

The region is drained by two primary watercourses, the Al Assi River and the Litani River. The distances between these rivers and various sites within the area are as follows:

- Hermel-Qaa sites: This site lies within the Assi River Watershed, situated within some 300 meters to 1.5 kilometers west of the Assi stream channel. Surface runoff and drainage predominantly follow a northwest trajectory. The Assi is characterized by perennial flow. The water from Assi River is predominantly used by nearby communities and businesses for agricultural (irrigation) purposes.
- Ras Baalbek sites: the pre-selected areas are located within approximately two kilometers east of Assi stream channel and about 35-40 kilometers from the Litani River.
- Maqneh site: Situated 35 kilometers from the Assi River and approximately 12 kilometers in a straight-line distance from the Litani River.
- Harbata sites: Located 24 kilometers from the Assi River, and around 25 kilometers from the Litani River.
- Taraiya sites: there are no natural watercourses or other water bodies situated in close proximity to the area.

6.7 Land Use

None of the areas include land in private ownership and none of the land is being used intensively, with some of the areas subject to livestock grazing. In Qaa, the land available for the project is a Mashaa owned by the Ministry of Finance but managed by the municipality of Qaa. The proposed site in the Qaa-Hermel area presents a semi-arid steppe landscape characterized by a low land capability with limited organic matter but higher clay contents. Some nearby lands are used for irrigation, and there are some modern irrigation systems.

The technically suitable areas near Ras Baalbek are situated in close proximity to a station for the Lebanese Army. It is also located six kilometers from Kamouh Al Hermel, an historical pyramid overlooking the site, and five kilometers from the Green Project managed by the Ministry of Agriculture, which predominantly houses stone pine trees. The area is also 10 kilometers away from Mar Touma Hill, a protected site owned by the Church. The landscape is semi-arid/arid and steppe-like, featuring low land capability characterized by minimal organic matter but higher clay contents. Sparse shrubs dominate the landscape, with many being endemic species. Goat and sheep droppings further indicate grazing activities within the area, although no one has rights for using the land.

The suitable areas in Harbata are owned by the municipality. Situated across the highway from Toufiqiyeh village, the region is characterized by a forest primarily populated by brutian pine (*Pinus*

brutia) and stone pine (*Pinus pinea*). The landscape is semi-arid and rocky steppe /semi-desert, with soil exhibiting low organic matter and high clay content, thus indicating limited agricultural potential. Grazing activities are evident, with numerous goat and sheep droppings scattered across the property, indicative of regular livestock grazing. Additionally, the area is frequented by local bird hunters, particularly targeting Ruffed grouse.

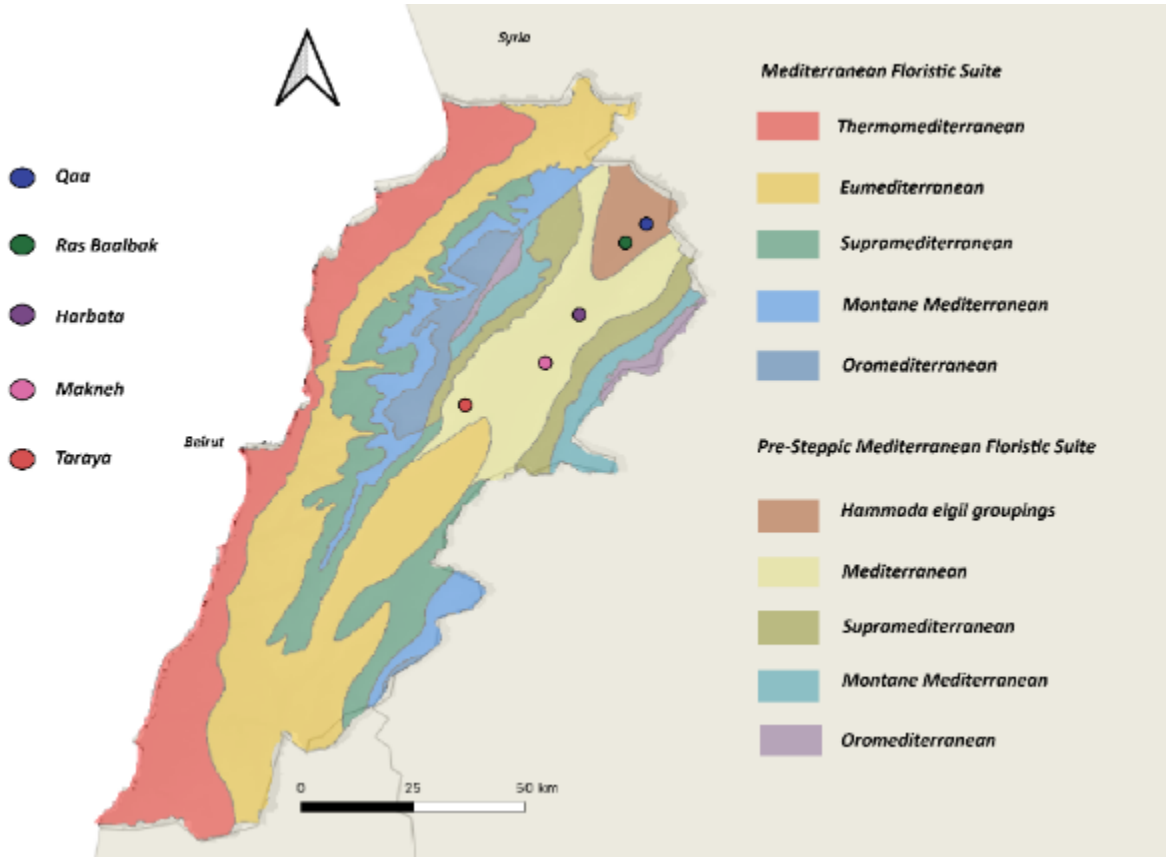
The Maqneh area is owned by the municipality of Maqneh. It presents the potential for expansion to a total of two square kilometers through the rental of adjacent private lands. Characterized by low land capability, the property features abundant clay content, sparse rocks compared to neighboring areas, and minimal organic matter. Similar to other sites, goat and sheep scats gives evidence of grazing, which is characterized as being of medium intensity by the mayor of Maqneh.

6.8 Biodiversity

Potential solar sites located at Qaa and Ras Baalbek are found within the *Hammada eigii* groupings of the Pre-steppic Mediterranean floristic suite, while the other three sites located at Harbata, Maqneh and Taraya are found within the Mediterranean pre-steppic vegetation zone Figure 6-5).

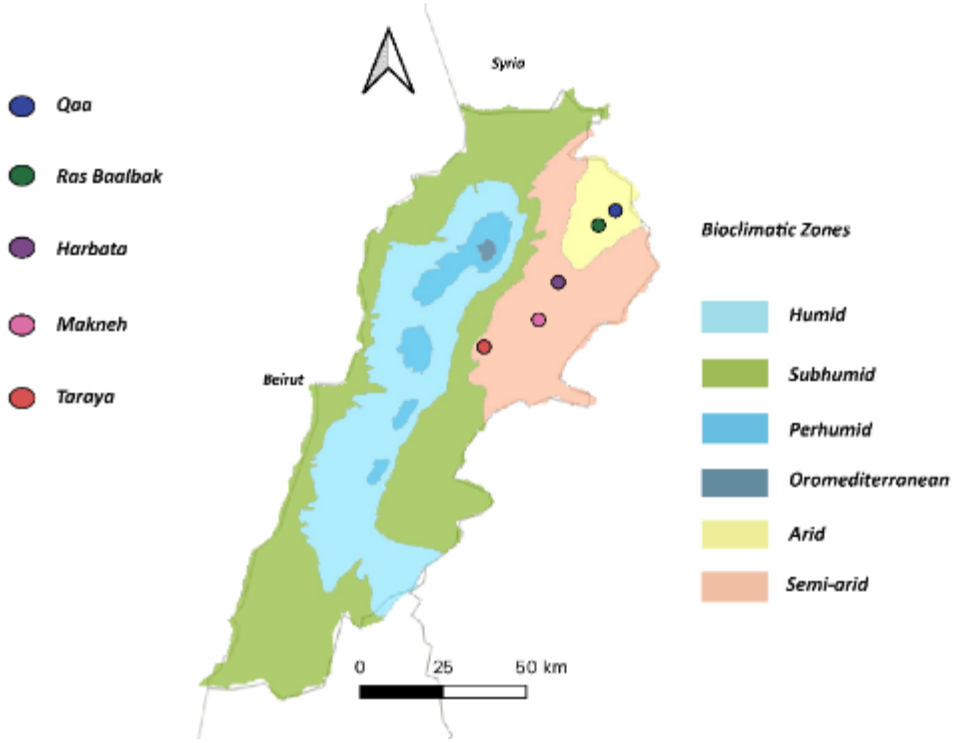
Figure 6-5. Schematic Map Of Ecosystems Of Lebanon

(*adapted from, Abi-Saleh & Safi, 1988; Safi, 2012)*, *prepared using* QGIS 3.16.3 (QGIS.org, 2020).



All of the potential solar PV sites of the Bekaa Valley are found within the arid to semi-arid bioclimatic zones, using the Emberger's bioclimatic zones classification of the Mediterranean (Figure 6-6).

Figure 6-6. Bioclimatic Zones of Lebanon



6.8.1 Flora

Vegetation within the sites and around the potential solar sites is adapted to a lower-than-average precipitation level, about 500mm per year, and to lower organic matter within the soil but higher clay content. Between the list of flora species that were encountered, or that were previously seen within and around the sites, no species is listed as being of conservation concern according to the IUCN Red List of Threatened Species, but most floral species have not yet been assessed. Among the species that are known to occur, including species observed during the site visit, many endemic to the Eastern Mediterranean, to Lebanon and adjacent countries, or to Lebanon solely. All of the potential sites support a number of endemic species, as shown in , including 24 species in the Qaa site, 41 species in the Ras Baalbak site, 13 species in the Harbata site, 21 species in the Maqneh site and 24 species in the Taraya site. In the semi-arid environments surrounding the Harbata, Maqneh, and Taraya sites, average precipitation is 500mm per year and vegetation is typical for a pre-steppic Mediterranean vegetation zone. The region and three of the sites are rich in floral biodiversity, supporting large numbers of plant species. Of herbaceous species listed by IUCN, most are not characterized as to conservation status, but most species are endemic to the Mediterranean region or to Lebanon itself.

Table 6-1. Floral Endemism at Potential SPP Sites

Location/Area	*Total number of herbaceous species*	*Percentage endemic*
Qaa	43	55.8
Ras Baalbak	61	67.2
Harbata	18	72.2
Magneh	26	80.7

Location/Area	*Total number of herbaceous species*	*Percentage endemic*
Taraya	29	82.7

6.8.2 Fauna

A total of 28 species of mammals are known to inhabit the area, with none confined to the region. The species is listed as Endangered by the International Union for the Conservation of Nature *IUCN), the Indian wolf (*Canis lupus pellipes),* two are *listed as Vulnerable, Hyena (Hyaena hyaena)* and the Marbled polecat (*Vormela peregusna syriaca*), and the remainder are not listed (seven species). The habitats that are suitable for solar development would support prey species for each of the species of concern, but would not be particularly valuable for them, as the habitats are common and widespread. Indeed, they could coexist with the operating facilities.

The area supports a great many bird species in residence or during migration, and the region is home to a number of Important Bird Areas recognized by BirdLife International. Across Lebanon as a whole, 404 bird species have been identified across Lebanon as a whole : 284 passage migrants and/or winter visitors, 69 vagrants, 73 summer breeders, and 65 breeding residents. Of these, 39 species are listed by IUCN as of conservation concern, including several waterfowl and wading species that would not be found on the sites but also including several species of raptors, vultures, and grassland birds, which would likely be occasional visitors or as sources of prey.

Given the semi-arid to arid nature of the region, it is not surprising the region is reported to support 22 species of reptiles, including seven species not listed by IUCN, 11 species of Least Concern, one species listed as Vulnerable (Greek tortoise, *Testudo graeca*) and two as Endangered (Lebanon viper, *Montivipera bornmuelleri*; Lebanese thin-toed gecko, *Mediodactylus amictopholi*; and Kulzer's rock lizard*, Phoenicolacerta kulzeri.* None were observed at the sites, and none would be confined to the sites.

As in most places, macroinvertebrates are not well studied. Based on the literature and site observations, lepidoptera (butterflies and moths) include 10 species of Least Concern and seven not listed. Of 26 other species listed by IUCN, five are of Least Concern, 20 are not listed, and one is Data Deficient.

6.8.3 Habitat

The sites are not in or near enough to affect any areas that are protected by law or that are recognized for their biodiversity value. There are a number of Important Bird Areas nearby, but all at sufficient distance that there would be no effect on resident birds or passing migrants.

The prospective solar sites are not natural habitats but rather are modified by human activities. Even though there are native species, the areas are subject to livestock grazing, and indeed this makes the areas more suitable for some floral species by increasing organic content of soil. However, all the areas do support endemic species. World Bank Environmental and Social Standard 6 defines “critical habitats” as those that are high of biodiversity importance or value, including (1) habitats of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches; (2) habitats of significant importance to endemic or restricted-range species; (3) habitats supporting globally or nationally significant concentrations of migratory or congregatory species; (4) highly threatened or unique ecosystems; and (5) the ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above.

Although there are IUCN-listed reptile species known to inhabit the general areas, the habitats at the solar sites are common in the region and would not be necessary for the species’ or even

populations' survival. Sufficient information is not available to dismiss the possibility that one or another of the sties is important to one or more of the endemic plant species, although the fact that the habitat type is somewhat degraded and is common in the region suggests they may not be important to the species; this would need to be verified during project planning. It is noted that other locations within or near the technically acceptable areas that are farther from roads or villages may be less modified, possibly to the point of being natural habitat.

Table 6-2. Solar Sites and Critical Habitat Under ESS6

Criterion	*Definition*	*Solar sites?*	*Justification*
1	habitats of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches	No	Some IUCN-listed EN species, but habitats potentially affected not of significant importance to these species.
2	habitats of significant importance to endemic or restricted-range species	Possibly	Further information needed on ranges and occurrence of species endemic to Lebanon
3	habitats supporting globally or nationally significant concentrations of migratory or congregatory species	Possible but unlikely	No known concentrations, and habitats are not uncommon
4	threatened or unique ecosystems	No	Common habitats in the region
5	the ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above.	No	Fairly typical functions and characteristics for the region

6.9 Ambient noise

During the site visits, rapid noise assessment surveys were conducted at the pre-selected sites. Noise levels were relatively high at most sites due to strong winds. Except the site near a road, there was little or no anthropogenic noise.

6.10 Social and Economic Baseline Conditions

6.10.1 Demography

Baalbek is the largest administrative district (Caza) in Lebanon, covering approximately 21.8 percent of the country's total land area. The district has an estimated population of 214,600, with an average household size of 4.2 members (CAS, 2020). Data provided by the Municipality of Harbata indicates notable seasonal fluctuations in population, with the number of residents increasing from 2,000 in winter to 6,000 in summer. The population of Harbata predominantly consists of Shiite Muslims, with a smaller Sunni minority, and includes around 100 refugees residing in households.

In Maqneh, the population during winter is about 5,000, increasing to 7,000 to 8,000 during the summer months. Additionally, the town hosts around 2,000 refugees residing in two camps. The population of Maqneh consists of Shiite Muslims.

In Qaa, the population is about 10,000 permanent Lebanese residents, including about 7,000 individuals who have settled in Qaa after relocating from other towns due to past conflicts. During the summer season, the Lebanese population surges to about 14,000. Furthermore, Qaa

accommodates a substantial population of Syrian refugees, estimated at around 33,000. The predominant religious affiliation in Qaa is Maronite, reflecting the community's cultural and religious diversity.

Ras Baalbek has a permanent population ranging from 4,000 to 6,000 residents. During summer, this figure significantly rises with the influx of 10,000 to 12,000 seasonal residents and 2,000 registered Syrian refugees, resulting in a total summer population of 16,000 to 20,000. Conversely, the winter population decreases to around 8,000. These seasonal variations underscore the dynamic demographic dynamics in Ras Baalbek, influenced by both permanent and transient populations.

6.10.2 Social Services

In Harbata, educational resources are limited, with only one middle school available. Consequently, students must commute to neighboring villages such as Labwa, Ras Baalbek, and Al Ain for access to high school education. University studies necessitate travel to Zahle, located approximately 69 kilometers away. Health care services in Harbata are also restricted--although the village maintains a municipal dispensary, there is no hospital. Residents must travel to Baalbek for hospital services, although plans are underway to establish a hospital within Harbata.

In Maqneh, there is one intermediate public school. Healthcare accessibility is limited, as the town lacks a hospital; the nearest health care facility, Dar Hekme's Hospital, is 3-4 kilometers away. However, Maqneh does operate a dispensary to address immediate medical needs.

In Qaa, there are four public schools, a technical institute, and a single private school. However, higher education opportunities are not locally available, necessitating students to commute to Zahle or Beirut for university studies. As for health care infrastructure, there is no hospital but there is a health care center in the area and a social affairs center serves the community's welfare needs.

In Ras Baalbek, there is one dispensary, and the nearest hospital is in Hermel. Therea are two public schools and two private schools but no local university.

6.10.3 Infrastructure

Harbata has no centralized wastewater treatment, so residents rely septic systems, which often cause discharges into the valley. Solid waste is collected and transported to an open dumpsite. There are plans to construct a solid waste sorting facility in Harbata to serve all municipalities within the Union of North Baalbek Municipalities.

The potable water supply in Maqneh primarily relies on two artesian wells, one managed by the Bekaa Water Establishment and the other by the municipality, both powered by local solar energy. Similar to Harbata, Maqneh relies on open-ended septic tanks. Solid waste management involves municipal collection and transportation to Baalbek's sorting facility. Electricity provision by EDL amounts to 10 hours per day, supplemented by private solar panels installed on residents' rooftops, as there are no private generators in the village.

Qaa relies heavily on artesian wells for its water supply, supplemented by ongoing initiatives aimed at capitalizing on floodwaters for additional water resources. Electricity from EDL is accessible for four hours daily, segmented into two-hour intervals across both day and night. Residents are progressively turning to rooftop solar panel installations, diminishing reliance on private diesel generators within the town. Solid waste management involves municipal collection and disposal in

an open dumpsite. Septic tanks are used for domestic wastewater. The contents of these tanks are emptied into a designated area adjacent to the solid waste disposal site.

Ras Baalbek relies on three public wells operated by the Bekaa Water Establishment for water supply, while irrigation water is primarily sourced from the Hoseib spring. EDL provides electricity for four hours per day, also distributed into two-hour intervals. Rooftop solar panel installations are becoming more prevalent among residents, eliminating the necessity for private diesel generators. Similar to the other towns, Ras Baalbek faces challenges in wastewater management, with most homes and businesses resorting to seepage pits or cesspools. Similarly, the area lacks proper municipal solid waste management infrastructure, with waste collected by the municipality and disposed of in an open dumpsite.

6.10.4 Economy

In Baalbek district, the total labor participation rate stood at 43.9 percent, below the national average of 48.8 percent. Gender disparity is pronounced, with men exhibiting higher participation rates (68.2 percent in Baalbek and 70.4 percent nationwide) compared to women (21.9 percent in Baalbek and 29.3 percent nationwide). The services sector is the predominant employment sector for both genders in Baalbek, with 89.9 percent for women and 67.3 percent for men. Notably, women surpassed men by 22.6 percentage points in this sector at the caza level. A distinct trend was observed where a smaller proportion of working men (21.8 percent) and women (5.1 percent) were engaged in industrial activities in Baalbek. Employment in agriculture was reported at 10.7 percent for working men and 4.8 percent for working women.

In Harbata, residents primarily derive income from public sector employment (40 percent), agriculture (30 percent), and trade (30 percent). The majority of agricultural land is devoted to rainfed crops, with some irrigation water obtained from Labwe Spring.

Maqneh's economy landscape is dominated by grazing activities and limited agriculture. The cultivation of lentils, once prominent, has declined, with wheat and other grains becoming more prevalent. Fruit trees are commonly cultivated by residents within their premises. Public sector employment, particularly in the army, serves as the primary livelihood source, supplemented by opportunities in professions sch as medicine and craftsmanship. The town also houses two brick industries, although only one is presently operational.

In Qaa, agriculture and tourism serve as the primary sources of income. The agricultural sector boasts a diverse range of crops, including apricots, peaches, grapes, cactus, apples, cherries, pears, lettuce, eggplants, tomatoes, wheat, and zucchini. Qaa's historical significance attracts tourists, with landmarks such as the Monastery of the Lady of Hill, Saint Georges Church, Saint Charbel Church, Saint Elias Church, and Saint Maroon Monastery drawing visitors. Roman and Ottoman ruins contribute to the village's historical allure, while traditional mud and thatch houses showcase Lebanon's heritage. Regarding industrial activity in the town, there is a brick industry and factories that manufacture food products from agricultural crops, such as makdous and jams.

Ras Baalbek boasts a diverse commercial landscape, featuring 16 poultry farms, three cattle farms, and 12 goat and sheep farms, indicating a focus on livestock agriculture. Additionally, the area hosts 3 gas stations and 9 car repair shops, catering to transportation needs. Small-scale enterprises further bolster economic diversity and resilience in Ras Baalbek.

6.10.5 Vulnerable Groups

In Baalbek Caza, women, the elderly, seasonal workers, and Syrian refugees are recognized as vulnerable communities. These groups face distinct challenges and are particularly susceptible to economic and social hardships. Women often encounter gender-specific barriers that limit their access to resources and opportunities. The elderly may struggle with health issues and lack adequate support systems. Seasonal workers, who constitute a significant portion of the population during peak times, typically face job insecurity and unstable living conditions. Syrian refugees also contend with displacement-related difficulties and integration challenges.

6.10.6 Cultural Heritage and Tourism

El-Qaa, known for its historical significance and stunning landscapes, attracts visitors from diverse cities and countries, showcasing a rich tapestry of cultures and stories passed down through generations. Notable landmarks include the ruins of Naamat El Tahta, situated beneath the ruins mentioned earlier and overlooking the plain, consisting of caves and wells that collect water. Sitt Balkis Canal, originating from Labweh and traversing to the Syrian Desert, terminates at the famed Hammam Abu Rabah, known for its geothermal springs. Adjacent to the canal lies the Castle of Sitt Balkis, which historically utilized water from this source. Additional ruins such as Damina, Zbib, Naqib, Naamat El Faw'a, Nasrani Valley, and Baayoun contribute to El-Qaa's rich historical tapestry. The Banjakiya Mill, a relic from the early Ottoman Empire, still stands as a testament to El-Qaa's industrial heritage (Photographs 7-6). Natural attractions like the expansive lake offer serenity and joy to both local and international visitors. Furthermore, the region boasts remarkable engineering feats such as Al El Aswad Canal and the White Canal, facilitating water transport across the landscape. The Gardens, surrounding Saint George Church, reflect the area's agrarian history dating back to the 19th century. George Mikhael Farha Residence, constructed in 2018, epitomizes the traditional architectural style of El-Qaa, featuring clay construction and various amenities such as a fireplace, oriental living room, and water fountain. Though many historical structures have faded into ruins, El-Qaa's allure persists, drawing visitors to explore its captivating history and natural wonders (El-Qaa, n.d.).

The Ruins Of Damina

The Banjakiya Mill

The lake

Photographs 6-6. Cultural and Touristic sites in Qaa

Ras Baalbek is a region steeped in historical significance, with continuous human occupation tracing back to the 8th millennium B.C.E. This rich heritage is evident through numerous archaeological sites spanning various eras. During the Neolithic period (8000–6000 B.C.E.), numerous tells—artificial mounds formed by the accumulation of successive human settlements—were identified between Hermel in the north and Baalbek in the south. Moving into the Chalcolithic period, beginning around the 6th millennium B.C.E., surveys uncovered 15 tells in the same area. The Bronze Age (circa 4000 B.C.E.) also saw the presence of 15 tells scattered between Hermel and Baalbek. The Roman period (1st century B.C. to 5th century A.D.) left its mark with remains of temples and necropolises, particularly visible in Ras Baalbek. This continuous sequence of occupation highlights the area's long-standing cultural and historical significance.

Harbata exhibits a fusion of historical and cultural facets, representative of its profound heritage. The village is characterized by traditional Lebanese architecture, exemplified by structures crafted from mud and thatch, emblematic of the area's rustic way of life. Additionally, local artisanal crafts like pottery and weaving add depth to Harbata's cultural legacy, preserving age-old traditions and craftsmanship within the community. The only town with archaeological ruins is Ras Baalbek. These ruins date back to the Roman, Byzantine, and Crusader eras. However, according to the municipality, the project site is far away from these ruins.

None of the prospective solar sites that were visited appear to have archaeological value or other artifacts, at least not visible on the surface or otherwise known. However, large areas were not visited and it cannot be ruled out that some locations may contain undiscovered artifacts or other cultural heritage.

6.11 Land Use and Land Acquisition

6.11.1 Categories of Land in Lebanon

In Lebanon, land ownership is generally classified into three categories: private land (Mulk Khas), Public or Common Land (Musha or Matrika), and land dedicated to a specific purpose which is not registered as useable property (Waqf, or “dedicated”). The Land Property Code of Lebanon enacted by Decree 3339 of 12 November 1930, as amended, identifies five different types of real estates (properties) as follows:

- Private Land (Mulk/ Milk) – Land susceptible to full ownership lying within the perimeter of administratively determined built up areas. This is the only category of land that can be sold and purchased.

- State Land (Amiri) – Land owned by the State but on which individuals may have land-use rights on it (taarof). This type of land today is like mulk (private property) mentioned under category I above.
- Public Land (Metrouke murfaka) – Land owned by the State but subject to a right of collective use, usually governed by local customs or administrative regulations. Land within the borders of municipalities is controlled by the municipalities, which previously had complete control and could sell or otherwise dispose of the land. An amendment to the Land Property Code (by Law No. 173 of 14 February 2000, Budget 2000) placed restrictions on the municipalities' freedom, and they now must obtain the prior approval of the Council of Ministers, based on the recommendation of the Minister for Finance and the Minister for Municipal and Rural Affairs, in order to sell or otherwise dispose of Public Land.
- State/ Government Land (Metroke mehmi) – Land that belongs to the State at the governorate or municipality level, and which is part of the public domain (e.g., streets, public squares, public gardens and public markets).
- Empty and Free Land (Khalie mubah) – land that has not been inventoried and delimited, and on which the first occupant with the State's permission acquires a right of preference. It is considered to be State private property and includes empty lands, forests, mountains, etc.

6.11.2 Lands in the Project Areas

The identified solar sites are all on Public Land (Category III above). Although it may be used communally, this type of land can be disposed of with prior approval of the Council of Ministers. The mayors of the municipalities in which all four sites are located reported that they would have no objection to transferring the land to EDL. Thus, the municipality and the Council of Ministers could transfer/reassign the title (through *Thakhsees*) to the name of EDL on lease, rent, sale for a specified period time. To this effect, a consensus would need to be developed among the stakeholders (i.e. EDL, Ministry of Finance, municipalities and local communities) regarding tenure, rent, lease concession, benefit-sharing, etc. Once agreement is reached, the land would be transferred or retitled to EDL through a ministerial decree. Such stakeholders as the Ministry of Finance, Ministry of Water and Energy,, EDL, Mayors and community leader generally agree to follow the procedure of *Takhsees* (dedication of land), which is reported not a difficult or lengthy process to implement.

As noted previously, the technical screening excluded residential areas, so there would be no physical displacement. The land does appear to be subject to light or medium grazing, and this would have to end on sites where SPPs were located. The degree of economic displacement this could cause is unclear, but would certainly be relatively minor, given the abundance of similar land available for similar use.

7. Stakeholder Engagement During Site Visit

On May 21, 2024, during the visit to the areas that had been found to be suitable for solar PV development, the site visit team met with stakeholders in the municipalities of Qaa, Ras Baalbek and Maqneh were consulted and interviewed. Stakeholders were given a brief explanation of the reason for the visit—the identification of certain areas in their municipalities as being technically suitable for SPP development—and asked about the characteristics of their populations and towns/villages. All who participated in the meeting were well aware that land was being considered for SPP

development and had a favorable opinion of such development. The perceptions and comments from these individuals are summarized in Table 7-1.

Table 7-1. Consultations During the Site Visit

Stakeholder	*Short description of stakeholder*	*Comments/feedback received*
Municipality of Qaa	• Mr. Bashir Matar • Mayor of Ain: Mr. Zakariya Noureddine	• Several studies have been conducted in the region to assess the viability of solar energy utilization, with the latest one conducted by LCEC focusing on CSP technology. These studies have indicated that Ras Baalbek exhibits optimal conditions for solar energy production. The planned project in Ras Baalbek aims to generate 70MW of solar power. • The surface area of Qaa spans 182km² and is divided into four cadastral areas, with three of them remaining undivided (غير مفرز). The municipality owns approximately 12 million m² of land in Qaa, with one-third allocated for industrial purposes. • Agriculture is the predominant type of land use in Qaa, encompassing 60 percent of its area and primarily utilizing drip irrigation systems. Prevalent crops include apricots, peaches, grapes, cactus, apples, cherries, pears, lettuce, eggplants, tomatoes, wheat, and zucchini. • The land proposed for the project belongs to the municipality. • Qaa relies mostly on artesian wells for its water supply, with ongoing projects aimed at utilizing floods to capture water and awaiting the implementation of the Assi River project. • Electricity supply from EDL amounts to four hours per day, split into two-hour intervals during the day and night. • Residents have increasingly turned to solar panel installations on their rooftops, eliminating the presence for private diesel generators in the town.
Municipality of Ras Baalbek	Municipality staff: Walid Fayad, Wadiaa Nabaa and IT at the municipality	• Surface area of the town: 176,150,000m$^{2.}$ • Population is 11,000 in the summer and 7000 in the winter. • According to a study by LCEC, Ras Baalbek experiences 320 sunny days per year, making solar energy highly favorable in this town. • Electricity from EDL is available for four hours per day, in two-hour intervals during the day and night. As in Qaa, residents have increasingly installed solar panels on their rooftops, eliminating the need for private diesel generators in the town. • It is expected that on January 1, 2027, construction of a PV farm will commence, implemented by Shams Baalbek Company. • The primary source of potable water is three artesian wells operated by the Bekaa Water Establishment. • Solid waste is collected by the municipality five days a week and disposed of in an open dumpsite. A local NGO has implemented awareness campaigns to encourage sorting at the source. However, since the

Stakeholder	*Short description of stakeholder*	*Comments/feedback received*
		sorted waste could not be sent to a nearby sorting facility, all sorted waste ends up at the dumpsite. • Ras Baalbek has two public schools and two private schools. There are no universities in Ras Baalbek, so students attend universities in Zahle or Baalbek. • There is no hospital in Ras Baalbek; the nearest hospital is Hermel Hospital. The village has only a dispensary. • Approximately 4 km² of land is available for a solar farm. The proposed site is located between Qaa, Ras Baalbek, and Hermel.
Municipality of Harbata	Mayor of Harbata	• The proposed site is approximately 1.3km² of rocky land owned by the municipality. • The population is 2,000 in the winter and 6,000 in the summer. • There is only one middle school; students travel to nearby villages (Labwa, Ras Baalbek, and Al Ain) for high school and to Zahle, which is about 69 km away, for university. • There is no hospital in the village, but the municipality has a dispensary. The nearest hospital is in Baalbek, 25 km away. There are plans to build a hospital in Harbata. • Solid waste is collected by the municipality and disposed of in an open dumpsite. There is a plan to build a sorting facility for the Union of municipalities in Harbata.
Municipality of Maqneh	Mayor of Maqneh:. Fawwaz Mokdad	• The proposed site is 0.6 km² and is owned by the municipality. This area can be increased to 2 km² by renting private lands located between these plots at a price of $0.1/m²/year. • Electricity is primarily supplied by EDL at a rate of 10 hours per day, supplemented by private solar panels located on rooftops. There are no private generators in the village. • The village has 5,800 voters. • The lands in the village are mostly used for grazing and some agricultural activities. • There are no archaeological sites in Maqneh, but there are caves in the mountains. However, these caves are not considered historical.

8. Environmental and Social Screening

This section discusses the Area of Influence within which impacts could occur and identifies the environmental and social risks and impacts that may result from development of SPPs, in general and in the areas visited. The potential need for mitigation measures to avoid or minimize likely risks and impacts is identified and outlined. The risks and impacts, and mitigation measures, are necessarily described at a relatively high level, given the nature of the screening exercise. with detailed mitigation measures to be defined in subsequent more detailed assessments, which are yet to be defined. Some potential impacts will need a deeper assessment in order to determine their

actual significance, and the specific mitigation measures that will be needed to avoid or reduce them to acceptable levels.

8.1 Project Area of Influence

The Area of Influence in which potential impacts could occur would be primarily on the sites selected for so we're development. However, due to the nature of the landscape, most or all of the SPPs would be within the view of one or more villages, and security lighting could be visible at even greater distance. At some locations, drilling, blasting (which is considered unlikely but possible), and the use of heavy equipment would generate noise that might be audible in the nearest villages under certain conditions. In addition, it is likely that workers would be accommodated in nearby towns rather than housed on site and that could have adverse and positive effects on local residents.

For these reasons, the Area of Influence would extend to at least the nearest town. The most significant traffic would be near the sites, so the roads between nearby towns would also be in the Area of Influence. Finally, each of the SPPs would have to be connected to the National Grid. Some of the prospective sites are within just a few kilometers of high-voltage transmission lines/substations but some maybe 10s of kilometers away. If these connecting lines, possibly with associated substations, are part of the development of the specific SPP, the corridors in which the lines where located would be part of the Area of Influence; on the other hand, if they are developed separately, they would be Associated Facilities within the meaning of World Bank ESS1.

8.2 Project Activities

The types of activities that will be necessary during development and operation of SPPs are introduced in

Table 4-1 above. In summary, those that may result in impacts to people, property, or the environment include:

- **Contractor mobilization**: land-clearing, site preparation and setup, transport and storage of equipment and supplies, installation of building/office, etc..
- **Construction:** drilling, blasting (unlikely), installation of panels, waste generation and management, worker and supplies transport, worker accommodation (unlikely on site, more likely in towns),. Transmission line corridor clearance, pole/tower and cable transport and installation, and substation construction, either as part of development of SPPs or separately (as Associated Facilities).
- **Demobilization:** removal and transport of Contractor equipment and waste/scrap, final inspection prior to handover and acceptance
- **Operation**: worker and equipment transport, security, lighting (likely), waste generation and management, panel cleaning, repairs as needed.

8.3 Topics Examined

Environmental and social topics of most concern include those in Table 8-1.

Table 8-1. Environmental and Social Topics Reviewed

Environmental and social management
Biodiversity (terrestrial flora, fauna, habitats)
Water resources (surface water and groundwater)
Materials and waste management
Air quality
Site Security
Socio-economics: employment generation, electricity supply
Community health, safety, and security (including nuisances such as noise and lighting), grievance management
Labor management: forced labor, child labor, SEA/SH, grievance management
Occupational health and safety
Cultural heritage, including archaeological heritage

8.4 Potential Risks and Impacts

The key environmental and social receptors and the issues that could arise are listed in Table 8-2. As noted, this should be considered a high-level screening, with some areas requiring further investigation, assessment, and evaluation.

Of critical importance to successful development of the SPPs will be the ability of EDL to manage the development of the SPPs from procurement through construction and operation. At present, EDL does not have a functioning program or staff to evaluate or manage the environmental and social performance of construction Contractors, or to design and manage the environmental and social performance of the operating SPPs.

Table 8-2. Environmental and Social Screening of Potential Issues and Impacts

Environmental Aspect	*Potential Issue of concern*	*Project Impact/Mitigation*
Physical Environment		
Air Quality	• Air pollutant emissions from vehicle and other engines • Dust from ground-clearing and ground-disturbing activities • Dust from vehicle and equipment movement on unpaved surfaces	• Traffic emissions minor and temporary • Traffic and other dust throughout construction (in dry season) • Likely a minor issue--readily mitigated through GIIP: dust suppression, paved areas, rehabilitate, etc.
Hydrology and water quality	• Stormwater runoff and sedimentation of river from Ras Baalbek sites 250 away • Stormwater runoff and other discharges from construction camp if located near river	• Distance to surface water makes any direct impact unlikely • Could erode onto affect downgradient land • Readily mitigated through GIIP drainage and erosion control measures, location of camp away from river (100m+)
	Contaminated runoff due to leaks and spills of hazardous substances, including fuels and other hydrocarbons	• Limited storage and usage of hazmats in construction and operation: some fuels, lubricants, concrete (construction) • Readily mitigated through GIIP for hazmat management (see below)
Noise	• Noise in workplaces • Noise at nearby villages	• Construction noise could reach nearest external receptors under unfavorable conditions • Typical construction workplace noise exposure by workers • Readily mitigated with Noise Management Plan/Procedure, including monitoring in communities, and with OHS Plan for noise at SPPs
Soils	• Loss of soil due to erosion during construction or operation • Loss due to failure to salvage or poor storage • Contamination due to leaks/spills of hazmats (more likely in construction due to higher usage)	• Construction: some potential during wet season • Operation: limited potential from washwater discharge • Readily mitigated through GIIP for hazmat management and for topsoil salvage and storage
Materials and waste management	• See soils above • Some fire hazard from fuel and other hazmat storage • Worker exposure	• Only minor amounts likely to be stored or used in either phase • Readily mitigated through GIIIP for hazmat, OHS, and emergency planning and management
Biodiversity		
Biodiversity	• Possible presence of Endangered mammal and reptile species (known in region) • Land provides habitat for many endemic plant species • Disturbance, injury, death of wildlife • Possible disturbance of bird species of concern and IBA near Ras Baalbek	• Disturbance and/or displacement of EN species (if present) • Disturbance and destruction of endemic plant species: conduct critical habitat assessment to determine if land needed is significant for the species of concern—if so, BMP for avoidance of those sites or offset • Disturbance or loss of habitat at Ras

Environmental Aspect	*Potential Issue of concern*	*Project Impact/Mitigation*
		Baalbek site for EN species and possibly nearby IBA: conduct critical habitat assessment for site(s) near Ras Baalbek to determine if impacts on IBA would be significant • Possible recommendation to enhance protection of endemic species and enhancement of IBA
Community Health, Safety, and Security		
Community health, safety, and welfare	• Labor influx by contractors (disease, social disruption, strained infrastructure, sexual exploitation, abuse, and harassment) • Community disturbance due to noise under certain conditions (see above) • Community disturbance due to night security lighting	• Negligible to minor adverse impact: very small additional workforce (a few 10s per SPP), limited interaction with community • Influx impacts readily avoided/mitigated by GIIP for labor management (COC, etc.) and stakeholder engagement (GRM) • Lighting impact readily mitigated with GIIP (low-intensity lights directed inward) • Positive impact from stabilization and enhancement of electricity supply
Local, regional, and national economies	Changes ln employment and personal incomes	• Minor temporary positive impact on local economy due to temporary employment • Moderate positive impact on regional and national economy due to improvements in electricity supply
Cultural heritage	• Damage or destruction of valuable artifacts or heritage sites • Disturbance or damage to recognized cultural heritage	• No impact: no activities will take place in existing workspaces
Stakeholder engagement	• Community not aware of projects or potential issues or GRM • Community opposition,	• Failure to inform or consult can cause failure to gain community support, loss of “social license to operate” • Mitigated through working GRM and SEP-required two-way engagement
Workforce and Site Security		
Labor management	• Welfare of workforce: uncertain or improper employment conditions, inadequate compensation, failure to pay compensation, inadequate benefits and rights), appropriate terms and conditions that defined benefits, rights • Child or forced labor • Inadequate lines of communication between workers and management	• Generally adequate existing HR procedures, including employment contracts • Some impact on workers due to late payments • Labor management plan to be required (OHS and labor management) • Mitigated through compliance with Labor Code and strong HR program: voluntary employment contracts, COC, no underage or forced labor, working GRM
Occupational health and safety	• Worker injury or death due to unsafe working conditions or lack of training	Moderate risks due to nature of work: – No formal OHS program, no

Environmental Aspect	*Potential Issue of concern*	*Project Impact/Mitigation*
	• Risks would include falls, to workers from falls, impact, electricity, hazmats, H2S release basements and pits. • Unsafe working conditions and equipment • Worker injury or death	training, limited or no personal protective equipment provided or used – No records or statistics of past incidents—anecdotal reports of no serious injuries reported for years • Occupational Health and Safety Plan to be required, including incident recording/reporting
Site Security	• Illegal trespassing on SPPs by locals • Conflicts with local community • Conflicts with workers	• Distance to communities will reduce risk • Code of Conduct for contractors or employed personnel • Background checks for all security personnel by EDL or contractor to verify no past abuses. • Use-of-force training for all security personnel • Working GRMs for workers and communities (and security personnel)

9. References and Documentary Sources of Information

Abdul-Wahed, M. K., & Asfahani, J. (2017, September). New insight on the recent instrumental seismic activity along the Serghaya Fault, Syria. Geofísica Internacional. Retrieved from https://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0016-71692017000300243

Assaf, H., & Saadeh, M. (2006, January). A case study of Upper Litani Basin, Lebanon - researchgate. Retrieved from https://www.researchgate.net/publication/357609841_Integrated_Water_Balance_and_Water_Quality_Management_Under_Future_Climate_Change_and_Population_Growth_A_Case_Study_of_Upper_Litani_Basin_Lebanon

Dar El Handasah Shair and Partners. (2014). Greater Beirut Water Supply Augmentation Project, Environmental and Social Impact Assessment, Volumes 1 & 2, L12002-0100D, August 2014.

El-Qaa (n.d.). El-Qaa Through History. Retrieved June 2, 2024, from https://www.elqaa-lebanon.com/en/history.php

Climate-Data.org. (n.d.). Climate: Harbata. Retrieved June 2, 2024, from https://en.climate-data.org/asia/lebanon/qada-baalbak/harbata-420183/

Climate-Data.org. (n.d.). Climate: Maqne. Retrieved June 2, 2024, from https://en.climate-data.org/asia/lebanon/qada-baalbak/maqne-419827/

Climate-Data.org. (n.d.). Climate: Ras Baalbek. Retrieved June 2, 2024, from https://en.climate-data.org/asia/lebanon/qada-baalbak/ras-baalbek-47462/

Dar Al-Handasah (Shair and Partners). (2012). Lebanon Earthquake Hazard Assessment and Seismic Risk Study.

Darwish, T., Jooma, I., Awad, M., Abou Daher, M., & Msann, J. (2005). Inventory and Management of Lebanese Soils Integrating the Soil Geographical Database of Euro-Mediterranean Countries. Lebanese Science Journal, 6(2).

Darwish, T. (2016, June 30). National priorities for Sustainable Soil Management in Lebanon (Rep.). Retrieved August 13, 2017, from National Council for Scientific Research (CNRS) website: http://www.fao.org/fileadmin/user_upload/GSP/docs/NENA2015/lebanon.pdf

Darwish, T. (2012, May 15). Soil Resources and soil database in Lebanon. JOINT RESEARCH CENTRE. European Soil Data Centre (ESDAC). Retrieved from https://esdac.jrc.ec.europa.eu/ESDB_Archive/ESDB_Data_Distribution/UPDATES/Extension/izmir2012_Lebanon_darwish.pdf

Dubertret, L. (1945). Géologie du site de Beyrouth avec carte géologique au 1/20.000 et 9 planches (56 pages). Délégation Générale de France au Levant, Section géologique, Beyrouth.

ELARD. (2024). Strategic Environmental and Social Assessment Report on Draft National Waste Management Strategy.

Elias, A., Tapponnier, P., Singh, S. C., King, G. C., Briais, A., Daëron, M., ... & Carton, H. (2007). Active thrusting offshore Mount Lebanon: Source of the tsunamigenic A.D. 551 Beirut–Tripoli earthquake. Geology, 35(8), 755-758.

Environmental Resources Monitoring in Lebanon (ERML) (n.d). Retrieved August 6, 2017, from http://erml.moe.gov.lb/

Fragaszy, S., Fraj, M. B., McKee, M., Jobbins, G., Fayad, A., Fakih, M., Lawrenson, L., & McDonnell, R. (2022). MENAdrought synthesis of drought vulnerability in Lebanon: Final report. International Water Management Institute (IWMI) for the Bureau for the Middle East of the United States Agency for International Development (USAID). Retrieved from https://reliefweb.int/report/lebanon/menadrought-synthesis-drought-vulnerability-lebanon-final-report

Lebanese Center for Energy Conservation. (n.d.). Solar farm 180. Retrieved June 1, 2024, from https://lcec.org.lb/our-work/MEW/solar-Farm-180

Ministry of Agriculture (MoA) & National Council for Scientific Research (NCSR). (2002). National action program to combat desertification (NAP).

Ministry of Energy and Water (MoEW). (2010). Policy paper for the electricity sector.

MoE/UNDP. (2019a). Renewable Energy SDG-NDC Synchronization: Assessment and Recommendations. Beirut, Lebanon.

MoE/UNDP. (2019b). Energy Efficiency SDG-NDC Synchronization: Assessment and Recommendations. Beirut, Lebanon.

MoEW/LCEC. (2011). The National Energy Efficiency Action Plan for Lebanon NEEAP 2011-2015. Beirut, Lebanon.

MoEW/LCEC. (2016a). The Second National Energy Efficiency Action Plan for the Republic of Lebanon NEEAP 2016-2020. Beirut, Lebanon.

MoEW/LCEC. (2016b). The National Renewable Energy Action Plan for the Republic of Lebanon NREAP 2016-2020. Beirut, Lebanon.

MoEW/LCEC/IRENA. (2020). Renewable Energy Outlook: Lebanon.

National Authority for the Litani River. (2024). About Litani River Basin. Retrieved from https://www.litani.gov.lb/en-us/aboutlrb

NDC. (2015). Republic of Lebanon's Intended Nationally Determined Contribution under the United Nations Framework Convention on Climate Change. Beirut, Lebanon

pseau. (2008). Lebanon. FAO. Retrieved from https://www.pseau.org/outils/ouvrages/fao_irrigation_in_the_middle_east_region_in_figures_2008.pdf

pseau. (2023, January). Al Assi river basin baseline report. pseau. Retrieved from https://www.pseau.org/outils/ouvrages/acted_btd_cnrsl_gvc_mee_al_assi_rbm_baseline_report_2023_2023.pdf

Sleiman, A. (2007). Litani River and Litani River Authority Projects, 8 June 2007.

UNDP/UNICEF/UNHCR/MoE. (2021). Lebanon State of the Environment and Future Outlook: Turning the Crises into Opportunities (SOER 2020).

UNDP/MoEW. (2014). Assessment of groundwater resources of Lebanon.

UNDP. (2018). Mashghara: Maintaining the Myth. https://www.undp.org/lebanon/stories/mashghara-maintaining-myth

UNDP. (2023). UNDP and the Ministry of Environment launch Lebanon's fourth National Communication on Climate Change report. Retrieved from https://www.undp.org/lebanon/press-releases/undp-and-ministry-environment-launch-lebanons-fourth-national-communication-climate-change-report

UNHCR Operational Data Portal (ODP). (n.d.). Water sector Lebanon: Baalbek-El Hermel Water Supply Map. Retrieved from https://data.unhcr.org/en/documents/details/60971

Université Saint-Joseph (Beirut, Lebanon). Observatoire de Ksara, & Lebanon Mudīrīyat al-Ṭayarān al-Madanī. (1966). Atlas climatique du Liban [Map]. République libanaise, Ministère des travaux publics et des transports, Direction générale des transports, Direction de l'aviation civile.(n.d.). Retrieved from https://en-gb.topographic-map.com/map-p7jfgt.

(2016). *Atlas Cilmatique du Liban.*

(2016). *Atlas Climatique du Liban.*

climate-data.org. (2021).

Dar El Handassah, S. a. (2012). *Greater Beirut Water Supply Augmentatiion Project ESIA.*

ELARD. (2024). *Strategic Environmental and Social Asssessment Report on Draft National Waste Mangement Strategy.*

Google maps. (n.d.).

https://www.weather-atlas.com/en/lebanon/joun-climate. (n.d.).

MOEW,UNDP,ELARD. (2014). *Asssessment of Groundwater Resources of Lebanon.*

Statistics, C. A. (2020). *"Labour Force and Household Living Conditions Survey 2018-2019 in Baalbek".*

T.Darwish, I. (2005). Inventory and management of Lebanese soils. *Lebanese Scientific Journal*.

www.globalwindatlas.info. (n.d.).

Weatherandclimate.com. (n.d.). El Qaa, Baalbek-Hermel, Lebanon Weather History for July 2010. Retrieved from https://weatherandclimate.com/lebanon/baalbek-hermel/el-qaa/july-2010