

Environmental & Social Impact Assessment (ESIA)

for

Jaisalmer Wind Farm Project (40 MW) at
Rajasthan

Submitted by:



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Environmental Consultant:



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Table of Contents

1.	Introduction	1
1.1.	Preamble	1
1.2.	Importance and Need of the Project.....	1
1.2.1.	Energy Overview.....	1
1.2.2.	Global Renewable Energy Scenario.....	2
1.2.3.	Indian Renewable Energy Scenario	3
1.2.4.	Wind Power Energy Scenario in India	6
1.3.	Project Overview.....	8
1.4.	Purpose and Scope of Work	11
1.5.	Agencies contacted.....	12
1.6.	Limitations of the Study.....	12
1.7.	Structure of the ESIA Report.....	12
2.	Project Description	14
2.1.	Project Layout.....	14
2.2.	Site Settings	14
2.3.	Land Use	16
2.4.	Project Components	19
2.4.1.	Turbine Components.....	19
2.4.2.	Technical Details of WTGs.....	21
2.5.	Status of the Wind Farm	22
2.6.	Power Evacuation	22
2.7.	Land Requirement	23
2.8.	Project Implementation and Schedule.....	24
2.9.	Project Development – Construction Phase.....	26
2.9.1.	Site Development.....	26
2.9.2.	Internal Pathways/Access Roads.....	26
2.9.3.	Civil Works.....	26
2.9.4.	Labor	26
2.9.5.	Water and Wastewater.....	26
2.9.6.	Waste Generation	27
2.10.	Operation and Maintenance.....	27
2.10.1.	Operation and Maintenance Staff.....	27
2.10.2.	Water requirement	27
2.10.3.	Waste water generation	27
2.10.4.	Routine Maintenance Services.....	27
2.10.5.	Routine Operational Services.....	28
2.10.6.	Monitoring and Reporting	28
3.	ESIA Process and Methodology	29
3.1.	ESIA Process.....	29
3.2.	Methodology followed	29
3.2.1.	Review of Regulatory and Legislative Framework.....	30
3.2.2.	Environmental and Social Assessment	30
3.2.3.	Assessment of Environmental and Social Impacts and Mitigation Measures proposed.....	34
3.2.4.	Formulation of Environmental and Social Management Plan (ESMP)	34
4.	Policy, Legal and Administrative Framework	35
4.1	IFC Performance Standards	35

4.2	IFC Categorization of Projects	41
4.3	Environment, Health and Safety (EHS) General Guidelines of IFC	42
4.4	EHS Guidelines Specific to Wind Energy	53
4.5	Equator Principles.....	59
4.6	Applicable Environmental and Social Laws, Regulations and Policies	61
5.	Description of Environment	67
5.1	Environmental Settings	67
5.1.1	Climate and Meteorology	67
5.1.2	Rainfall.....	67
5.1.3	Seismicity	69
5.2	Environmental Baseline Settings.....	69
5.2.1	Ambient Air Quality	69
5.2.2	Water Environment	75
5.2.3	Soil Quality	78
5.2.4	Noise Environment.....	85
5.2.5	Ecological Environment	89
5.2.6	Socio-Economic Environment	96
5.3	Corporate Social Responsibility	107
6.	Environmental and Social Impact Assessment.....	108
6.1	Approach	108
6.2	Community Consultation	108
6.3	Impact Assessment.....	109
6.3.1	Construction Phase.....	109
6.3.2	Operation Phase.....	116
7.	Environmental and Social Management Plan	131
7.1	Introduction.....	131
7.2	Environmental and Social Management System (ESMS).....	131
7.3	Organizational Structure	131
7.4	Roles and Responsibilities	132
7.5	Monitoring and Audit.....	134
7.6	Documentation and Record Keeping	134
7.7	Proposed Environment and Social Management Plan	134
7.8	Management Plans and Procedures	145
7.8.1	Occupational Health and Safety Management Plan	145
7.8.2	Road Safety and Traffic Management Plan.....	147
7.8.3	Emergency Management Plan.....	148
7.8.4	Crane Safety Plan.....	150
7.8.5	Community Liaison Plan	153
7.8.6	Grievance Redressal Mechanism	154
7.8.7	Community Property Replacement Plan	155
8.	Summary and Conclusions	157

List of Tables

Table 1.1 : Progress of Renewable Energy Scenario in India	5
Table 1.2 : State-Wise and Year-Wise Wind Power Installed Capacity in India (As of 31 st May, 2014)	7
Table 1.3 : Framework of Regulations referenced for ESIA Study	11
Table 2.1 : WTG Location Details of Jaisalmer Wind Farm.....	14
Table 2.2 : WTG Location Details of Jaisalmer Wind Farm.....	15
Table 2.3 : Land Use Category of the Surrounding Area	16
Table 2.4 : Key Technical Details of INOX DF 93 Model WTG	21
Table 2.5 : Land Details of the Parcels for proposed Jaisalmer Wind Farm	24
Table 2.6 : Project Schedule Details.....	25
Table 3.1 : Details of Sampling Locations.....	31
Table 4.1 : IFC Performance Standards for Environmental and Social Sustainability	39
Table 4.2 : Summary of General EHS Guidelines.....	45
Table 4.3 : Performance Indicators – IFC Sectoral Guidelines specific to wind energy ..	54
Table 4.4 : Summary of Sectoral Specific EHS Guidelines	56
Table 4.5 : Applicable Environmental and Social Laws, Regulation and Policies.....	61
Table 5.1 : Rainfall Pattern in last 10 years recorded in Jaisalmer District (2004-2013).	68
Table 5.2 : Ambient Air Quality Analysis Results	71
Table 5.3 : Water Quality Monitoring Analysis Results	77
Table 5.4 : Major Type of Soil in Jaisalmer District	80
Table 5.5 : Geological Classification by GSI.....	80
Table 5.6 : Physico-Chemical Characteristics of Soil.....	81
Table 5.7 : Ambient Noise Quality in the Study Area	87
Table 5.8 : Phytosociological Characters of Vegetation around Bonada Area	90
Table 5.9 : Phytosociological Characters of Vegetation around Khelana Area.....	92
Table 5.10 : Mammals recorded during Primary Survey	95
Table 5.11 : Bird species recorded from the study area.....	95
Table 5.12 : Area of Tehsils and the respective population - District Jaisalmer.....	97
Table 5.13 : Village-wise Details of Population of Project Affected Villages.....	98
Table 5.14 : Village-wise Details of SC/ST Population of Project Affected Villages	99
Table 5.15 : Literacy Profile of Project Affected Villages.....	100
Table 5.16 : Workforce Participation for Study Area Villages.....	101
Table 5.17 : Basic Amenities in the study area.....	103
Table 5.18 : Identifying CSR initiatives in line with local requirements.....	107
Table 6.1 : Resultant Noise Levels at Receptor Locations.....	119
Table 6.2 : ICNIRP Exposure Limits for General Public Exposure	126
Table 6.3 : ICNIRP Exposure Limits for Occupational Exposure	126
Table 6.4 : Impacts of Shadow Flicker effects	127
Table 7.1 : Proposed Environmental and Social Management Plan (ESMP)	136
Table 7.2 : Crane Safety Plan	151

List of Figures

Figure 1.1 : Wind Power Total World Capacity, 2000-2013	3
Figure 1.2 : Wind Power Capacity and Additions of Top 10 Countries, 2013	3
Figure 1.3 : Proposed Location of Jaisalmer Wind Farm	9
Figure 1.4 : Micro-siting Details of Jaisalmer Wind Farm	10
Figure 2.1 : Site Photographs	15
Figure 2.2 : Land use Breakup of Proposed Jaisalmer Wind Farm	17
Figure 2.3 : Land Use Map of Jaisalmer Wind Farm	18
Figure 2.4 : Anatomy of WTG	20
Figure 2.5 : Power Evacuation Details from the Proposed Wind Farm to Barmer SS	23
Figure 3.1 : Sampling Locations for the ESIA Study	32
Figure 5.1 : Average Rainfall Pattern in Jaisalmer District (2004-2013)	68
Figure 5.2 : Predominant Wind Direction in the Study Area – Morning Hours (08:30)....	70
Figure 5.3 : Predominant Wind Direction in the Study Area – Evening Hours (17:30)....	70
Figure 5.4 : Pictures of AAQ Monitoring Locations	71
Figure 5.5 : Graphical Representation of PM ₁₀ Concentrations.....	73
Figure 5.6 : Graphical Representation of PM _{2.5} Concentrations.....	73
Figure 5.7 : Graphical Representation of SO _x Concentrations	74
Figure 5.8 : Graphical Representation of NO _x Concentrations	74
Figure 5.9 : Graphical Representation of CO Concentrations	75
Figure 5.10 : Pictures taken during water sampling	76
Figure 5.11 : Pictures taken during soil sampling	81
Figure 5.12 : Pictures taken during Noise Monitoring	86
Figure 5.13 : Graphical Representation of Noise Environment	88
Figure 5.14 : Diversity, Evenness & Species Richness of Bonada Area	92
Figure 5.15 : Diversity, Evenness & Species Richness of Khelana Area	93
Figure 5.16 : Graph Representation of Tehsil Population of Jaisalmer District	97
Figure 5.17 : Graphical Representation of Male/Female Population	98
Figure 5.18 : Comparative Graph of SC/ST Population in Study Area	99
Figure 5.19 : Gender-wise Distribution of Literacy and of Illiteracy in Study Area	100
Figure 5.20 : Workforce Participation in Study Area	101
Figure 5.21 : Main Workforce Participation in Study Area	102
Figure 5.22 : Main Workforce Participation in Study Area	102
Figure 5.23 : Pictures taken during Stakeholder Consultation	106
Figure 6.1 : Noise Level generated due to operation of WTGs with ambient noise during day time	120
Figure 6.2 : Noise Level generated due to operation of WTGs with ambient noise during night time	121
Figure 6.3 : Shadow Flicker Assessment Map.....	129
Figure 7.1 : Organizational Chart.....	132

Annexures

Annexure I – Output Files of the Noise Analysis

Annexure II – Output Files of the shadow Flicker Assessment

1. INTRODUCTION

This chapter provides background information of the project proponent, location and brief description of the project, methodology adopted for ESIA study and structure of the report.

1.1. Preamble

Hero Future Energies Pvt. Ltd. (HFEPL) is a part of the Hero Group and is a public limited company. HFEPL was incorporated on October 18th, 2012, with an objective to generate and supply of clean and green energy from non-conventional sources of energy.

HFEPL carries an illustrious legacy of The Hero Group, a USD 5.6 billion conglomerate. A strategic decision of the Group is to enter the domain of power generation from clean and non-polluting sources of energy. The young Company is an Independent Power Producer (IPP) with growth plans to invest progressively in wind, solar and hydro sector over the years. As the Indian economy continues its growth trajectory, HFEPL is poised to provide clean power to industries, businesses, educational institutes, non-profits and governmental organizations at competitive rates. HFEPL will assist its clientele in fulfilling their Renewable Purchase Obligations (RPOs) by reducing their dependence on power generated by fossil fuels like coal, oil and natural gas.

HFEPL, in a short span of 3-4 months since incorporation, has implemented and commissioned its first 37.5 MW wind power project in Rajasthan through its 100% subsidiary. HFEPL intends to develop over 500 MW of renewable capacity in a period of around 3 years in wind and solar verticals. HFEPL would be doing these projects through a judicious mix of both the strategies, i.e. turn-key EPC projects as well as self-development route. HFEPL would also be developing projects in solar vertical under various state solar policies as well as various phases of Jawaharlal Nehru National Solar Mission (JNNSM).

1.2. Importance and Need of the Project

1.2.1. Energy Overview

Energy plays a key role in the economic growth of the country. There is a close link between energy and future growth of a nation. Not only in India but in the entire world there is a never ending need for energy. Since, time immemorial, the energy is derived from one source or another. In much older periods, the demand for light and fuel was met with traditional sources like wood or animal dung or plants waste. Later they got replaced by coal, water and nuclear energy which were then available in abundance. However, as the time progressed, the depleting natural resources of conventional energy compelled the hunt for alternative sources of energy. Considering the future generation and their needs, more awareness is created for using the environment friendly resources.

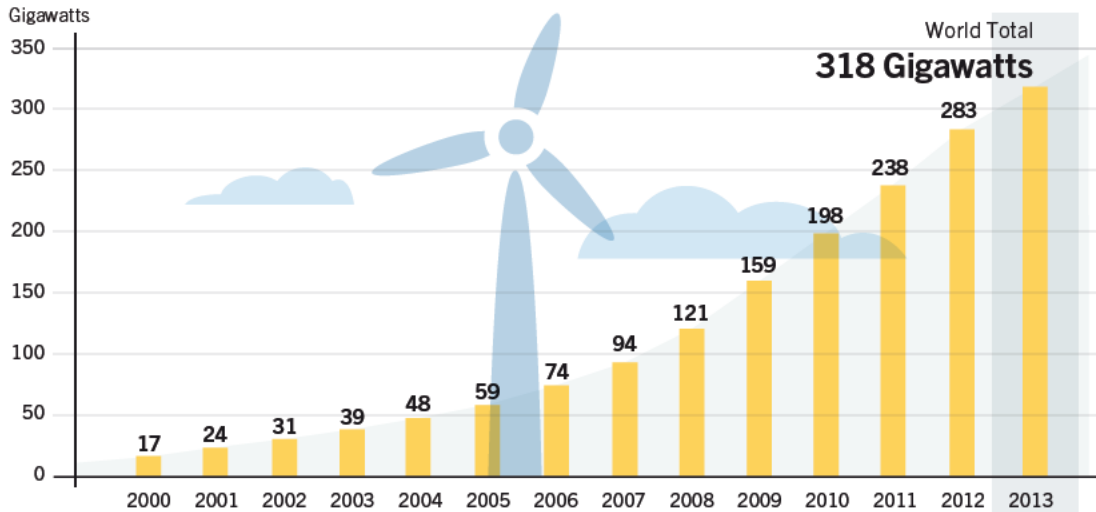
Though sunlight is considered a “compelling solution” to the “need for clean, abundant sources of energy,” solar energy currently provides only 0.01% of the total electricity supply needs. However, recent market trends, Government policies, regulatory support, consumer incentives, and technological advancements are together driving solar energy costs drastically down relative to conventional fossil fuel-derived energy.

Compared to conventional and other renewable energy sources, solar power is more attractive because it can be easily scaled up and also can be generated nearer to consumers and even on site, which greatly reduces or eliminates transmission costs and losses. Furthermore, the increasing adoption of variable pricing or net metering schemes also favor solar electricity. Under these schemes, electricity rates are higher when peak demand is highest and this generally correlates to when more solar energy is available and electric output is highest. Solar costs are reduced significantly through higher volume production, improved manufacturing techniques, and alternative solar technologies that reduce the amount of semiconductor material. Total installed system costs are further being reduced through cheaper “balance-of-system” components such as inverters through improved design and installation techniques. Fundamentally, the solar industry as a whole has advanced and grown to the point where solar solutions are not only an environmentally friendly option but also a cost effective.

1.2.2. Global Renewable Energy Scenario

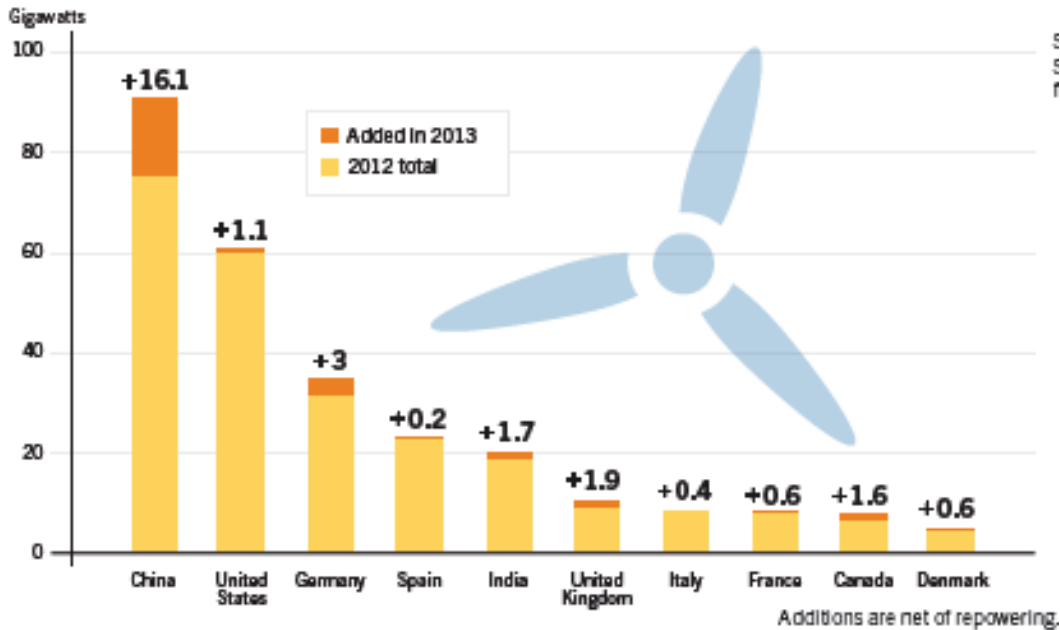
The energy demand worldwide is increasing rapidly, especially in developing countries, which seek to catch up with the economic development achieved by industrialized nations during the last century. Until now, fossil fuel resources have been utilized extensively resulting in an adverse impact on its reserves and on the atmosphere. With growing awareness on climate change and its implications, developed as well as developing countries have begun realizing the potential of hydro, wind and solar energy, and efforts are being made to exploit all the new and renewable energy sources to meet the ever increasing energy demand.

The total global wind power capacity is 318 GW and more than 35 GW of wind power capacity was added in the year 2013. The wind power market however has declined slightly by 10 GW compared to the year 2012, reflecting primarily a steep drop in the U.S. market. The top 10 countries accounted for 85% of year-end global capacity, but there are dynamic and emerging markets in all regions. By the end of 2013, at least 85 countries had seen commercial wind activity, while at least 71 had more than 10 MW of reported capacity by year's end, and 24 had more than 1 GW in operation. Annual growth rates of cumulative wind power capacity have averaged 21.4% since the end of 2008, and global capacity has increased eight-fold over the past decade (*source: Ren'21 Renewables 2014 Global Status Report*). Figure 1.1 and 1.2 present the total world wind power capacity and top 10 nations of the world harnessing wind power respectively.



(Source: Ren'21 Renewables 2014 Global Status Report)

Figure 1.1 : Wind Power Total World Capacity, 2000-2013



(Source: Ren'21 Renewables 2014 Global Status Report)

Figure 1.2 : Wind Power Capacity and Additions of Top 10 Countries, 2013

1.2.3. Indian Renewable Energy Scenario

With ever-increasing demand for energy continues to squeeze fossil fuel reserves, India is looking at fossil fuel-rich countries around the world. Consequently, India has emerged as a major importer of energy and this has seriously sensitized the Government of India to look for alternate ways to meet the energy requirements by lowering the demand-supply gap and strategically developing energy security of the country.

Electricity consumption in India has more than doubled in the last decade, outpacing economic growth. Despite capacity additions, electricity demand continues to outstrip power generating capacity, compelling the Central Government to enact Electricity Act 2003, release the National Electricity Policy, 2005 and spell Vision 2020. The said Acts and the Vision 2020, while giving due importance to electricity generation through conventional sources, have recognized the need to increase power generation through non-conventional sources too. However, in the recent past worldwide concern over environment pollution has compelled the developed countries to take appropriate measures in this direction and this has led to adoption of renewable energy route. India too realized its role in curbing pollution and formulated strategies to explore the potential of all renewable energy resources like hydro, wind and solar along with biomass.

A capacity addition of 30,000 MW is envisaged for the 12th and 13th Plans for renewables, raising the total capacity to 54,000 MW by 2022, which would comprise 40,000 MW wind power, 6,500 MW from small hydropower and 7,500 MW from biomass. This would raise the share of NRES in total electricity-mix to 15% by the end of 2032, i.e. end of the 15th Plan. The potential from renewables is estimated to be approximately 85,000 MW. Table 1.1 presents the status of the progress of the renewable energy source in India.

Table 1.1 : Progress of Renewable Energy Scenario in India

Sector	Target		Achievements during the Month of July		Achievements during the month of July		Cumulative Achievements	
	2013-14	2014-15	2013-14	2014-15	2013-14 (% of Target)	2014-15 (% of Target)	(as on 31.07.2013)	(as on 31.07.2014)
GRID-INTERACTIVE POWER (CAPACITIES IN MW)								
Wind Power	2500.00	2000.00	608.2	561.15	96.2 (24.33)	83.45(28.06)	19661.15	21692.98
Solar Power	1100.00	1100.00	152.56	106.00	79.56(13.87)	- (-)	1839.0	2753.00
Small Hydro Power	300.00	250.00	74.50	22.50	20.5 (24.83)	12.00 (9.00)	3706.75	3826.18
Biomass Power & Gasification	105.00	100.00	-	-	- (-)	- (-)	1264.80	1365.20
Bagasse Cogeneration	300.00	300.00	-	32.00	- (-)	- (-)	2337.43	2680.35
Waste to Power	20.00	20.00	-	-	- (-)	- (-)	96.08	106.58
Total	4325.00	3770.00	835.26	721.65	196.26(19.31)	95,45 (19.14)	28905.21	32424.29

(Source: MNRE, Govt. of India)

1.2.4. Wind Power Energy Scenario in India

India became the world's first nation to form a "Ministry of New and Renewable Energy (MNRE)" in the early 1980s. Due to the power shortage and the ever increasing prices of fossil fuels, India has taken up the task of augmenting the current energy supply with renewable sources. Presently, India has an installed power generation capacity of a little over 207.8 GW, of which renewable energy accounts for about 25 GW. The wind power generation capacity in India is 49,130 MW as per the official estimates in the Indian Wind Atlas (2010) by the Center for Wind Energy Technology (C-WET).

India is relatively new to the wind energy sector as compared to Denmark or USA. But Indian policy's support for wind energy has led India to rank fifth with largest installed wind power capacity in the world. The total installed power capacity was 20,298.83 MW on January 31st, 2014 (MNRE) and now India is just behind USA, China, Spain and Germany. As per MNRE, wind power accounts for the largest share of renewable power installed capacity i.e.70% (2012), as compared to the other renewable sources.

A rapid growth in wind power installation has been measured in southern and western states in India. A need for about 350-360 GW of total energy generation capacity was reported by the Central Electricity Authority in its National Electricity Plan (2012) by the year 2022. Only on-shore wind potential has been utilized by India so far. In spite of the fact that India has long coast line over 7500 km, we have not yet tapped our off-shore wind resource for energy generation.

Table 1.2 presents the state-wise and year-wise wind power installed capacity in India.

Table 1.2 : State-Wise and Year-Wise Wind Power Installed Capacity in India (As of 31st May, 2014)

State	Andhra Pradesh	Gujarat	Karnataka	Kerala	Madhya Pradesh	Maharashtra	Rajasthan	Tamil Nadu	West Bengal	Others	Total
Up to March'2002	93.2	181.4	69.3	2.0	23.2	400.3	16.1	877.0	1.1	3.2	1666.8
2002-03	0.0	6.2	55.6	0.0	0.0	2.0	44.6	133.6	0.0	0.0	242.0
2003-04	6.2	28.9	84.9	0.0	0.0	6.2	117.8	371.2	0.0	0.0	615.2
2004-05	21.8	51.5	201.5	0.0	6.3	48.8	106.3	675.5	0.0	0.0	1111.7
2005-06	0.45	84.60	143.80	0.0	11.40	545.10	73.27	857.55	0.0	0.0	1716.17
2006-07	0.80	283.95	265.95	0.0	16.40	485.30	111.90	577.90	0.0	0.0	1742.05
2007-08	0.0	616.36	190.30	8.50	130.39	268.15	68.95	380.67	0.0	0.0	1663.32
2008-09	0.0	313.6	316.0	16.5	25.1	183.0	199.6	431.1	0.0	0.0	1484.9
2009-10	13.6	197.1	145.4	0.8	16.6	138.9	350.0	602.2	0.0	0.0	1564.6
2010-11	55.4	312.8	254.1	7.4	46.5	239.1	436.7	997.4	0.0	0.0	2349.2
2011-12	54.1	789.9	206.7	0.0	100.5	416.5	545.7	1083.5	0.0	0.0	3196.7
2012-2013	202.10	208.30	201.70	0.0	9.60	288.50	614.00	174.60	0.0	0.0	1698.8
2013-2014	753	3414	2409	55	439	4098	2820	7276	0.0	0.0	21264

(Source: MNRE, Govt. of India)

HFEPL has the vision of harnessing the wind to produce the '*planet positive power*' and provide access to clean and affordable power to the masses. In order to solve the twin problem of power deficit and access to power, HFEPL has adopted a two pronged strategy.

- Develop megawatt size wind and solar plants to produce clean and economical energy
- Provide rooftop and off-grid solutions for decentralized power generation

1.3. Project Overview

HFEPL proposes to set up a 40 MW wind power project (Jaisalmer Wind Farm) in Jaisalmer District of Rajasthan. Jaisalmer Wind Farm is spread across 2 villages of Bonada and Khelana in Jaisalmer District of Rajasthan. The capacity of Jaisalmer Wind Farm is rated at 40 MW and will comprise of 20 Wind Turbine Generators (WTGs) of INOX DF 93 model with a rated capacity of 2 MW each. The extent of the Wind Farm is spread over approximately 50 acres.

The associated facilities for the project include:

- Construction of external 220 KV transmission lines of about 47 km
- Construction of internal 33 KV transmission lines of about 15 km
- Construction of internal pathways of varying lengths (1-2 km between WTGs) and 6 m in width

HFEPL has contracted INOX to provide turn-key solutions for the following aspects at Jaisalmer Wind Farm:

- micro-siting
- wind resource analysis
- Supply of WTGs
- erection of WTGs
- commissioning
- Operation and Maintenance (O&M)

INOX purchased the land parcels for the siting of the WTGs directly from the private owners from each of the respective villages. INOX has further sub-contracted the following companies for the tasks listed below:

- SMP and Manohar Singh & Company – Foundation work and RCC reinforcement and concreting
- Geo Tech – Soil testing

The proposed location and the micro-siting details of the 20 WTGs of Jaisalmer Wind Farm are shown in Figure 1.3 and 1.4 respectively.

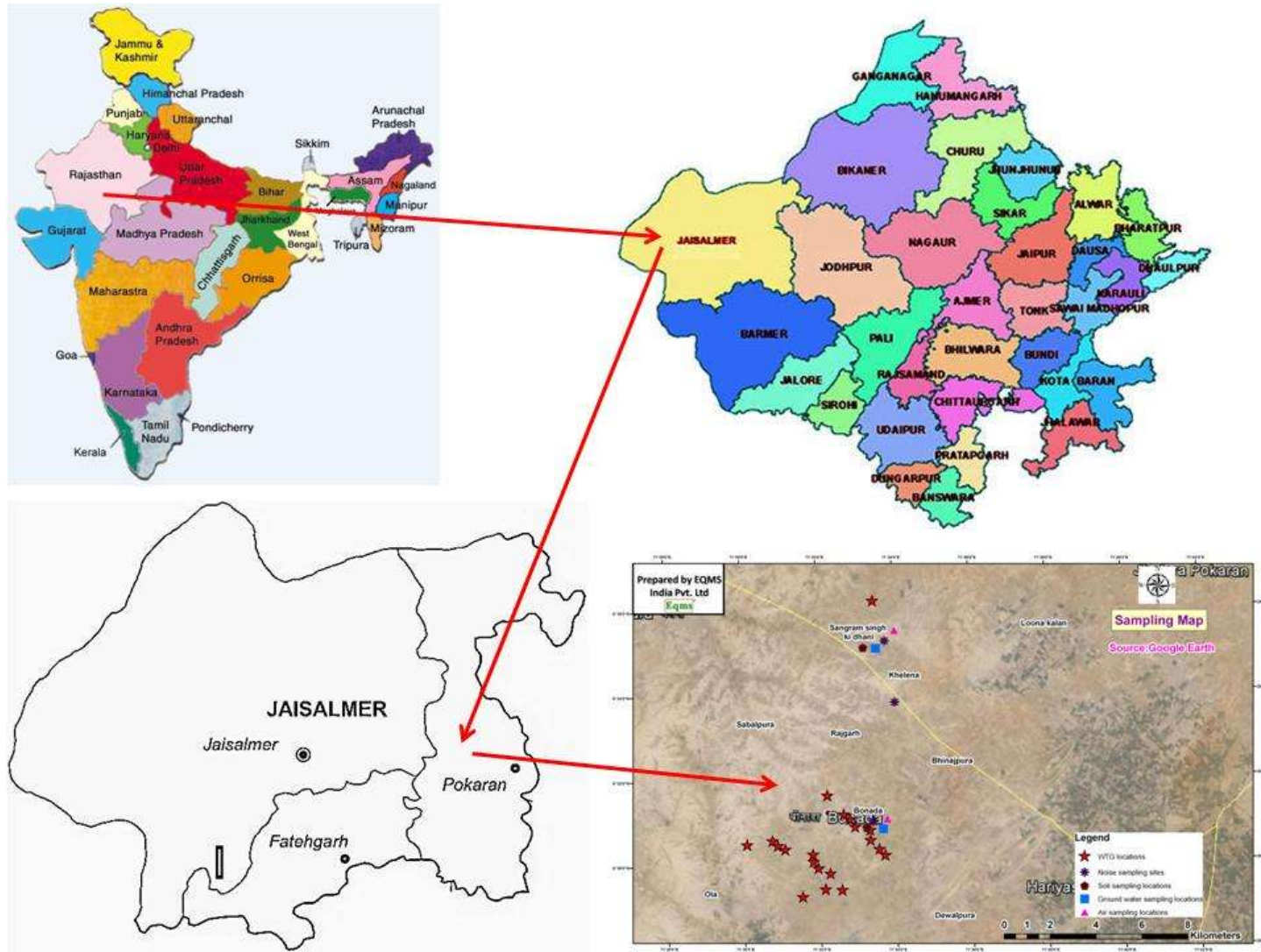


Figure 1.3 : Proposed Location of Jaisalmer Wind Farm

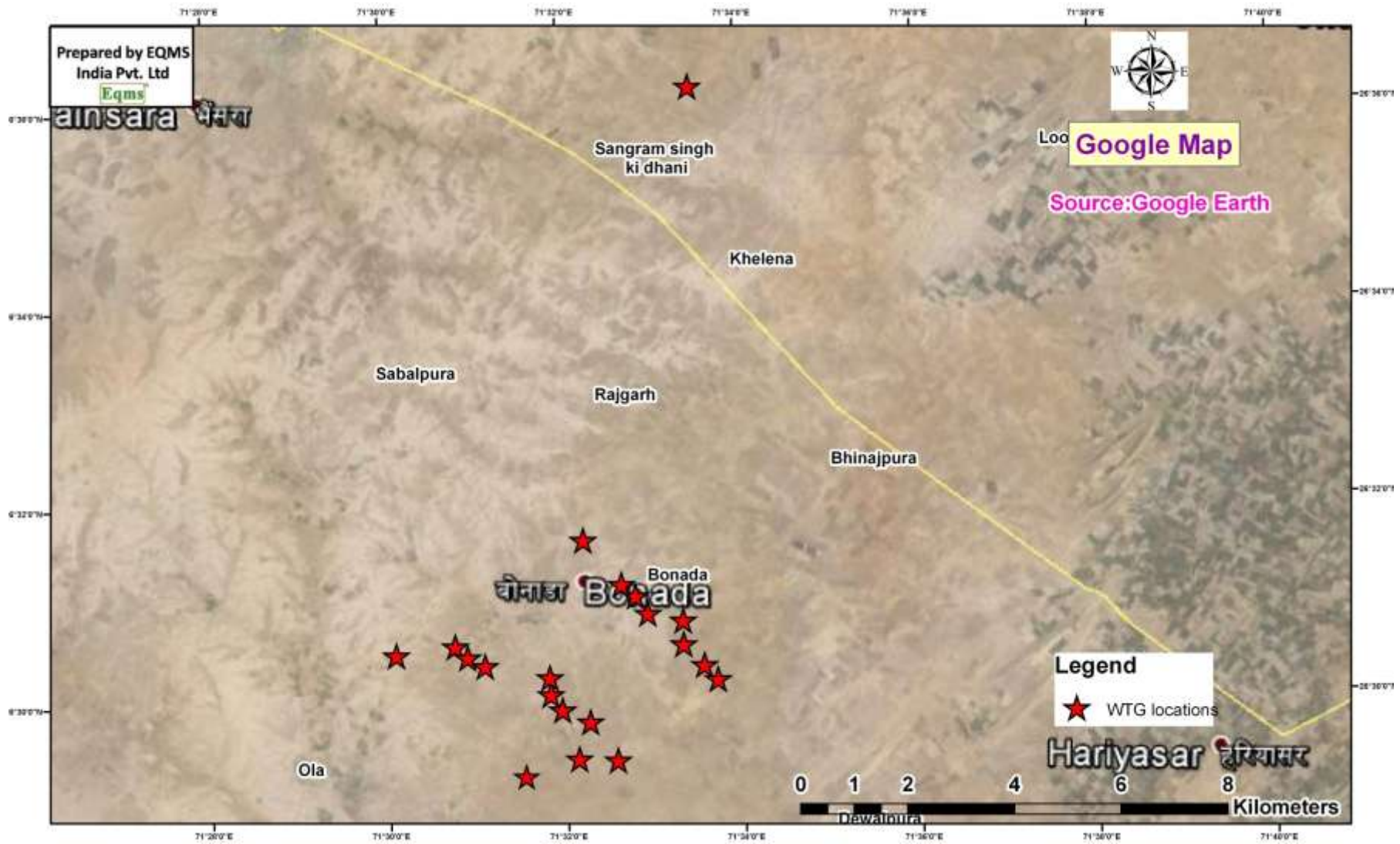


Figure 1.4 : Micro-siting Details of Jaisalmer Wind Farm

1.4. Purpose and Scope of Work

The study has been undertaken to assess the Environmental and Social impacts associated with Jaisalmer Wind Farm as per the requirements of International Finance Corporation (IFC) Guidelines. Appropriate mitigation measures and environmental management plans have been suggested to prevent and minimize all impacts identified during the Assessment Study. Table 1.3 presents the framework of regulations referenced for the ESIA study.

Table 1.3 : Framework of Regulations referenced for ESIA Study

S. No.	Regulations
1	IFC Performance Standards for Environmental and Social Sustainability <ul style="list-style-type: none"> • Performance Standard 1 (PS1): Assessment and Management of Environmental and Social Risks and Impacts • Performance Standard 2 (PS2): Labour and Working Conditions • Performance Standard 3 (PS3): Resource Efficiency and Pollution Prevention • Performance Standard 4 (PS4): Community Health, Safety, and Security • Performance Standard 5 (PS5): Land Acquisition and Involuntary Resettlement • Performance Standard 6 (PS6): Biodiversity Conservation and Sustainable Management of Living Natural Resources • Performance Standard 7 (PS7): Indigenous Peoples • Performance Standard 8 (PS8): Cultural Heritage
2	IFC General Environment, Health and Safety (EHS) Guidelines
3	IFC Guidelines for Wind Sector
4	Equator Principles, June 2006
5	Applicable Indian Regulatory Requirements

The scope of work for the ESIA study includes:

1. Reconnaissance survey and primary site assessment to collect and review baseline environmental and social conditions
2. Generation of primary baseline environmental data including air, water, noise and supplementing with secondary data, wherever applicable
3. Primary data collection of flora and fauna with specific emphasis on avi-fauna and supplementing with secondary data
4. Consultations with stakeholders and local community
5. Assessment of impact of noise and shadow flicker on the community using WindPRO version 2.9 software
6. Identification and review of the applicable standards and regulations
7. Identification of the potential impacts of the Project and the associated activities

8. Formulation of Management Plan for the mitigation of impacts identified. Preparation of Environmental and Social Management Plan (ESMP) based on the findings of the ESIA and develop procedures for mitigation and monitoring of environment and social impacts on an on-going basis and to identify any impacts/mitigation requirements that may occur subsequent to the completion of the ESIA Study
9. Review of the current HR, Social, Environmental, Occupational Health and Safety Management System of HFEPL and INOX to understand its adequacy and efficacy with respect to the IFC PS requirements.
10. Preparation of an ESIA Report for the project as per the requirements of IFC PS, General EHS guidelines and wind energy specific guidelines.

1.5. Agencies contacted

The following Agencies were contacted during the course of the Study:

- HFEPL
- INOX
- Forest Department
- Census of India

1.6. Limitations of the Study

The ESIA Report is based on the data provided by the Project Proponent (HFEPL) and their contractor (INOX). The environmental and social assessment is based on the documents made available, community consultations and observations done by EQMS India Pvt. Ltd. (EQMS). The findings, conclusions, and the suggestions resulting from the consulting service are based upon information provided by the Project Proponent. Professional judgement and subjective interpretation of facts and observations has been applied for the preparation of the ESIA Report.

1.7. Structure of the ESIA Report

The ESIA Report is presented as defined below:

Chapter 1: Introduction

This chapter provides background information of the project proponent, location and brief description of the project, methodology adopted for ESIA study and structure of the report.

Chapter 2: Project Description

This chapter deals with the details of the Proposed Project such as layout, site settings, project components and details regarding the procurement of land.

Chapter 3: ESIA process and Methodology

This chapter presents the approach and methodology adopted for the ESIA Study for the proposed Jaisalmer Wind Farm.

Chapter 4: Policy, Legal and Administrative Framework

This chapter presents the legal framework and highlights the environmental and social regulations applicable to the proposed Jaisalmer Wind Farm.

Chapter 5: Description of Environment

This chapter describes the baseline environmental conditions around the surrounding area of the proposed Jaisalmer Wind Farm for various environmental attributes, viz., physical, biological and socio-economic. Topography, soil, water, meteorology, air, noise, and land constitute the physical environment, whereas flora and fauna constitute the biological environment. Demographic details and occupational pattern in the study area constitute socio-economic environment. Baseline environmental conditions are based on the field studies carried out at and around the proposed site and through secondary data collected from published sources.

Chapter 6: Environmental and Social Impact Assessment

This chapter details the inferences drawn from the environmental impact assessment of the proposed project. It describes the overall impacts of the project activities and underscores the areas of concern, which need mitigation measures.

Chapter 7: Environmental and Social Management Plan

This chapter addresses the requirement of IFC PS1 which highlights the importance of managing the social and environmental performance throughout the life of a project by implementing an effective ESMS.

Chapter 8: Summary and Conclusions

This chapter concludes on the findings that emerged from the environmental assessment study and summarizes the key points to be addressed to ensure the environmental sustainability of the project during the construction and operation phases.

2. PROJECT DESCRIPTION

This chapter deals with the details of the Proposed Project such as layout, site settings, project components and details regarding the procurement of land.

2.1. Project Layout

HFEPL proposes to set up a 40 MW wind power project (Jaisalmer Wind Farm) in Jaisalmer District of Rajasthan. Jaisalmer Wind Farm is spread across 2 villages of Bonada and Khelana in Jaisalmer District of Rajasthan. HFEPL develops projects under its various project companies/SPV's. Clean Wind Power (Devgarh) Private Limited (CWP-Devgarh) is the subsidiary company of HFEPL under which 40 MW Jaisalmer Wind Farm shall be developed.

Jaisalmer Wind Farm will comprise of 20 Wind Turbine Generators (WTGs) of INOX DF 93 model with a rated capacity of 2 MW each. The extent of the Wind Farm is spread over 50 acres approximately. Power generated from 40 MW proposed project shall be evacuated at 220 kV level using 33/220 kV Dangri Pooling Sub-Station (PSS) which in turn will be connected to Rajasthan Rajya Vidyut Prasaran Nigam Limited (RVPNL) AKAL 220/400 kV SS.

The proposed Jaisalmer Wind Farm is spread across 2 villages in three clusters. There are 19 WTGs spread in two clusters near the village of Bonada – 8 of which are sited in a line parallel to the remaining 11 WTGs and third cluster comprises of a single WTG near the village of Khelana. The site elevation of the three clusters varies from 279 to 300 m. The location of WTGs with respect to geographic proximity to the villages is presented in Table 2.1.

Table 2.1 : WTG Location Details of Jaisalmer Wind Farm

S. No.	Village	Tehsil	District	Number of WTGs	Type of Land
1	Bonada	Bhaniyana	Jaisalmer	19	Private Land
2	Khelana	Bhaniyana	Jaisalmer	1	Private Land
Total				20	

2.2. Site Settings

The distance of the WTG from the first cluster of the proposed Jaisalmer Wind Farm is located at a distance of 520 m from the village of Bonada. The distance of the WTG from the second cluster is located at a distance of 2.42 km from the village of Ola. The third cluster of single WTG is located at 1.78 km from Sangram Singh ki Dhani. The nearest State Road, 40/Barmer Road, is located at a distance of 26 km. The site elevation of the three clusters varies from 279 to 300 m. The site predominantly consists of open grass and shrub land. Figure 2.1 presents the site photographs taken during the Site Assessment Survey. Table 2.2 enlists the geographical coordinates of each of the WTGs of the proposed Jaisalmer Wind Farm.

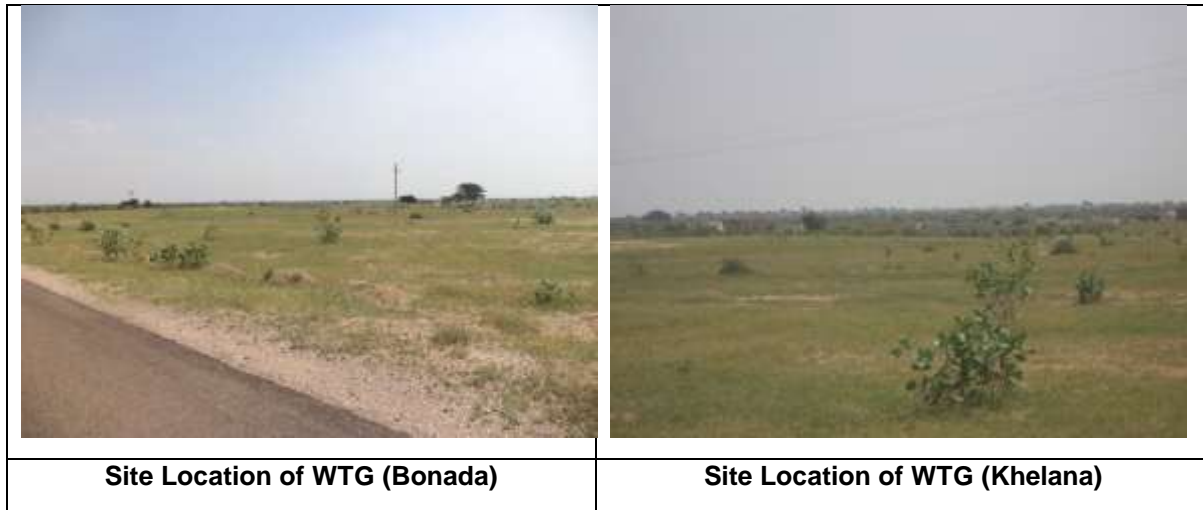


Figure 2.1 : Site Photographs

Table 2.2 : WTG Location Details of Jaisalmer Wind Farm

S. No.	WTG	Geographical Coordinates (m)		Village	Tehsil	District
		Easting	Northing			
1	KBS-T-05	753974	2935280	Bonada	Bhaniyana	Jaisalmer
2	KBS-T-73	750405	2934579	Bonada	Bhaniyana	Jaisalmer
3	KBS-T-74	750635	2934371	Bonada	Bhaniyana	Jaisalmer
4	KBS-T-79	752198	2933684	Bonada	Bhaniyana	Jaisalmer
5	KBS-T-80	752415	2933397	Bonada	Bhaniyana	Jaisalmer
6	KBS-T-78	752177	2933997	Bonada	Bhaniyana	Jaisalmer
7	KBS-T-70	749303	2934409	Bonada	Bhaniyana	Jaisalmer
8	KBS-T-06	753778	2935537	Bonada	Bhaniyana	Jaisalmer
9	KBS-T-07	753510	2935747	Bonada	Bhaniyana	Jaisalmer
10	KBS-T-65	755329	2933984	Bonada	Bhaniyana	Jaisalmer
11	KBS-T-66	755079	2934174	Bonada	Bhaniyana	Jaisalmer
12	KBS-T-75	750945	2934213	Bonada	Bhaniyana	Jaisalmer
13	KBS-T-81	752942	2933171	Bonada	Bhaniyana	Jaisalmer
14	KBS-T-10	752634	2936589	Bonada	Bhaniyana	Jaisalmer
15	KBS-T-82	752772	2932524	Bonada	Bhaniyana	Jaisalmer
16	KBS-T-83	753421	2932443	Bonada	Bhaniyana	Jaisalmer
17	KBS-T-67	754682	2934637	Bonada	Bhaniyana	Jaisalmer
18	KBS-T-68	754670	2935082	Bonada	Bhaniyana	Jaisalmer

S. No.	WTG	Geographical Coordinates (m)		Village	Tehsil	District
		Easting	Northing			
19	KBS-T-34	754734	2945132	Khelana	Bhaniyana	Jaisalmer
20	KBS-T-47	751741	2932147	Bonada	Bhaniyana	Jaisalmer

Source: HFEPL

2.3. Land Use

The basic purpose of land use pattern and classification is to identify the manner in which different parts of land in an area are being utilized or not utilized. Remote sensing data provides reliable accurate baseline information for land use mapping as it is a rapid method of acquiring up-to-date information of over a large geological area.

A systematic digital image interpretation approach was used to delineate the land use classes. The present study was focused on demarcating boundaries of different land use/land cover units from an analysis of different types of color registrations of land use/land cover units from satellite imagery. The surrounding area (2-7 km) of the proposed Wind Farm was determined using GIS software (ARC GIS 9.3). The digital image processing is done in Image processing software ERDAS 9.1. Multi-spectral supervised classification using the maximum likelihood algorithm followed by smoothing and editing of pixels was performed in that platform. Satellite data which is used to make Land use and Land cover of the area is LISS III (23.5 meters) and Land sat 4-5 Thematic mapper (30 meters resolution). The area contains different types of land cover and land use:-

- Agricultural land
- Agricultural fallow land
- Settlement
- Open grass and shrub land
- Barren land
- Vegetation

There are no perennial and non-perennial surface water bodies. Table 2.3 and Figure 2.2 present the land use categories with the respective percentages in the study area. Open grass and shrub land dominates the surrounding area of the proposed Jaisalmer Wind Farm covering approximately 55% of the surrounding area. 24% of the surrounding area is classified as agricultural fallow land followed by 20% of barren land. There are a few settlements in the surrounding area. Figure 2.3 depicts the land use of the proposed Jaisalmer Wind Farm.

Table 2.3 : Land Use Category of the Surrounding Area

Class	Area (Sq. km)	Percentage (%)
Agricultural land	1.45	0.58
Agricultural fallow land	59.46	23.92
Settlement	0.54	0.22
Open grass and shrub land	136.80	55.04

Class	Area (Sq. km)	Percentage (%)
Barren land	49.46	19.90
Vegetation	0.85	0.34
Total	248.56	100

Source: Primary Data Analysis

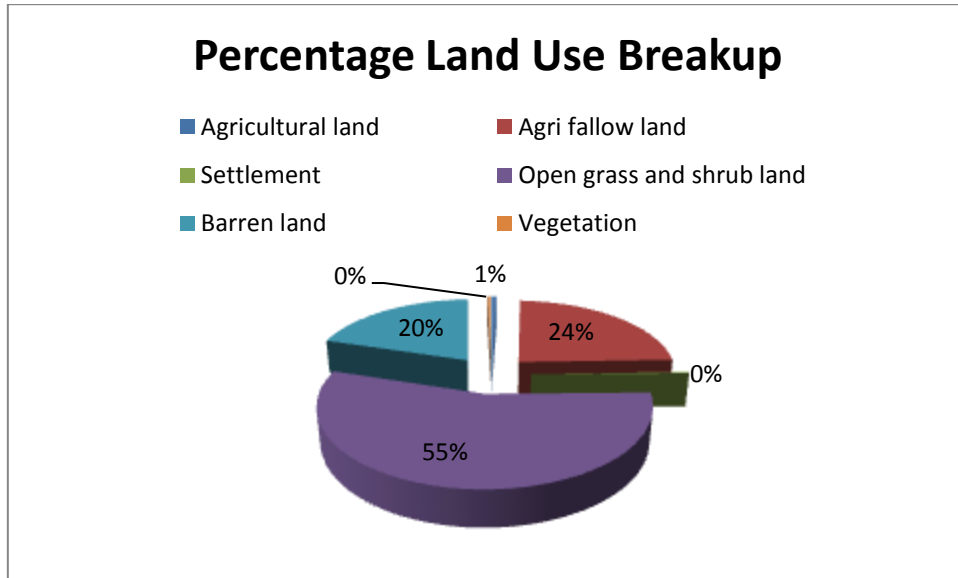


Figure 2.2 : Land use Breakup of Proposed Jaisalmer Wind Farm

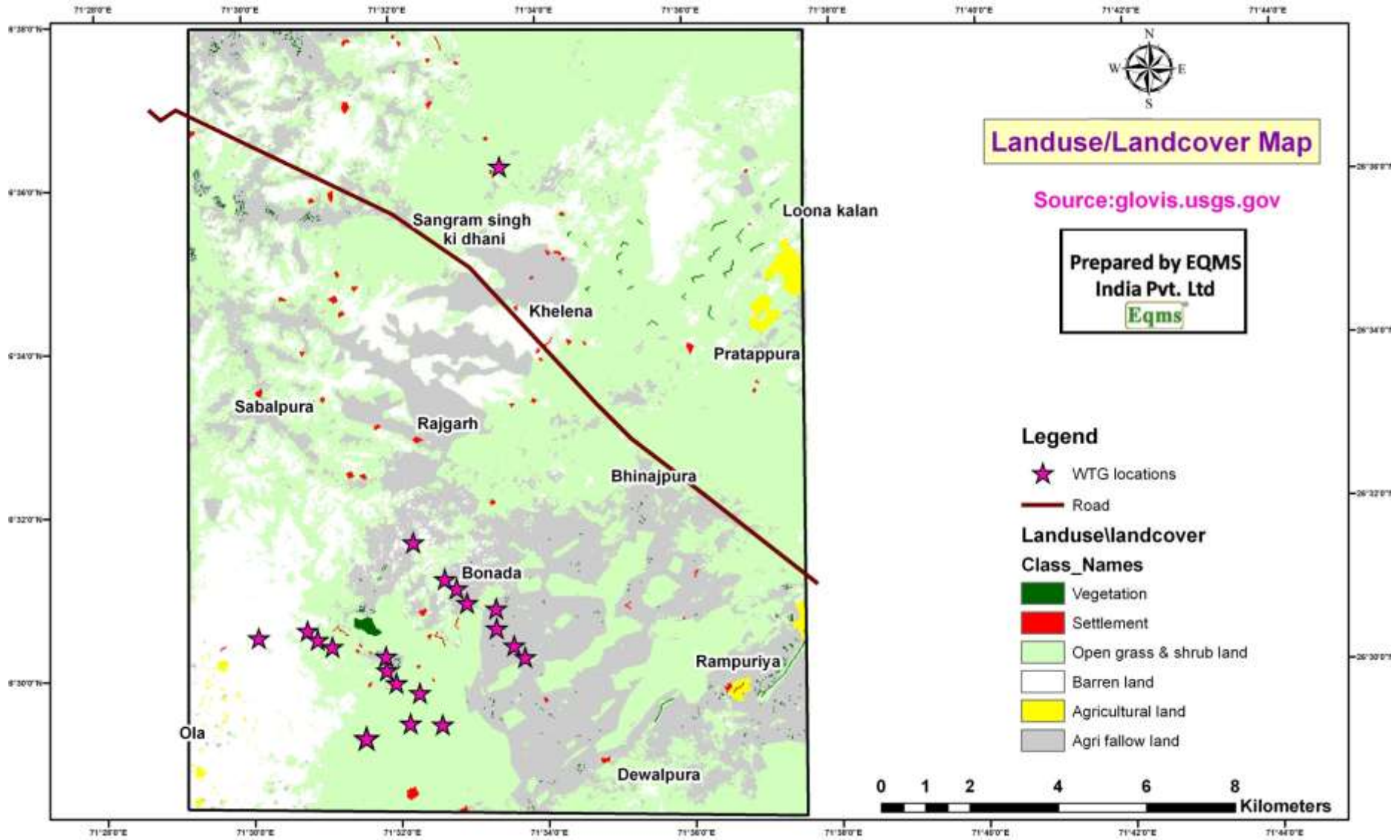


Figure 2.3 : Land Use Map of Jaisalmer Wind Farm

2.4. Project Components

2.4.1. Turbine Components

The three major mechanical components of a WTG (*Source: Wind Energy Siting Handbook, February 2008 (American Wind Energy Association)*) are listed below:

- Rotor
- Nacelle
- Tower

Each of the mechanical components is described below:

Rotor

The rotor generally consists of three fiberglass blades that extend out of the hub. The rotor is mounted to a driveshaft within the nacelle to operate upwind of the tower. However, in some cases, the rotor is located behind the tower and nacelle. The rotor attaches to the drive train emerging from the front of the nacelle. Hydraulic motors within the rotor hub feather each blade according to the wind conditions, which enables the turbine to operate efficiently at varying speeds.

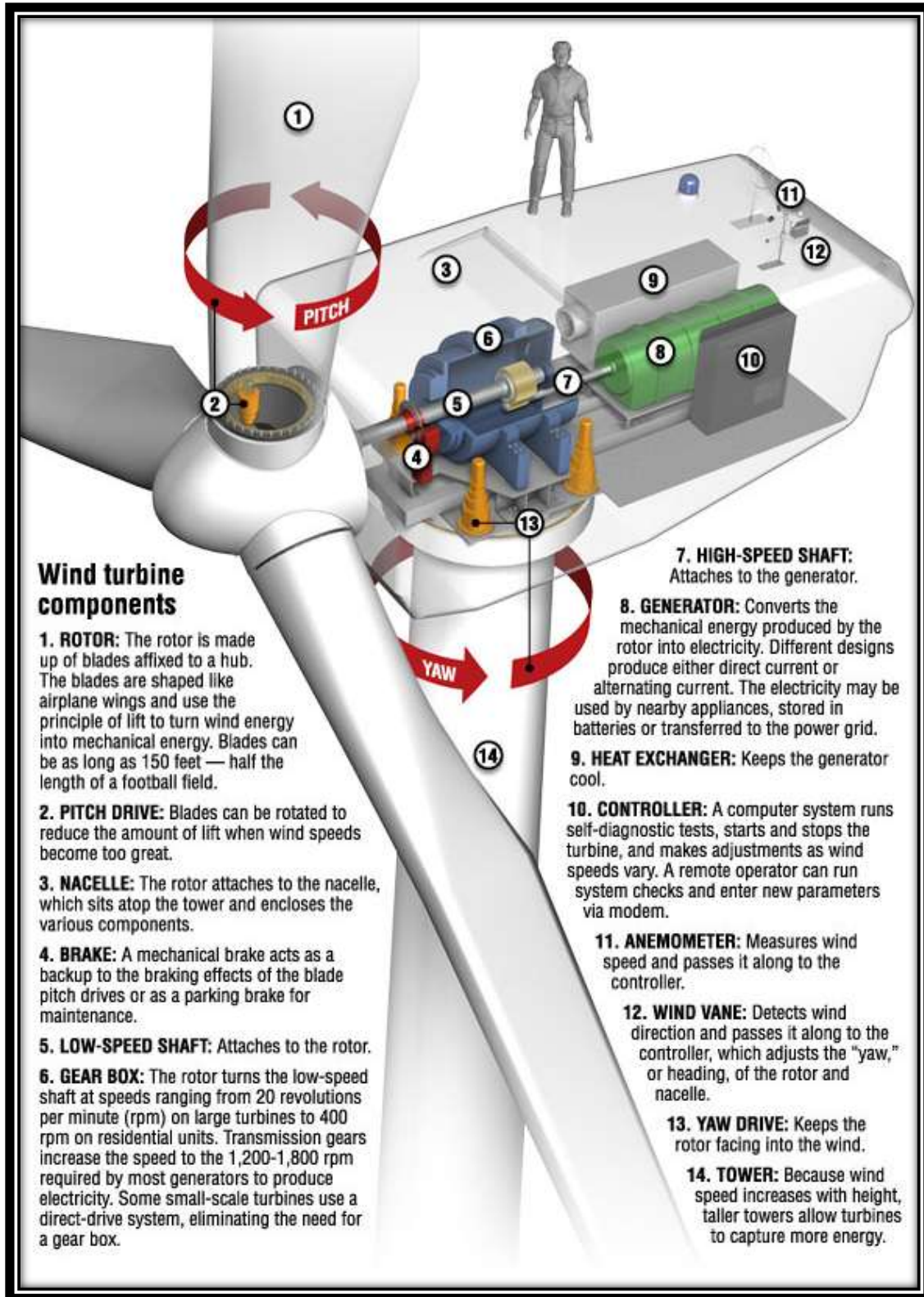
Nacelle

The nacelle is a large housing that sits on top of the tower behind the rotor. It houses the main mechanical components of the wind turbine - drive train, gearbox, transformer and generator. The nacelle is generally externally equipped with anemometer and a wind wane that signals wind speed and direction information to an electronic controller. The nacelle is mounted over a yaw gear, which constantly positions the rotor upward of the tower.

Tower

The tower supports the nacelle and rotor. Towers are generally made of steel and can be either tubular or lattice. Most tubular towers will have an access door and an internal safety ladder and/or elevator to access the nacelle.

The anatomy of a WTG is illustrated in Figure 2.4.



(Source: <http://www.awea.org/Resources>)

Figure 2.4 : Anatomy of WTG

2.4.2. Technical Details of WTGs

Jaisalmer Wind Farm will comprise of 20 WTGs of INOX DF 93 model with a rated capacity of 2 MW each. The rotor diameter and hub height is 93 m and 80 m respectively. The key technical details of INOX DF 93 model are presented in Table 2.4.

Table 2.4 : Key Technical Details of INOX DF 93 Model WTG

S. No.	Parameter	Value
A	Operating Data	
1	Rated Power	2 MW
2	Cut-in-wind speed	3 m/s
3	Rated wind speed	11.5 m/s
4	Cut-out wind speed	20 m/s
5	Survival wind speed	52.5 m/s
6	Hub height	80 m
7	Type class	TC IIIB
8	Rotor speed	15.9 RPM
9	Operational mode	Variable speed
10	Design standards	Germanischer Lloyd
B	Rotor	
1	Pitch system	Pitch control – electrical, variable speed inverters, power backup with ultra-capacitors
2	Diameter	93 m
3	Swept area	6795 m ²
4	Blade material type	Epoxy glass fiber
C	Generator	
1	Type	Double fed induction generator
2	Rated power	2 MW
3	Rated voltage	690 V AC, 3 Phase
4	Frequency	50 Hz
5	Cooling system	Water cooled
6	Insulation	Class H
D	Braking System	
1	Aerodynamic brake	Full span independent blade pitching
2	Mechanical brake	Disc brakes

S. No.	Parameter	Value
E	Drive Train	
1	Drive train	Patented integral drive train with rotor shaft and drive train as single unit
2	Rated drive torque	1280 kNm
3	Maximum static torque	2235 kNm
4	Type of Gearing	Two planetary and one parallel shaft gear
5	Transmission ratio	1:~114.7
6	Gear lubrication	Forced lubrication
7	Connect on gear/generator	Flexible coupling
F	Yaw System	
1	Type	Driven by 4 gear motors
2	Bearings	Slide bearings
G	Tower	
1	Type	Conical tubular steel tower
2	Tower height	78 m
3	Corrosion protection	Protective paint

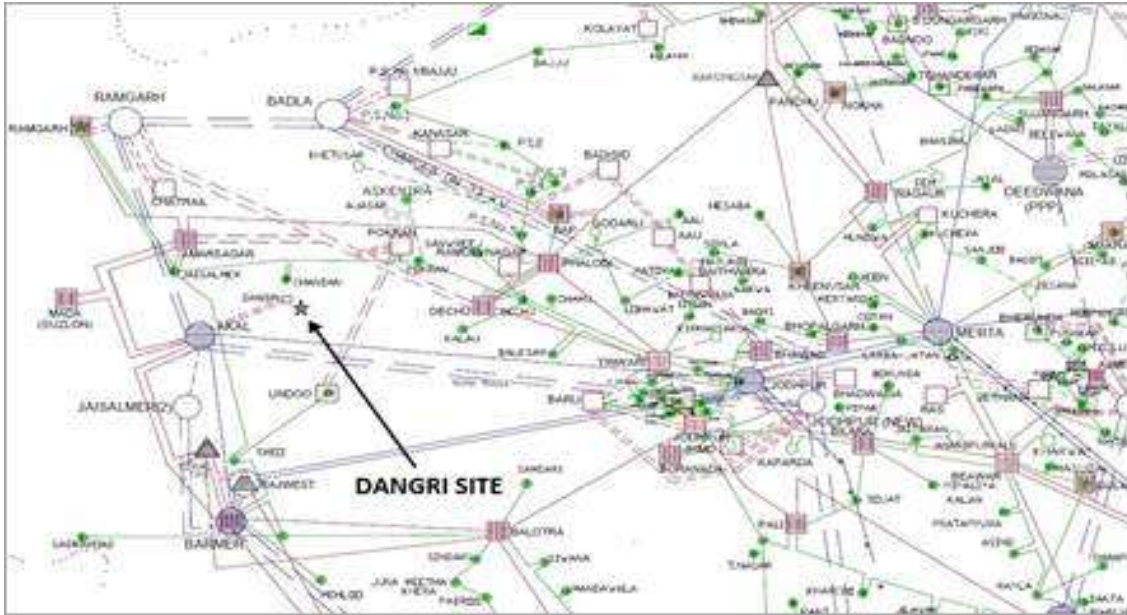
(Source: <http://inoxwind.com/pdf/Brochure.pdf>)

2.5. Status of the Wind Farm

Jaisalmer Wind Farm will comprise of 20 WTGs spread across 2 villages of Bonada and Khelana in Jaisalmer District of Rajasthan. Power generated from the Wind Farm will be evacuated at 220 kV level using 33/220 kV Dangri PSS which in turn is connected to RRVPN AKAL 220/400 kV SS. The construction of the access roads has been initiated.

2.6. Power Evacuation

Power generated from 40 MW proposed project shall be evacuated at 220 kV level using 33/220 kV Dangri PSS which in turn will be connected to RVPNL AKAL 220/400 kV SS. Dangri PSS is presently connected with 264 MW wind power project load and is expected to connect to an additional 150 MW (approximately) by 2014-15. With this addition, Dangri PSS shall be connected with more than 400 MW. Dangri PSS is connected with double circuit 220 kV line with Akal SS which is owned by RVPNL. Akal GSS is further connected with Amarsagara and Barmer RVPNL sub-stations. Figure 2.5 presents the map for the power evacuation details from the proposed Jaisalmer Wind Farm to Barmer SS.



(Source: HFEPL)

Figure 2.5 : Power Evacuation Details from the Proposed Wind Farm to Barmer SS

2.7. Land Requirement

INOX had sub-contracted Sahej for the process of land procurement of the private land for the proposed Jaisalmer Wind Project. The Project comprises of 20 WTGs and hence there are 20 land parcels involved. The land procurement process has been done in an amicable manner on willing seller-buyer basis. Each of the stakeholders of the private parcel land and the Gram Panchayats had been briefed of the project before negotiations for the land procurement started.

The extent of the Wind Farm is spread over approximately 50 acres. The distance of the WTG from the first cluster of the proposed Jaisalmer Wind Farm is located at a distance of 520 m from the village of Bonada. The distance of the WTG from the second cluster is located at a distance of 2.42 km from the village of Ola. The third cluster of single WTG is located at 1.78 km from Sangram Singh ki Dhani. The site elevation of the three clusters varies from 279 to 300 m. The site predominantly consists of open grass and shrub land.

Table 2.5 presents the land details of the parcels procured for the proposed Jaisalmer Wind Farm.

Table 2.5 : Land Details of the Parcels for proposed Jaisalmer Wind Farm

WTG Identifier	Village	Tehsil	Khasra Number	Extent of Area (Hectare)	Owner Name Prior to Sale Deed
KBS-T-05	Bonada	Bhaniyana	370	1	Sh. Buth Singh & Sh. Nathu Singh
KBS-T-73	Bonada	Bhaniyana	207	1	Sh. Bhoor Singh
KBS-T-74	Bonada	Bhaniyana	578/217	1	Sh. Mansukh Dan
KBS-T-79	Bonada	Bhaniyana	265	1	Sh. Kan Dan
KBS-T-80	Bonada	Bhaniyana	265	1	Sh. Kan Dan
KBS-T-78	Bonada	Bhaniyana	265	1	Sh. Kan Dan
KBS-T-70	Bonada	Bhaniyana	784/216	1	Smt. Prem Kanwar
KBS-T-06	Bonada	Bhaniyana	785/388	1	Sh. Chandan Singh
KBS-T-07	Bonada	Bhaniyana	786/388	1	Sh. Pabu Singh, Sh. Kan Singh, Sh. Kanwar Raj Singh and Smt. Nijar Kanwar
KBS-T-65	Bonada	Bhaniyana	717/492	1	Smt. Aim Kanwar
KBS-T-66	Bonada	Bhaniyana	717/492	1	Smt. Aim Kanwar
KBS-T-75	Bonada	Bhaniyana	582/217	1	Sh. Vijay Dan
KBS-T-81	Bonada	Bhaniyana	288	1	Sh. Chhagna Ram
KBS-T-10	Bonada	Bhaniyana	410	1	Smt. Santosh Kanwar
KBS-T-82	Bonada	Bhaniyana	272	1	Sh. Shaitan Singh
KBS-T-83	Bonada	Bhaniyana	277	1	Sh. Kalyansingh, Sh. Nathusingh, Sh. Sabalsingh, Sh. Maansingh, Smt. Antarkanwar & Smt. Jaithikanwar
KBS-T-67	Bonada	Bhaniyana	790/382	1	Sh. Chandan Dan
KBS-T-68	Bonada	Bhaniyana	793/382	1	Sh. Gorakhdan
KBS-T-34	Khelana	Bhaniyana	552/31	1	Sh. Revant Singh
KBS-T-47	Bonada	Bhaniyana	590/264	1	Sh. Morudan

2.8. Project Implementation and Schedule

INOX has been contracted by CWP-Devgarh for the construction of the proposed Jaisalmer Wind Farm including works related to land acquisition, obtaining statutory

approvals, development of logistics route, construction of internal pathways, crane beds, 33 kV and 220 kV transmission lines and pooling substation, etc. INOX is also responsible for work related to supply, erection and commissioning of WTGs. Site preparation activities such as micro-siting, arranging temporary water and power supply etc. will also be undertaken by INOX.

Furthermore, INOX has also been contracted by CWP-Devgarh for the Operations and Maintenance (O&M) Agreement for the operation and maintenance of the Proposed Wind Farm.

CWP-Devgarh and INOX will be partly in charge for the Project Management including financial and administrative control, overall project coordination, manpower selection for operation and maintenance etc.

The proposed Wind Farm is envisaged to be commissioned by end of March, 2015 and operational by 1st April, 2015. The section below provides a detailed description and anticipated schedule of all activities that will occur as a part of the construction phase of the proposed Wind Farm. Table 2.6 presents the schedule for the completion of activities for the proposed Jaisalmer Wind Farm.

Table 2.6 : Project Schedule Details

S. No.	Activity	Status/Schedule
1	Land Procurement	20 land parcels have already been procured.
2	Micro Siting Activities	Wind resource assessment for the region was undertaken by INOX in the month of September, 2014, and identified as a good wind potential site.
3	Internal Pathways/Access Roads	Access roads of varying lengths and width of 6 m is planned for the wind farm. Same is expected to be completed by 31 st March, 2015.
4	Pooling Substation and Power Evacuation System	Power generated from 40 MW proposed project shall be evacuated at 220 kV level using 33/220 kV Dangri PSS which in turn will be connected to RVPNL AKAL 220/400 kV SS. There is no construction associated with this aspect as the power will be evacuated to an existing SS and no pooling station is required. The length of the external 220 kV and internal 33 kV transmission lines is approximately 47 km and 15 km respectively and is expected to be completed by Feb, 2015.
5	Foundation of WTGs	The task is expected to be completed by end of Mid-March, 2015.
6	Erection and Commissioning of WTGs	This phase is expected to be completed by end of March, 2015.

2.9. Project Development – Construction Phase

The construction phase of the proposed Jaisalmer Wind Farm will involve land survey, geotechnical investigation, component delivery; construction of access roads, turbines lay down area, crane pads, WTG foundation and electrical substations followed by final erection and commissioning of power generating facilities and its auxiliaries. The construction works will also entail site clearance and leveling works. The section below describes the various aspects involved in the construction phase of the project.

2.9.1. Site Development

The development of site will require site clearance and leveling works, if any required. There will be removal of ground vegetation during the construction works.

2.9.2. Internal Pathways/Access Roads

The construction of the access roads to the WTGs is planned and construction shall soon be started. This phase shall also cover the maintenance of some of the existing roads prior to transport of heavy construction equipment and widening of intersections for smooth movement of heavy vehicles.

2.9.3. Civil Works

The major civil works for the Project will include laying of wind turbine foundations, erection of turbines and equipment foundations including power transformer. Minor works will involve construction of security kiosks, roads and drainage facilities. The wind turbine towers proposed for the Wind Farm will have a hub height of 80 m and will require substantial foundations which would extend to a depth of about 2.5 to 3 m. The depth of foundation will depend on soil and surface conditions. The foundation structure will be floating type which is essentially a gravity foundation that relies upon soil overburden and concrete to provide sufficient weight to resist overturning of the foundation at extreme wind loads.

The erection of tower would require cranes and preparation of platforms for installing cranes. The crane will undertake the lifting activities to erect the turbines; the nacelle will be installed atop the tower first followed by installation generator, rotor and blades. Construction of related structures will involve civil and steel work for installation of transformers, substation, and electric cables and signal wires.

2.9.4. Labor

Approximately 100-150 workers shall be hired during the construction phase. The labor required for the construction works will be hired locally and therefore, no labor camp will be required to be set up.

2.9.5. Water and Wastewater

The water demand during the construction works will be sourced through authorized/approved tankers.

Waste water generation from the construction activities will be limited to washing and cleaning activities related to construction activities. Portable toilets with septic tank and soak pits will be provided at site to facilitate the disposal of sewage generated.

2.9.6. Waste Generation

The construction activities will lead to generation of wastes such as construction debris, waste from packaging and crafting material for wind turbine components. The movement of heavy machinery for site clearance, earth moving, transportation and erection of wind turbine components will generate waste oil, hydraulic oil, lubricants, paints, degreasers and gearbox oil. Waste oil is classified as a hazardous waste and its storage, transportation and disposal will be done in accordance with the Hazardous Waste Management Handling and Trans-boundary Movement Rules, 2008 and amendments thereof. The hazardous waste generated will be disposed off through an approved recycler.

2.10. Operation and Maintenance

An O&M agreement has been signed with INOX which entrusts them with responsibility of maintenance and repairs for the proposed Wind Farm. The typical maintenance and repair activity during operation phase involves preventive and breakdown maintenance of WTGs and/or the related equipment in accordance with the safety management plans and procedures, as applicable and/or in accordance with accepted industry practices.

There will be an O&M Facility involving the Supervisory Control and Data Acquisition (SCADA) system. This system provides two-way communication with each WTG. A SCADA system allows a central computer system to monitor and control each WTG's operation.

2.10.1. Operation and Maintenance Staff

Approximately 20 O&M INOX personnel will be staffed at the proposed Wind Farm Site. It is envisaged to hire security from the local community.

2.10.2. Water requirement

The daily water requirement for the project will be limited to domestic consumption and will be met through packaged drinking water.

2.10.3. Waste water generation

Waste water generation during the operation phase of the project will be limited to the domestic waste water from the toilets. Septic tanks with adequate capacity and soak pit arrangement shall be maintained at the project site for managing the waste water generated.

2.10.4. Routine Maintenance Services

Preventive Maintenance involves use of materials and consumables such as lubricants and oils, electrical and mechanical parts etc., for preventive maintenance and upkeep of the equipment including transformer yard, greasing of main bearings, Yaw Bearing and Blade Bearings; topping up of hydraulic and transformer oil; painting of equipment; brake pads for main brakes and yaw brakes; oil and dry filters; batteries; carbon brushes; coolant; cleaning detergents and solvents; pitch Capacitors; all electrical panels.

Major breakdown maintenance anticipated for wind farms include repairs/replacement of Generator and Motors, Nacelle, Rotor Unit, Hub, Transformers, yard, equipment, Blades,

Frequency Converter Panels and Control Panels, Tower Components and Electricals; and servicing of Anemometer, Wind vanes, wind sensors and other sensors, Limit switches, etc.

2.10.5. Routine Operational Services

Routine activities during operation phase include cleaning and up-keep of the equipment such as:

- Torquing
- Blade Cleaning
- Nacelle and Tower head torquing and cleaning
- Frequency Converter Panel and Low Tension Panel Maintenance
- Site Maintenance
- Security

2.10.6. Monitoring and Reporting

The following records will be maintained during operational phase:

- Data logging records for power generation - wind speed, grid availability, machine availability, machine breakdown, etc. shall be prepared
- Daily and Monthly performance reports will be made
- Monthly meter reading for State Electricity Board
- Visual observation record of the proposed Wind Farm and its components
- Record of visitors
- Record of accidents/incidents

3. ESIA PROCESS AND METHODOLOGY

This chapter presents the approach and methodology adopted for the ESIA Study for the proposed Jaisalmer Wind Farm.

3.1. ESIA Process

This section describes the tasks that were undertaken to complete the ESIA Study:

- Regulatory Review was done to assess the regulatory framework within which the project will operate and propose a legal register to track and monitor compliance.
- Site assessment of all the components of the Wind Farm including the detailed WTG profiling, substation area, store yards, internal and external transmission lines was carried out by the experts following standard observation and secondary data analysis.
- Primary and secondary data on environmental and social parameters was generated. This included monitoring of environmental parameters (primarily ambient air quality, water quality and noise levels) along with focused formal and informal group discussions at impacted villages and in and around study area.
- Ecological assessment was also carried out to site birds/bat during site visit assessment. This was supplemented with secondary data collection and interaction with forest and wild life officials.
- Developed a positive understanding of the project among the affected village communities by understanding their basic issues and suggesting a plan to address their issues. At the same time, community outlook/opinion was ascertained towards the development and execution of the proposed project in their vicinity.
- Impact assessment and mitigation measures based on qualitative and quantitative methods were undertaken based on the understanding of the project activities and existing baseline status.
- Developed an Environmental and Social Management Plan (ESMP).

3.2. Methodology followed

Since the wind power projects do not have impacts as that related to conventional thermal or hydro power plants, the methodology followed is a bit different than the conventional power plant projects. These projects have more issues associated with land, community, agricultural and bio-diversity (specifically avi-fauna). Assessment of the above-mentioned environmental and social parameters was therefore made with respect to the following:

- IFC standards particularly related to Social and Environmental Risks and Impacts

- Pollution Prevention & Abatement
- Bio-diversity Conservation & Sustainable Natural Resource Management
- Community Health, Safety & Security, Labour & Working Conditions
- Land Acquisition & Involuntary Resettlement
- Indigenous Peoples and Cultural Heritage

A study area of 5 km from the location of WTGs was considered for the evaluation of existing environmental and social existing status and potential impacts. The key aspects of the methodology are summarized briefly.

3.2.1. Review of Regulatory and Legislative Framework

A review of the applicable environmental and social legislations was carried out to assess the framework for the proposed Jaisalmer Wind Farm. The assessment was carried out with particular emphasis on the applicability of IFC's Performance Standards, Environment, Health and Safety (EHS) General Guidelines and EHS Guidelines specific for Wind Energy sector.

3.2.2. Environmental and Social Assessment

An environmental and social assessment of the proposed Jaisalmer Wind Farm was done through primary and secondary surveys and data collection. The assessment included the establishment of existing environmental baseline for ambient air quality, water, soil, noise, ecological profile of the study area and land use pattern. The **project villages** were defined as the ones from which the land parcels for the location of the WTGs has been procured and the villages falling within 5 km of the project area and likely to be affected because of the project and its associated activities, such as access roads, transmission lines and substation, were classified as **project influenced villages**. The various survey/site assessments done are listed below:

3.2.2.1 Site Assessment

A site visit to assess the actual conditions of the 20 WTG locations and the associated facilities such as transmission line route and substation was done by a two member team of EQMS in the second week of September, 2014. The assessment focused on the land details of the WTG locations (500-700 m) such as existing land use pattern, and identification of sensitive receptors e.g. settlements, schools, temples, etc.

3.2.2.2 Baseline Environmental Monitoring

Environmental monitoring was undertaken to establish the existing baseline status of the area surrounding the proposed Jaisalmer Wind Farm. The monitoring locations were identified based on the meteorological factors, project villages, project influenced villages, accessibility, availability of power, etc. The environmental monitoring was carried out by EQMS in association with M/s. Kamal Enviro Labs (Gurgaon, India). The baseline environmental monitoring locations for air, water, soil and noise are presented in Table 3.1 and Figure 3.1.

Table 3.1 : Details of Sampling Locations

Sampling Location	Code
Air	
Bonada	AQ1
Khelana	AQ2
Ground Water	
Bonada	GW1
Khelana	GW2
Soil	
Bonada	S1
Khelana	S2
Noise	
Barmer Road/40	N1
Bonada	N2
Khelana	N3

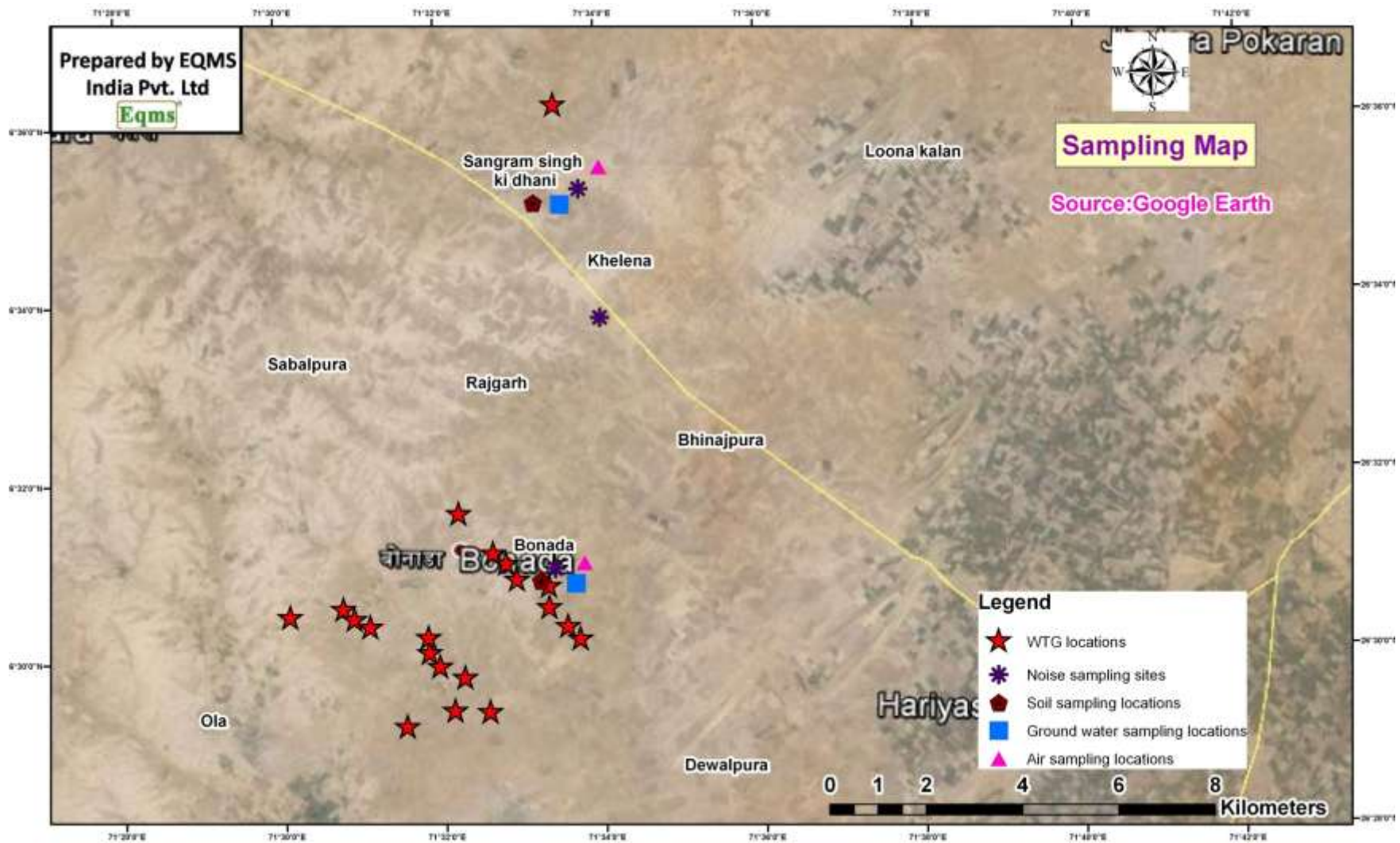


Figure 3.1 : Sampling Locations for the ESIA Study

Ambient Air Quality

Two locations for ambient air quality monitoring (AAQM) stations were identified for the proposed Wind Farm. PM_{2.5} Dust sampler of Envirotech Instruments, New Delhi, was used for monitoring of Particulate Matter (PM₁₀ and PM_{2.5}), Oxides of Sulphur (SO_x), Oxides of Nitrogen (NO_x) and Carbon Monoxide (CO). Monitoring was done twice a week for two weeks at each location. The monitoring was conducted as per National Ambient Air Quality Standards (NAAQS) notified by Central Pollution Control Board (CPCB) on 18th November, 2009. The details of the AAQM analysis are presented in Chapter 5.

Ground Water Quality

Two locations for ground water quality were identified for the assessment of the baseline status for the proposed Wind Farm. Ground water quality was compared with the drinking water norms (IS: 10500, 2012). The details of the analysis are presented in Chapter 5.

Soil Quality

Two locations were identified for the assessment of the soil quality. The soil samples were examined for various physico-chemical parameters to determine the existing soil characteristics of the study area. Physico-chemical characteristics of soil are presented in Chapter 5.

Noise

Three locations – one near Barmer Road/40 and two residential locations were identified for assessing the noise quality. The monitored levels were compared against Ambient Noise Standards prescribed under Gazette Notification 643 of Ministry of Environment, Forest & Climate Change (MoEFCC), Government of India. The results of the monitoring analysis are provided in Chapter 5.

3.2.2.3 Socio-economic Survey and Public Consultations

Consultation (Formal and informal) with local community, stakeholders, household surveys and review of land procurement and compensation process was undertaken to assess compliance with IFC's Performance Standard 5 (PS5). A two member team of EQMS appraised the socio-economic status of the project villages and project influenced villages. The assessment is primarily based on the questionnaire survey with regards to establishing the existing socio-economic status of the surrounding area of the Project and the informal interviews on the basic views of the community regarding the Wind Power Projects in general.

3.2.2.4 Ecological Assessment

A detailed ecological assessment was undertaken by EQMS in the second week of October, 2014. The assessment focused on identification of floral and faunal species, sensitive habitats, endangered species, forest land and estimating the bio-diversity indices. Primary assessment was supplemented with secondary information as collected from the Forest Department.

The vegetation of the project area was assessed by using phyto-sociological survey. A total of 30 quadrats measuring 10x10 m² were placed in two study sites. Quadrats were regularly placed at an interval of 0.5 km in each of the two sites of the study area.

The faunal diversity was assessed through the site visit findings and observations. Direct sighting and indirect evidences such as calls, signs and trophies of mammals were recorded along the survey routes. The visual observations were supplemented with information collected from local villagers for the presence and relative abundance of various animal species within each locality. The Forest Working Plan of the Forest Division falling in the project area was referred to for secondary information on the wildlife of the area.

3.2.3. Assessment of Environmental and Social Impacts and Mitigation Measures proposed

The assessment of environmental and social impacts during the construction and operation of the Project was carried out by identifying the impacts based on the review of available project information and consultation with the local community and project proponent. Once the impacts were identified, the next step was to propose mitigation measures for the same.

3.2.4. Formulation of Environmental and Social Management Plan (ESMP)

An Environmental and Social Management Plan (ESMP) has been formulated for the proposed Jaisalmer Wind Farm based on the impacts identified. The ESMP was developed based on the gap analysis (including HFEPL's internal policies – organizational structure, requirements for EMP, etc.), procedures developed for mitigation and monitoring of environment and social impacts on an on-going basis and identification of any impacts/mitigation requirements that may occur subsequent to the completion of the ESIA.

The ESMP provides economically feasible control technologies and procedures to minimize any impact on environment and mechanism for continuous consultation and involvement of the community throughout the various stages of the Project. The ESMP also describes the desired outcomes as measurable events to the extent possible, such as performance indicators, targets or acceptance criteria that can be tracked over defined time periods, and indicating the resources and responsibilities required for implementation.

4. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

This chapter presents the legal framework and highlights the environmental and social regulations applicable to the proposed Jaisalmer Wind Farm.

The section details the various regulations, statutory guidelines and standards that are applicable to the environmental and social performance of the proposed Jaisalmer Wind Farm. The following regulations are discussed in the following sections below:

- IFC Performance Standards
- Equator Principle
- Applicable Environmental and Social regulations and policies
- Enforcement Agencies
- Applicable Standards

4.1 IFC Performance Standards

IFC Performance Standards, effective January 1, 2012, provide guidance on how to identify risks and impacts associated with a project/site. These Standards are designed to help avoid, mitigate and manage risks and impacts in a sustainable way. IFC requires its clients to apply these Standards and demonstrate compliance throughout the life of investment. The Performance Standards are divided in 8 categories:

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

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

Performance Standard 1 (PS1) establishes the importance of managing environmental and social performance throughout the life of a project in the form of an Environmental and Social Management System (ESMS). An effective ESMS at a project involves engagement amongst the management, its client and workers and also any local communities that get directly affected by the project and wherever applicable, its stakeholders. A good ESMS can ensure sound and sustainable growth for the project.

The main objectives of PS1 are:

- Identify and evaluate environmental and social risks and impacts associated with the project.
- Adopt mitigation measures to help avoid, mitigate and manage risks and impacts in a sustainable way.
- Employ effective management systems to promote improved environmental and social performance, including engagement with the affected communities.

Performance Standard 2: Labor and Working Conditions

Performance Standard 2 (PS2) underlines that the economic growth, as in employment creation and income generation, should be accompanied by protection of the fundamental rights of the workers. Detailing of this Standard has been laid out with guidance from International Labor Organization (ILO) and the United Nations (UN).

The main objectives of PS2 are listed below:

- Promote fair treatment, non-discrimination, and equal opportunity of workers.
- Establish, maintain, and improve the worker-management relationship.
- Promote compliance with national employment and labour laws.
- Protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain.
- Promote safe and healthy working conditions, and the health of workers.
- Avoid the use of forced labour.

Performance Standard 3: Resource Efficiency and Pollution Prevention

Performance Standard 3 (PS3) defines the approach for resource efficiency and pollution prevention and control in line with the prevalent international technologies and practices. PS3 can be implemented through continuous improvement methodologies similar to those used to enhance quality or productivity, which are generally well-known to most industrial, agricultural, and service sector companies.

The main objectives of PS3 are listed below:

- Avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities.
- Promote more sustainable use of resources, including energy and water.
- Reduce project-related GHG emissions.

Performance Standard 4: Community Health, Safety, and Security

Performance Standard 4 (PS4) addresses the Management's responsibility to avoid or minimize the risks and impacts to community health, safety, and security that may arise from project related-activities, with particular attention to vulnerable groups.

The main objectives of PS4 are listed below:

- Anticipate and avoid adverse impacts on the health and safety of the affected community during the project life from both routine and non-routine circumstances.
- Ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the affected communities.

Performance Standard 5: Land Acquisition and Involuntary Resettlement

Performance Standard 5 (PS5) recognizes that project-related acquisition and restrictions on land use can have adverse impacts on the communities and people that use that land. PS5 aims at anticipating and avoiding any adverse social and economic impacts from land acquisition or restrictions on land use.

The main objectives of PS5 are listed below:

- Avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs.
- Avoid forced eviction.
- Anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by providing compensation for loss of assets at replacement cost ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected.
- Improve, or restore, the livelihoods and standards of living of displaced persons.
- Improve living conditions among physically displaced persons through the provision of adequate housing with security of tenure at resettlement sites.

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

Performance Standard 6 (PS6) recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. PS6 addresses how clients can sustainably manage and mitigate impacts on biodiversity and ecosystem services throughout the project's lifecycle.

The main objectives of PS6 are listed below:

- Protect and conserve biodiversity.
- Maintain the benefits from ecosystem services.
- Promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.

Performance Standard 7: Indigenous Peoples

Performance Standard 7 (PS7) recognizes that Indigenous Peoples, social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. In many cases, their

economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development. It identifies that Indigenous Peoples may be more vulnerable to the adverse impacts associated with project development, which may include loss of identity, culture, and natural resource-based livelihoods, as well as exposure to impoverishment and diseases.

The main objectives of PS7 are listed below:

- Ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples.
- Anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts.
- Promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner.
- Establish and maintain an on-going relationship based on Informed Consultation and Participation (ICP) with the Indigenous Peoples affected by a project throughout the project's life-cycle.
- Ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples when the circumstances described in this Performance Standard are present.
- Respect and preserve the culture, knowledge, and practices of Indigenous Peoples.

Performance Standard 8: Cultural Heritage

Performance Standard 8 (PS8) recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention concerning the Protection of the World Cultural and Natural Heritage, PS8 aims to ensure that clients protect cultural heritage in the course of their project activities. In addition, the requirements of PS8 on a project's use of cultural heritage are based in part on standards set by the Convention on Biological Diversity.

The main objectives of PS8 are listed below:

- Protect cultural heritage from the adverse impacts of project activities and support its preservation.
- Promote the equitable sharing of benefits from the use of cultural heritage.

These performance standards and guidelines provide ways and means to identify impacts and affected stakeholders and lay down processes for management and mitigation of adverse impacts.

Table 4.1 sums up the IFC PS1 through 8 and discuss the applicability of these eight Performance Standards to the proposed Jaisalmer Wind Farm.

Table 4.1 : IFC Performance Standards for Environmental and Social Sustainability

S. No.	IFC Performance Standards (PS)	Applicability
1	<p>Performance Standard 1 (PS1): Assessment and Management of Environmental and Social Risks and Impacts</p>	<p>PS1 is applicable to the proposed Jaisalmer Wind Farm as there will be some social and environmental impacts such as generation of noise and negligible quantities of hazardous waste. In accordance with the provisions of PS1, ESIA study has been conducted and ESMS has also been developed for the proposed project.</p> <p>As the proposed project involves only private land, therefore public consultation was limited to land owners and nearby village community. However, it is important to maintain continuous dialogue with the local communities and establish a grievance redressal mechanism to address any potential conflicts and concerns.</p>
2	<p>Performance Standard 2 (PS2): Labor and Working Conditions</p>	<p>The applicability of PS2 will be more important during the construction phase as operation phase will only have limited number of staff. As per PS2, both CWP-Devgarh and INOX will need to comply with the applicable national labor laws, such as Contract Labor Act, Minimum Wages Act, Child Labor Act, Workmen Compensation Act etc. PS2 covers all employees – full-time, part-time and contractual labor. Labor will be hired from local villages; therefore standards pertaining to campsites will not be applicable. CWP-Devgarh /INOX shall provide adequate provisions such as access to clean water, sanitary facilities and other necessary facilities at the construction sites.</p> <p>CWP-Devgarh/INOX shall also ensure measures to prevent child labor, forced labor, and discrimination. Freedom of association and collective bargaining shall be provided. Wages, work hours and other benefits shall be as per the national labor and employment laws.</p> <p>CWP-Devgarh/INOX need to develop and implement an Occupational Health & Safety Procedure particularly for focusing on use of appropriate Personal Protective Equipment (PPEs), health and safety training and awareness programs, reporting of occupational health & safety performance indicators etc.</p>

S. No.	IFC Performance Standards (PS)	Applicability
3	<p>Performance Standard 3 (PS3): Resource Efficiency and Pollution Prevention</p>	<p>In conformance with PS3, CWP-Devgarh/INOX will need to develop and implement a Pollution Prevention & Abatement Plan and Environmental Monitoring Plan to address any potential adverse impacts on community and environment.</p> <p>CWP-Devgarh/INOX shall assess the impacts and risks associated with the generation, use, storage, release, and/or disposal of pollutants during the ESIA, planned as part of the ESMS, and implement them as per the Action Plan.</p>
4	<p>Performance Standard 4 (PS4): Community Health, Safety, and Security</p>	<p>The applicability of PS4 will be limited to construction phase due to the movement of heavy machinery/vehicles and thus shall result in preparation of an Action Plan to be disclosed to the community. With respect to emergencies associated with vehicular traffic movement a Road Safety & Traffic Management Procedure needs to be formulated and communicated to the nearby village communities. Labor and security staff will be engaged from local community.</p> <p>The Action Plan and any other relevant project-related information will enable the project villages and project influenced villages and any relevant government agencies to understand the risk</p> <p>Enable the influenced communities and relevant government agencies to understand these risks and impacts, and will engage the influenced communities and agencies on an on-going basis consistent with the requirements of PS 1.</p> <p>The shadow flicker and noise levels at adjoining villages are also evaluated to be within the acceptable norms. Additionally, the siting of the project WTGs need to be carried out in accordance to the micro-siting guidelines and the WTG model need to have valid type approval, including power curve certification, from designated international Test Stations and Classification Societies here under the Type Approval Provisional Scheme – 2000 (TAPS) introduced by C-WET (Refer SI. No. 17). An Emergency Preparedness & Response Plan/Procedure also need to be formulated and implemented by the contractor to this regard.</p>

S. No.	IFC Performance Standards (PS)	Applicability
5	Performance Standard 5 (PS5): Land Acquisition and Involuntary Resettlement	The Proposed project is located on private land only and the land is mostly open grass/shrub land. The purchase of land for the proposed project is on a willing seller – buyer basis. There is no loss of assets or access from the project. There will be no physical resettlement and relocation of people as the project area is not inhabited.
6	Performance Standard 6 (PS6): Biodiversity Conservation and Sustainable Management of Living Natural Resources	<p>Since the proposed project does not involve forest land, it will not lead to disturbance to the natural habitat. There are no notified wildlife sanctuary and national park within the 10 km radius of project site.</p> <p>The implementation of the actions necessary to meet the requirements of PS6 shall be managed through the suggested mitigation measures. The operation phase of the proposed project shall ensure protection of fauna and flora of the site and the surrounding areas.</p>
7	Performance Standard 7 (PS7): Indigenous Peoples	No indigenous people have been identified in the proposed project region and its surrounding areas. Hence, PS7 is not applicable for this project.
8	Performance Standard 8 (PS8): Cultural Heritage	The project site has no cultural heritage as defined under the PS8. Hence, PS8 is not applicable for this project.

4.2 IFC Categorization of Projects

IFC uses a system of social and environmental categorization to assess a project's expected social and environmental impacts. IFC categorizes the projects as A, B or C in descending order of environmental and social sensitivity or FI in case of financial institutions that on-lend to clients who may present environmental and social concerns. The following categories are defined below:

- **Category A Projects:** Projects with potential significant adverse social or environmental impacts that are diverse, irreversible or unprecedented
- **Category B Projects:** Projects with potential limited adverse social or environmental impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures
- **Category C Projects:** Projects with minimal or no adverse social or environmental impacts, including certain financial intermediary (FI) projects with minimal or no adverse risks

- **Category FI Projects:** All FI projects excluding those that are Category C projects

4.3 Environment, Health and Safety (EHS) General Guidelines of IFC

The Equator Principle 3 requires follow up of the environmental, health and safety requirements as per the following guidelines released by IFC on 30th April 2007:

- Environmental, Health, and Safety General Guidelines
- Environmental, Health, and Safety Guidelines for Wind Energy

The General EHS Guidelines are technical reference documents which include general and industry-specific examples of Good International Industry Practice (GIIP). These Guidelines address the performance levels and measures that are considered to be achievable in the new facilities at reasonable costs by existing technologies. These Guidelines can be applied to the existing facilities as well with the establishment of site-specific targets and an appropriate time table can be set for achieving them. The General EHS Guidelines should be tailored to the hazards and risks associated for each project/site based on the environmental assessment of the site-specific factors, such as host country context, assimilative capacity of the environment, and other project factors.

The General EHS Guidelines are organized in four (4) main categories:

- Environmental
- Occupational Health and Safety
- Community Health and Safety
- Construction and Decommissioning

Each of the four (4) categories is further sub-categorized for easy review and application of the EHS standards. Each of the 4 categories is summarized below.

Environmental

The environmental aspect of the General EHS Guidelines covers the different environmental parameters ranging from air quality to noise impact assessment. The Environmental Guidelines are further sub-categorized into eight (8) divisions:

- Air Emissions and Ambient Air Quality
- Energy Conservation
- Wastewater and Ambient Water Quality
- Water Conservation
- Hazardous Materials Management
- Waste Management
- Noise
- Contaminated Land

Occupational Health and Safety

This Section of the General EHS Guidelines provides guidance and examples of reasonable precautions to implement in managing principal risks to occupational health and safety. The sub-categories under this section are listed below:

- General Facility Design and Operation
- Communication and Training
- Physical Hazards
- Chemical Hazards
- Biological Hazards
- Radiological Hazards
- Personal Protective Equipment (PPE)
- Special Hazard Environments
- Monitoring

A bulleted list of the preventive and protective measures can be introduced at the work place to ensure health and safety of the workers, according to the following order of priority:

- Eliminating the hazard by removing the activity from the work process. Examples include substitution with less hazardous chemicals, using different manufacturing processes, etc.;
- Controlling the hazard at its source through use of engineering controls. Examples include local exhaust ventilation, isolation rooms, machine guarding, acoustic insulating, etc.;
- Minimizing the hazard through design of safe work systems and administrative or institutional control measures. Examples include job rotation, training safe work procedures, lock-out and tag-out, workplace monitoring, limiting exposure or work duration, etc.
- Providing appropriate personal protective equipment (PPE) in conjunction with training, use, and maintenance of the PPE.

The application of prevention and control measures to occupational hazards should be based on comprehensive job safety or job hazard analyses.

Community Health and Safety

This section of the General EHS Guidelines address those aspects of the project activities that take place outside the traditional project boundaries but however are related to the project operations. These Guidelines complement the guidance provided in the preceding environmental and occupational health and safety sections. This section is further categorized into the following divisions:

- Water Quality and Availability
- Structural Safety of Project Infrastructure
- Life and Fire Safety (L&FS)

- Traffic Safety
- Transport of Hazardous Materials
- Disease Prevention
- Emergency Preparedness and Response

Construction and Decommissioning

This section provides additional, specific guidance on prevention and control of community health and safety impacts that may occur during new project development, at the end of the project life-cycle, or due to expansion or modification of existing project facilities. This section is further categorized into the following divisions:

- Environment
- Occupational Health & Safety
- Community Health & Safety

The key requirements stated in the EHS guidelines are tabulated in Table 4.2.

Table 4.2 : Summary of General EHS Guidelines

S. No.	EHS Guideline	Applicability	Requirements	Description
Environmental				
1.1A	Air Emissions	N/A	-	This guideline applies to facilities or projects that generate emissions to air at any stage of the project life-cycle. No air emissions are emitted during the operation of the WTGs.
1.1B	Ambient Air Quality	Y	Results of baseline air quality monitoring readily available	Impacts should be estimated through qualitative or quantitative assessments by the use of baseline air quality assessments and atmospheric dispersion models to assess potential ground level concentrations
			Frequency of the monitoring	
1.2	Energy Conservation	N/A	-	This guideline applies to facilities or projects that consume energy in process heating and cooling; process and auxiliary systems; compressed air systems and heating, ventilation and air conditioning systems (HVAC); and lighting systems.
1.3	Wastewater and Ambient Water Quality	Y	Sludge, as a result of the sanitary wastewater, from septic tanks should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long term sustainability of water and land resources.	This guideline applies to facilities or projects that have the potential to generate, but not limited to, process wastewater, sanitary (domestic) sewage, or storm water. Such facilities should incorporate the necessary precautions to avoid, minimize, and control adverse impacts to human health, safety, or the environment.
1.4	Water Conservation	Y	Water conservation measures may include water monitoring/management techniques; process and cooling/heating water recycling, reuse, and other techniques; and sanitary water	This guideline promotes continuous reduction in water consumption and to achieve savings in the water pumping, treatment and disposal costs.

S. No.	EHS Guideline	Applicability	Requirements	Description
			conservation techniques.	
1.5	Hazardous Materials Management	Y	Inventories, along with MSDS, of any hazardous material stored should be readily available on-site.	This guideline apply to projects that use, store, or handle any quantity of hazardous materials (Hazmats)
1.6	Waste Management	Y	Waste Management Plan including Hazardous Waste Management and monitoring associated with the management of hazardous and non-hazardous wastes	This guideline applies to projects that generate, store, or handle any quantity of waste.
Occupational Health and Safety				
2.1	General Facility Design and Operation	Y	The building structures should be in compliance with the National Building Codes	Integrity of Workplace Structures
		Y	OHS plan for wind storms SOP for process shut-down	Severe Weather and Facility Shutdown
		Y	Ample space for the employees Emergency exit signs	Workspace and Exit
		Y	Fire alarm system Fire and emergency alarm system	Fire Precautions
		Y	Lavatory facilities with hot and cold running water, soap, and hand drying devices.	Lavatories and Showers
		Y	Adequate supplies of potable drinking water should be provided	Potable Water Supply
		Y	Clean Eating Area should be available for employees	Clean Eating Area
		Y	Natural lighting supplemented with artificial illumination should be used to	Lighting

S. No.	EHS Guideline	Applicability	Requirements	Description
			light up the workspace. Emergency lighting should be installed upon failure of principal artificial lighting.	
		Y	Passageways for pedestrians and vehicles within and outside buildings should be segregated and provide for easy, safe, and appropriate access. Measures to prevent unauthorized access to dangerous areas should be in place.	Safe Access
		Y	Qualified first-aid can be provided at all times.SOP for dealing with cases of trauma or serious illness up to the point at which patient care can be transferred to an appropriate medical facility.	First Aid
		Y	Sufficient fresh air should be supplied for indoor and confined work spaces.	Air Supply
		Y	The temperature in work, rest room and other welfare facilities should, during service hours, be maintained at a level appropriate for the purpose of the facility.	Work Environment Temperature
2.2	Communication and Training	Y	Provisions should be made to provide OHS orientation training to all new employees	OHS Training
		Y	A visitor orientation and control program should be established to ensure visitors do not enter hazard areas unescorted.	Visitor Orientation
		Y	Adequate training and information enabling the workers to understand work hazards prior to commencement of new assignments	New Task Employee and Contractor Training

S. No.	EHS Guideline	Applicability	Requirements	Description
		Y	Basic occupational training program and specialty courses should be provided, as needed, to ensure that workers are oriented to the specific hazards of individual work assignments.	Basic OHS Training
		Y	Hazardous areas (electrical rooms, compressor rooms, etc.), installations, materials, safety measures, and emergency exits, etc. should be marked appropriately.	Area Signage
		Y	All vessels that may contain substances that are hazardous should be labeled as to the contents and hazard, or appropriately color coded.	Labeling of Equipment
		Y	Communication of hazard codes and any information of the hazardous materials stores, handled, or used at the facility to emergency services and security personnel.	Communicate Hazard Codes
2.3	Physical Hazards	Y	SOP for Turning off, disconnecting, isolating, and de-energizing (Locked Out and Tagged Out) machinery with exposed or guarded moving parts, or in which energy can be stored (electrical components) during servicing or maintenance, in conformance with a standard such as CSA Z460 Lockout or equivalent ISO or ANSI standard	Rotating and Moving Equipment
		Y	No employee should be exposed to a noise level greater than 85 dB (A) for a duration of more than 8 hours per day without hearing protection. Hearing protective devices provided	Noise

S. No.	EHS Guideline	Applicability	Requirements	Description
			should be capable of reducing sound levels at the ear to at least 85 dB (A). Periodic medical hearing checks should be performed on workers exposed to high noise levels	
		Y	Marking all energized electrical devices and lines with warning signs Locking out (de-charging and leaving open with a controlled locking device) and tagging-out (warning sign placed on the lock) devices during service or maintenance Establishing "No Approach" zones around or under high voltage power lines	Electrical
		Y	SOP for implementation of safe defensive driving for drivers of company vehicles.	Industrial Vehicle Driving and Site Traffic
		Y	SOP for working in extreme weather conditions.	Working Environment Temperature
		Y	These OHS problems should be minimized or eliminated to maintain a productive workplace by implementing a healthy working environment.	Ergonomics, Repetitive Motion, Manual Handling
		Y	Fall prevention and protection measures should be implemented whenever a worker is exposed to the hazard of falling more than two meters. Appropriate training in use, serviceability, and integrity of the necessary PPE. Inclusion of rescue and/or recovery plans, and equipment to respond to workers after an arrested fall.	Working at Heights

S. No.	EHS Guideline	Applicability	Requirements	Description
		Y	Work area light intensity should be adequate for the general purpose of the location and type of activity, and should be supplemented with dedicated work station illumination, as needed.	Illumination
2.4	Chemical Hazards	N/A	-	There will be no chemical hazards associated with the operation of Jaisalmer Wind Farm
2.5	Biological Hazards	N/A	-	There will be no biological hazards associated with the operation of Jaisalmer Wind Farm
2.6	Radiological Hazards	N/A	-	There will be no radiological hazards associated with the operation of Jaisalmer Wind Farm
2.7	Personal Protective Equipment (PPE)	Y	Proper maintenance of PPE, including cleaning when dirty and replacement when damaged or worn out. Proper use of PPE should be part of the recurrent training programs for employees	PPE provides additional protection to workers exposed to workplace hazards in conjunction with other facility controls and safety systems.
2.8	Special Hazard Environments	N/A	A confined space is defined as a wholly or partially enclosed space not designed or intended for human occupancy and in which a hazardous atmosphere could develop as a result of the contents, location or construction of the confined space or due to work done in or around the confined space.	Confined Space
		Y	SOP should be developed and implemented for any lone and isolated worker. SOPs should establish, at a minimum, verbal contact with the worker at least once every hour, and ensure the worker has a capability for summoning emergency aid.	Lone and Isolated Workers

S. No.	EHS Guideline	Applicability	Requirements	Description
2.9	Monitoring	Y	OHS Monitoring program should include safety inspection, testing and calibration; surveillance of the working environment and worker's health and training	OHS Monitoring Program
			A log of all reported occupational accidents and diseases, dangerous occurrences, and incidents together with near misses should be maintained. These should also be investigated with the assistance of a person knowledgeable/competent in occupational safety.	Accidents and Diseases monitoring
Community Health and Safety				
3.1	Water Quality and Availability	Y	Water quality should comply with national acceptability standards or in their absence the current edition of with WHO Drinking Water Guidelines.	Water Quality
		Y	The overall target should be the availability of 100 liters per person per day.	Water Availability
3.2	Structural Safety of Project Infrastructure	Y	International codes, such as those compiled by the International Code Council (ICC) should be followed to regulate the design, construction, and maintenance of a built environment. During the operation phase of the project, hazard analysis can be undertaken to identify opportunities to reduce the consequences of a failure or accident.	Hazard Analysis
3.3	Life and Fire Safety (L&FS)	Y	Compliance with local building code, local fire department regulations, local legal/insurance requirements and	Detection and Alarm Systems Fire Suppression and Control Emergency Response Plan

S. No.	EHS Guideline	Applicability	Requirements	Description
			international L&FG standards	
		Y	Buildings should be constructed and maintained in compliance with the National Building Codes Storage areas should be uncluttered, providing clear evacuation routes in the event of an emergency Cabinets and lockers containing hazardous materials equipped with positive latching or sliding doors.	Other hazards such as earthquakes
3.4	Traffic Safety	Y	SOP for implementation of safe defensive driving for drivers of company vehicles.	Emphasizing safety aspects among drivers
3.5	Transport of Hazardous Materials	Y	Compliance with local laws and international requirements applicable to the transport of hazardous materials	Transfer and transport of hazardous materials
3.6	Disease Prevention	Y	Preventing illness among workers in local communities by undertaking health awareness and education initiatives, training health workers in disease treatment immunization programs for workers in local communities and health services	Providing surveillance and active screening and treatment of workers
3.7	Emergency Preparedness and Response	Y	Project should have an Emergency Preparedness and Response Plan that is commensurate with the risks of the facility.	Emergency Response Plan

4.4 EHS Guidelines Specific to Wind Energy

The EHS Guidelines specific to the Wind Energy are broadly classified in three sub-categories:

- Environment
- Occupational Health and Safety
- Community Health and Safety

Environment

Environmental issues associated with the construction and decommissioning of the wind energy farms may include, among others, noise and vibration, soil erosion, and threats to biodiversity, including habitat alteration and impacts to wildlife. Due to the typically remote location of wind energy conversion facilities, the transport of equipment and materials during construction and decommissioning may present logistical challenges.

Environmental issues specific to the operation of wind energy projects and facilities include the following:

- Visual impacts
- Noise
- Species mortality or injury and disturbance
- Light and illumination issues
- Habitat alteration
- Water quality

Occupational Health and Safety

Occupational health and safety hazards during the construction, operation, and decommissioning of the wind energy farms are generally similar to those of most large industrial facilities and infrastructure projects. These may include physical hazards such as working at heights, working in confined spaces, working with rotating machinery, and falling objects. Occupational health and safety hazards specific to wind energy facilities and activities primarily include the following:

- Working at heights
- Working over water

Community Health and Safety

Community health and safety hazards during the construction, operation, and decommissioning of wind energy farms are similar to those of most large industrial facilities and infrastructure projects. They may include structural safety of project infrastructure, life and fire safety, public accessibility, and emergency situations.

Community health and safety hazards specific to wind energy facilities primarily include the following:

- Aircraft and marine navigation safety
- Blade and ice throw
- Electromagnetic interference and radiation
- Public access

Table 4.3 presents the performance indicators to assess the environmental attributes of a Wind Farm against the IFC Sectoral Guidelines specific to wind energy.

Table 4.3 : Performance Indicators – IFC Sectoral Guidelines specific to wind energy

Environmental Parameters	Applicability to Jaisalmer Wind Farm	Limits/Methodology	Monitoring Frequency											
Environment														
Emissions and Effluent Guidelines	1.No Air Emissions 2.Sanitary sewage will be discharged to a septic tank	1. NA 2. NA	1. NA 2. NA											
Noise Guidelines	Noise generated from the propulsion of the WTGs	Noise generated should not exceed the following limits: <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th rowspan="2">Receptor</th> <th colspan="2">One hour L_{Aeq} (dBA)</th> </tr> <tr> <th>Day time</th> <th>Night time</th> </tr> </thead> <tbody> <tr> <td>Residential; institutional; educational</td> <td>55</td> <td>45</td> </tr> <tr> <td>Industrial; commercial</td> <td>70</td> <td>70</td> </tr> </tbody> </table> <p>Day time – 0700-2200 Night time – 2200-0700</p> <p style="text-align: center;">NOR</p> <p>Result in a maximum increase in background levels of 3 dB at the nearest receptor location</p>	Receptor	One hour L _{Aeq} (dBA)		Day time	Night time	Residential; institutional; educational	55	45	Industrial; commercial	70	70	Frequency should be sufficient to provide representative data
Receptor	One hour L _{Aeq} (dBA)													
	Day time	Night time												
Residential; institutional; educational	55	45												
Industrial; commercial	70	70												
Environmental Monitoring of Bird and bat injury and mortality		Dead bird searches, involving entire carcasses, partial remains, and feathers, is the most common way to monitor for collisions with wind blades	Periodic searches											

Environmental Parameters	Applicability to Jaisalmer Wind Farm	Limits/Methodology	Monitoring Frequency
Occupational Health and Safety			
Accident and Fatality Rates		Project Rates to be benchmarked against performance of similar Wind Farms in developed countries through consultation with published sources	Working environment should be periodically monitored for occupational hazards. Project should maintain a record of occupational accidents, diseases and dangerous occurrences and accidents

The key requirements stated in the Sectoral specific EHS guidelines are tabulated in Table 4.4.

Table 4.4 : Summary of Sectoral Specific EHS Guidelines

S. No.	EHS Guideline	Applicability	Requirements	Description
Environmental				
1	Visual impacts	Y	Visual impacts associated with wind energy projects typically concern the turbines themselves (e.g. color, height, and number of turbines) and impacts relating to their interaction with the character of the surrounding landscape.	Consult the community on the location of the wind farm to incorporate community values into design;
2	Noise	Y	Adherence to national or international acoustic design standards for wind turbines (e.g. International Energy Agency, International Electrotechnical Commission [IEC], and the American National Standards Institute).	Proper siting of wind farms to avoid locations in close proximity to sensitive noise receptors (e.g. residences, hospitals, and schools);
3	Species mortality or injury and disturbance	Y	Conduct site selection to account for known migration pathways or areas where birds and bats are highly concentrated. Configure turbine arrays to avoid potential avian mortality. Implement appropriate storm water management measures to avoid creating attractions such as small ponds which can attract birds and bats for feeding or nesting near the wind farm.	
4	Light and illumination issues	Y	There should be no, to the extent possible, or minimum shadow flicker and blade glint.	Shadow Flicker and Blade Glint

S. No.	EHS Guideline	Applicability	Requirements	Description
5	Habitat alteration	Y	There should be zero or minimum impacts on the habitat alteration.	Impacts of the operation of WTGs to the nearest habitants.
6	Water quality	Y	There should be zero or minimum impacts to the quality of surface water as a result of the installation of turbine foundations, underground cables, and access roads.	Impact on water quality of surface water
Occupational Health and Safety				
1	Working at heights	Y	Fall prevention and protection measures should be implemented whenever a worker is exposed to the hazard of falling more than two meters. Appropriate training in use, serviceability, and integrity of the necessary PPE. Inclusion of rescue and/or recovery plans, and equipment to respond to workers after an arrested fall.	Prior to undertaking work, test structure for integrity;
Community Health and Safety				
1	Aircraft and marine navigation safety	Y	Consultations with air and marine regulatory traffic authorities before installation, in accordance with air and marine traffic safety regulations.	Siting of wind farms away from airports and/or ports and harbors
2	Blade and ice throw	Y	Establish safety setbacks, and design/site wind farms such that no buildings or populated areas lie within the possible trajectory range of the blade. Wind turbines should be equipped with vibration sensors that can react to any imbalance in the rotor blades and shut	A failure in the rotor blade or ice accretion can result in the 'throwing' of a rotor blade or ice from the wind turbine, which may affect public safety, although the risk of ice throw is only relevant to cold climates and the overall risk of blade throw is extremely low.

S. No.	EHS Guideline	Applicability	Requirements	Description
			down the turbine, if necessary. Warning signs should be used to alert the public of risk.	
3	Electromagnetic interference and radiation	Y	The Wind Farms should be sited and the layout should be such so as to cause zero or minimum interference to the aviation radar, telecommunication systems and television reception signals.	Impacts of operation of wind farm to aviation radar, telecommunication systems and television reception signals.
4	Public access	Y	The Wind Farms should be secured against any kind of unauthorized public access	Security of wind farm against unauthorized public access

4.5 Equator Principles

The Equator Principles comprise of a group of ten principles adopted by the Equator Principle Financial Institutions (EPFIs) in order to ensure that the projects funded by them are developed in a manner that is socially responsible and reflect sound environmental management practices. The Principle strives towards avoidance of negative impacts on project-affected ecosystems and communities where possible, and in case unavoidable, need to be adequately reduced, mitigated and/or compensated. Complying with these Principles, which serve as environmental and social safeguards, offer significant benefit to the proponent, financial institutions and local stakeholders.

The applicability of each of the principles with respect to proposed project is discussed below:

Principle 1: Review and Categorization

When a project is proposed for financing, the EPFI will, as part of its internal social and environmental review and due diligence, categories such project based on the magnitude of its potential impacts and risks in accordance with the environmental and social screening criteria of IFC.

Based on the IFC environmental and social screening criteria, the proposed Jaisalmer Wind Farm is identified as a “Category B” project with potential limited adverse social or environmental impacts that are few in number, generally site-specific, largely reversible and can be readily addressed through mitigation measures.

Principle 2: Social and Environmental Assessment

Under the provision of this Principle, it is required by the proponent, for all Category A and B projects, to conduct a social and environmental assessment process to address, as appropriately aligned to the EPFI’s guidelines, the relevant social and environmental impacts and risks of the proposed project. The Assessment should also propose mitigation and management measures relevant and appropriate to the nature and scale of the proposed project.

In line with Principle 2, the proponent of the proposed Jaisalmer Wind Farm has undertaken an Environmental and Social Impact Assessment study to identify, assess, evaluate and mitigate the potential environmental and social risks.

Principle 3: Applicable Social and Environmental Standards

This Principle requires the Environment and Social Assessment to refer to the applicable IFC PS and the then applicable Industry Specific EHS Guidelines including the project’s overall compliance with, or justified deviation from, the respective PS and EHS Guidelines. The Assessment process also needs to address compliance with relevant host country laws, regulations and permissions that pertain to social and environmental matters.

A similar exercise has been carried out for the proposed Jaisalmer Wind Farm and has been discussed in detail in Sections 4.1 through 4.4 and 4.6 of this Report.

Principle 4: Action Plan and Management System

For all Category A and B projects, an Action Plan (AP) needs to be prepared which addresses relevant findings, and draws on the conclusions of the Assessment. The AP will describe and prioritize actions needed to implement mitigation measures, corrective actions and monitoring measures necessary to manage the impacts and risks identified in the Assessment. In this regard, the borrower/proponent needs to maintain or establish an Environmental and Social Management System (ESMS) that addresses the management of these impacts, risks and corrective actions required to comply with applicable host country social and environmental laws and regulations, and requirements of the applicable IFC PS and EHS Guidelines.

Hence, in accordance with the provision of this Principle, an ESMP has been drafted as a part of the ESIA study for the proposed project specifying appropriate plans and procedures which requires to be implemented during various phases in order to prevent, control and mitigate any potential environmental and social risks. Chapter 7 details the ESMP for the proposed Jaisalmer Wind Farm.

Principle 5: Consultation and Disclosure

According to this Principle, for all Category A and (as appropriate) Category B projects, the Government, borrower or third party expert to consult with project affected communities in a structured and culturally appropriate manner. For projects with significant adverse impacts on affected communities, the process will ensure their free, prior and informed consultation and facilitate their informed participation as a means to judge, vide EPFI norms, whether a project has adequately slot in affected communities concern.

Given the proposed project is rated as “Category B”, with no potential adverse impacts on the neighboring community; it does not necessitate the formulation of a Public Consultation and Disclosure Plan. However, as per the requirement of this Principle, the proponent has undertaken social consultation with land holders and nearby village representatives to establish the socio-economic condition of the area. This social consultation also helped to understand any community concern that might be associated with the proposed project, particularly related to loss of land, livelihood, resource requirement etc. Section 6.2 documents the community consultation.

Principle 6: Grievance Mechanism

For all Category A and (as appropriate) Category B projects, it needs to be ensured by the proponent that consultation, disclosure and community engagement continues throughout construction and operation of the project and community concerns/grievances addressed through establishing a ‘Grievance Redressal Mechanism’.

In this regard, the proponent of the proposed Jaisalmer Wind Farm needs to develop and implement a ‘Grievance Redressal Mechanism’ (GRM) to receive and facilitate resolution of any concern and grievance that may be raised by people whose land has been acquired and/or nearby village communities during both construction and

operational phase of the project. As part of this Principle, it is also imperative that the proponent maintains regular dialogue with communities through implementation of focused CSR programs/initiatives. Section 7.8.6 details the GRM proposed for Jaisalmer Wind Farm.

Principle 7: Independent Review

In accordance with the provision of this Principle, an independent social or environmental review needs to be undertaken by an external expert of the proposed Jaisalmer Wind Farm’s ESIA, ESMP, legal/permit documents (CTE/CTO) and consultation process documentation in order to assist EPFI's due diligence, and in order to assess Equator Principles compliance.

Principle 8: Covenants

Under this Principle, the proponent of the proposed Jaisalmer Wind Farm is required to covenant in financing documentation to ensure compliance with all applicable national, environmental, health, safety and social laws and regulations; demonstrate compliance to environmental and social management plans and procedures drafted as part of the ESIA study; carry out periodic reporting to EPFIs on compliance to the national EHSS regulations and ESMP; and undertake decommissioning of facilities viz. WTGs etc. in accordance with an agreed decommissioning plan.

Principle 9: Independent Monitoring and Reporting

To ensure ongoing monitoring and reporting of the environmental and social performance of the proposed Jaisalmer Wind Farm over the life of the loan, the EPFIs might require the project proponent to hire an independent environmental and/or social expert or retain qualified and experienced external experts to verify its monitoring information which would be shared with EPFIs.

Principle 10: EPFI Reporting

This Principle is particularly applicable for EPFIs under which each EPFI is committed to report publicly at least annually about its Equator Principles implementation processes and experience, taking into account appropriate confidentiality considerations.

4.6 Applicable Environmental and Social Laws, Regulations and Policies

The relevant Acts and Rules pertaining to the project have been summarized in Table 4.5.

Table 4.5 : Applicable Environmental and Social Laws, Regulation and Policies

S. No.	Applicable Legislation	Enforcing Agency	Applicable Permits and Requirement
1.	The Environment (Protection) Act 1986 , as amended in April 2003; EPA Rules 1986 , as amended in	RSPCB MoEFCC CPCB	CWP-Devgarh/INOX shall ensure compliance under these Rules in order to maintain stipulated standards and environmental management through various supporting rules promulgated under the EP

S. No.	Applicable Legislation	Enforcing Agency	Applicable Permits and Requirement
	2002.		Act.
2.	The Water (Prevention and Control of Pollution) Act, 1974 , amended in 1988	RSPCB	As per the re-classification of industries into Red, Orange and Green Category, issued by CPCB dated June 4, 2012, and orders issued by RSPCB regarding the same, the solar power generation through solar photovoltaic cell, wind power & mini hydel power (<25 MW) are classified under Green Category Industries and require Consent to Establish and Consent to Operate under Water (Prevention and Control of Pollution) Act, 1974. CWP-Devgarh/INOX shall ensure that 'Consent to Establish' and 'Consent to Operate' under Water Act are obtained for Jaisalmer Wind Farm from RSPCB.
3.	The Air (Prevention and Control of Pollution) Act, 1981 , amended in 1987. Movement of vehicles, excavation of pits for tower erection, operation of diesel generators for power at campsite or other construction activities).	RSPCB	-
4.	The Noise (Regulation & Control) Rules, 2000 as amended in October 2002 As per the Environment (Protection) Act (EPA) 1986 the ambient noise levels are to be maintained as stipulated by the Central Pollution Control Board (CPCB) for different categories of areas like, commercial, residential and silence zones etc.	RSPCB	The Rules require activity/processes generating noise to ensure that the ambient noise standards are within the prescribed Standards. The proposed project will result in generation of noise during construction and operation activities. The project is required to maintain the noise limits prescribed for residential (55 dB (A) for daytime and 45 dB (A) for night-time). CWP-Devgarh/INOX shall ensure compliance under the rules to maintain stipulated standards.
5.	Hazardous Wastes (Management Handling and Trans boundary Movement)	RSPCB	The operation phase of the proposed project will result in generation of some quantities of hazardous waste, mostly in the

S. No.	Applicable Legislation	Enforcing Agency	Applicable Permits and Requirement
	<p>Rules, 2008 as amended up to 2009 under the Environment (Protection) Act, 1986</p>		<p>form of waste/used oil.</p> <p>The project shall make an application in Form 1 of The <i>Hazardous Waste (Management, Handling and Trans-boundary Movement) Rules, 2008</i> and submit to the state pollution control board for authorization of handling, packaging, storing and offering for sale; hazardous waste generated due to the project.</p> <p>After authorization is granted, the project shall maintain the record of hazardous wastes handled in Form 3 and prepare and submit to RSPCB, an annual return containing the details specified in Form 4 on or before the 30th day of June following to the financial year.</p> <p>All the hazardous waste generated due to the project shall be stored and disposed as per the requirements of the <i>Hazardous Waste Rules</i>, i.e. on a paved surface in a designated area with adequate secondary containment, with adequate labeling and before it is disposed to an RSPCB approved vendor.</p>
6.	<p>Ozone Depleting Substances (Regulation) Rules, 2000 as amended in 2005</p>	MoEFCC	<p>The proposed project will involve use of insulating material for wiring and electrical units. Some of the insulating materials may comprise of ozone depleting substances.</p> <p>CWP-Devgarh/INOX shall ensure that all the insulation material used for wiring and electrical units used for the proposed project are free of ozone depleting substances.</p>
7.	<p>The Electricity Act, 2003 including rules 1956 and 2005</p> <p>The Rules specify the general safety requirements for construction, installation, protection, operation and maintenance of electricity supply lines and apparatus.</p>	<p>Rajasthan State Electricity Board (RSEB)</p> <p>Rajasthan Electricity Regulatory Commission (RERC)</p>	<p>The Electricity Act, 2003 allows private sector projects to obtain distribution Licenses from the State Electricity Regulation Committee and to have open access to the transmission lines. The license requires power generating companies to comply with the standards of performance specified in the Act.</p> <p>CWP-Devgarh/INOX shall obtain license as mandated under provisions of the Electricity Act and ensure that the health and safety</p>

S. No.	Applicable Legislation	Enforcing Agency	Applicable Permits and Requirement
			requirements specified under the rules are complied to.
8.	<p>The Motor Vehicles Act 1988, as amended by Motor Vehicles (Amendment) Act 2000, dated 14th August 2000</p> <p>The Central Motor Vehicles Rules 1989, as amended through 29th June, 2012</p>	Rajasthan Motor Vehicles Department	<p>Every motor vehicle other than motor cycles of engine capacity not exceeding 70 cc, manufactured prior to the first day of March 1990, shall be maintained in such condition and shall be so driven so as to comply with the standards prescribed in these rules.</p> <p>CWP-Devgarh/INOX shall ensure Compliance of stipulated emission standards under Rule 115.</p>
9.	Explosives Act 1884 and Rules 2008	<p>PESO</p> <p>Department of Geology and Mining, Rajasthan</p>	<p>The rules mandate the EPC contractor to obtain a prior approval and No Objection Certificate (NOC) from the District Magistrate or Director General of Mines Safety for usage of explosives in blasting during construction process (if any).</p> <p>INOX shall obtain the approval and NOC from the relevant licensing authority prior to construction for use of explosives as per the provisions mentioned under Chapter VIII of the Rules.</p>
10.	<p>The Contract Labor (Regulation and Abolition) Act, 1970</p> <p>Rajasthan Contract Labor (Regulation and Abolition) Rules, 1971</p>	Chief Labor Commissioner , Rajasthan	<p>CWP-Devgarh shall ensure that INOX has a valid license under the Contract Labor (Regulation and Abolition) Act, 1970 for executing any work through contract labor. Any other contractors or third parties to be involved in the construction works for the proposed project, if required, will also be engaged only subject to availability of valid license.</p> <p>CWP-Devgarh/INOX shall also ensure that conditions like hours of work, fixation of wages and other essential amenities in respect of contract labor are provided and in compliance with the standards.</p>
11.	The Trade Union Act, 1926	Directorate of Industrial Safety and Health, Rajasthan	<p>Provides procedures for formation and registration of Trade Unions and lists their rights and liabilities. It encompasses any combination, permanent or temporary, that gets formed to regulate relationship between workmen and their employers.</p> <p>CWP-Devgarh/INOX shall ensure that there</p>

S. No.	Applicable Legislation	Enforcing Agency	Applicable Permits and Requirement
			is no policy restricting association of workers union.
12.	The Child Labor (Prohibition and Regulation) Act, 1986	Directorate of Industrial Safety and Health, Rajasthan	<p>The Act prohibits employment of children in certain occupation and processes. The Act also specifies conditions of work for children, if permitted to work.</p> <p>CWP-Devgarh/INOX shall ensure that no child labor is engaged at site for construction or operation works either directly or by the sub-contractors. CWP-Devgarh shall include a clause in the subcontractor agreements prohibiting employment of child labor for the proposed project.</p>
13.	Bonded Labor (Abolition) Act 1976	Directorate of Industrial Safety and Health, Rajasthan	<p>The act states that all forms of bonded labour stands abolished and every bonded labourer stands freed and discharged from any obligations to render any bonded labour.</p> <p>CWP-Devgarh/INOX shall ensure no bonded labor is engaged at site for construction or operation works.</p>
14.	Minimum Wages Act, 1948	Directorate of Industrial Safety and Health, Rajasthan	<p>Requires the Government to fix minimum rates of wages and reviews this at an interval of not more than 5 years. Every employer shall be responsible for the payment to persons employed by him of all wages required to be paid under this Act.</p> <p>CWP-Devgarh/INOX shall ensure payment of minimum wages as fixed by the government without any gender bias.</p>
15.	Equal Remuneration Act, 1976	Directorate of Industrial Safety and Health, Rajasthan	<p>It is the duty of an employer to pay equal remuneration to men and women workers for same work or work of a similar nature.</p> <p>CWP-Devgarh/INOX shall ensure compliance to the requirements of the Act.</p>
16.	Workmen's Compensation Act, 1923	Directorate of Industrial Safety and Health, Rajasthan	<p>The Act requires if personal injury is caused to a workman by accident arising out of and in the course of his employment, his employer shall be liable to pay compensation in accordance with the provisions of this Act.</p>

S. No.	Applicable Legislation	Enforcing Agency	Applicable Permits and Requirement
			CWP-Devgarh/INOX shall ensure compliance to the requirements of the Act.
17.	<p>Maternity Benefit Act, 1961</p> <p>No employer shall knowingly employ a woman in any establishment during the six weeks immediately following the day of her delivery or her miscarriage. No pregnant woman shall, on a request being made by her in this behalf, be required by her employer to do during the period any work which is of an arduous nature or which involves long hours of standing, or which in any way is likely to interfere with her pregnancy or the normal development of the fetus, or is likely to cause her miscarriage or otherwise to adversely affect her health.</p>	Directorate of Industrial Safety and Health, Rajasthan	CWP-Devgarh/INOX shall ensure that engagement of female workers, if any, during their pregnancy adheres the requirement of the act.
18.	<p>National Environmental Policy 2006</p>	RSPCB	<p>The dominant theme of this policy is that while conservation of environmental resources is necessary to secure livelihoods and well-being of all, the most secure basis for conservation is to ensure that people dependent on particular resources obtain better livelihoods from the fact of conservation, than from degradation of the resource.</p> <p>CWP-Devgarh/INOX shall ensure compliance to the requirements of this policy.</p>

Since the land parcels for the location of WTGs is private land and the negotiations have been done on willing seller-willing buyer basis, other Social Act and Policy such as Land Acquisition Act, 1984 and Resettlement and Rehabilitation, 2007 are not applicable for this proposed project.

5. DESCRIPTION OF ENVIRONMENT

This chapter describes the baseline environmental conditions around the surrounding area of the proposed Jaisalmer Wind Farm for various environmental attributes, viz., physical, biological and socio-economic. Topography, soil, water, meteorology, air, noise, and land constitute the physical environment, whereas flora and fauna constitute the biological environment. Demographic details and occupational pattern in the study area constitute socio-economic environment. Baseline environmental conditions are based on the field studies carried out at and around the proposed site and through secondary data collected from published sources.

5.1 Environmental Settings

The section describes the climate and meteorology of Jaisalmer district and study area.

5.1.1 Climate and Meteorology

The climate of Jaisalmer is typically of a desert region, i.e. hot and arid, with large day-night temperature extremes and sporadic or erratic rainfall. The hot weather is very prolonged and heat during the summer extends up to the end of June. Temperatures begin to rise in March and during May-June months reach its peak value, sometimes rising to 48°C. Winter extends from November to March, and the coolest period occurs in January when average daytime temperatures are recorded below 20°C and often fall at freezing values during night. Maximum temperature range recorded in Jaisalmer is 48°C while the minimum is 2°C.

Winds are generally light in winter and moderate to strong in the monsoon, and blow mainly from the north-west and south-west, and from the south and south west in the monsoon. Wind speeds may also increase at this time, and dust storms are common.

5.1.2 Rainfall

The rainfall in the district is scanty and precarious. The south-west monsoon arrives in July, causing a sudden drop in temperature, although the air remains dry as rain only falls on an average of six days per year. The monsoon ends in mid-September and air temperatures rise, only to fall again a few weeks later with the onset of winter.

As per the climate data for last ten years (2004-2013), published by Department of Water Resources, Rajasthan, maximum rainfall during the southwest monsoon has been observed during the months July-September. Table 5.1 presents the annual and monthly rainfall in Jaisalmer District in the last ten years. The rains are erratic and so is the distribution of the rainfall. Figure 5.1 depicts the mean monthly rainfall received during last ten years.

Table 5.1 : Rainfall Pattern in last 10 years recorded in Jaisalmer District (2004-2013)

Rainfall (mm)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2004	0	0	0	0	0	2.3	0	33	1	11	0	0	47.3
2005	0	0	0	0	48	28	43	2	99.5	0	0	0	220.5
2006	0	0	19	7	0	59	3	411.3	4	0	0	9.5	512.8
2007	0	31.8	16	6	12	0	17.2	95.2	15	0	0	2	195.2
2008	5	0	0	1.5	7	11	30	82.5	0	0	0	36.5	173.5
2009	5	0	0	0	0	33.5	30.5	22	0	0	0	0	91
2010	2	0	0	4	0	88	56	75	66	6	12	0	309
2011	0	2	0	1	0	0	44	92	138	0	0	0	277
2012	0	0	0	32	1	13	2	97	74	0	0	0	219
2013	0	18	27	0	10	20	14	109	2	0	0	0	200

Source: Department of Water Resources, Rajasthan

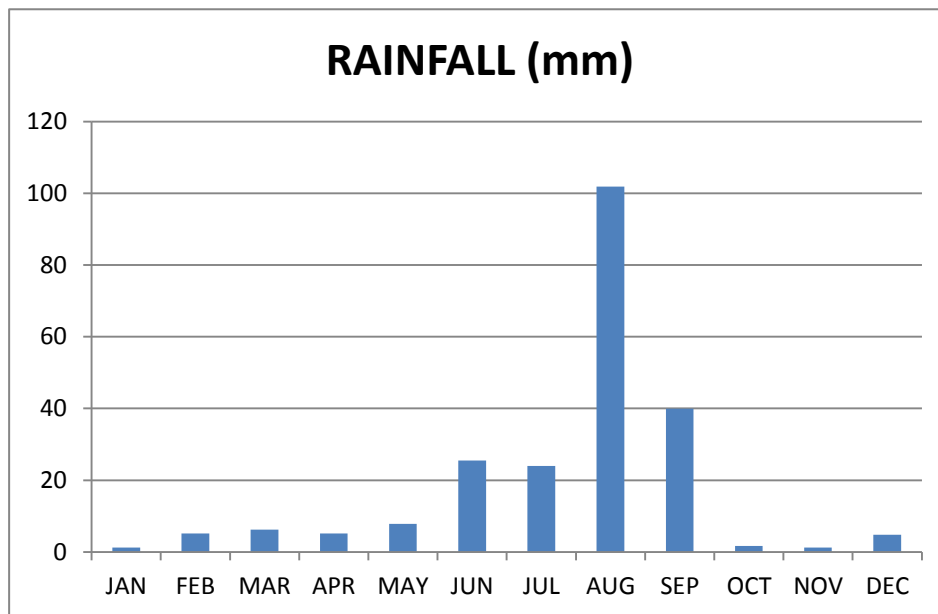


Figure 5.1 : Average Rainfall Pattern in Jaisalmer District (2004-2013)

5.1.3 Seismicity

According to the seismic-zoning map of India, Jaisalmer district lies in medium risk zone, III. The seismic data has been verified from “*Vulnerability Atlas of India, Rajasthan Urban Sector Development, 2002*”.

5.2 Environmental Baseline Settings

5.2.1 Ambient Air Quality

The existing quality of the ambient air environment serves as an index for assessing the pollution load and the assimilative capacity of any region and forms an important tool for planning project activities in the area.

The ambient air quality monitoring was conducted at two representative locations during the month of October, 2014. The baseline air quality status of the study area (5 km) was primarily assessed by monitoring for particulates and gaseous pollutants at the two stations.

PM_{2.5} Dust sampler of Envirotech Instruments, New Delhi, was used for monitoring of PM₁₀, PM_{2.5}, SO_x, NO_x and CO. Monitoring was done twice a week for two weeks at each location for PM₁₀ and PM_{2.5}, SO_x and NO_x for 24 hours and 8 hours a day twice a week for two weeks for CO. The monitoring was conducted according to the NAAQS notified by CPCB on 18th November, 2009. The concentrations of various pollutants at all the monitoring locations were assessed for different statistical parameters like arithmetic mean, minimum concentration, maximum concentration and percentile values. The summary of ambient air quality results are presented in Table 5.2.

Based on the analysis of the Indian Meteorological Data (IMD), 30-year climatological data for Jaisalmer, the predominant wind direction in the area is from south west and south in the morning and evening hours. Figure 5.2 and 5.3 present the predominant wind direction in the study area for the morning and evening hours respectively. In order to establish the baseline status of the air environment in the project area, AAQM was conducted at the following two locations in the project area:

- Bonada
- Khelana

Figure 5.2 depicts that the predominant wind direction for the 30 year data period (1951-1980) considered for the analysis is south-west (34.1%) followed by south (14%) in the morning hours (8:30 am). The calm days (wind speed less than 1 kmph) account for 21.8% of the data period.

Figure 5.3 depicts that the predominant wind direction for the 30 year data period (1951-1980) considered for the analysis is south-west (30.2%) followed by south (14.3%) in the evening hours (17:30). The calm days (wind speed less than 1 kmph) account for 6.6% of the data period.

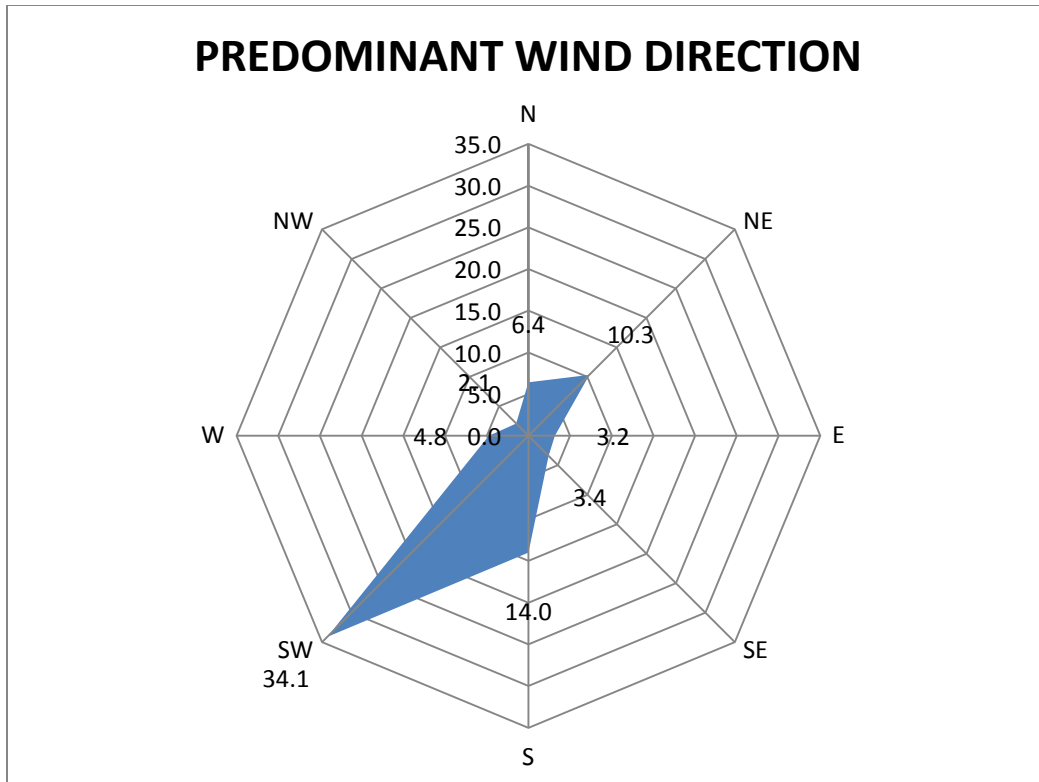


Figure 5.2 : Predominant Wind Direction in the Study Area – Morning Hours (08:30)

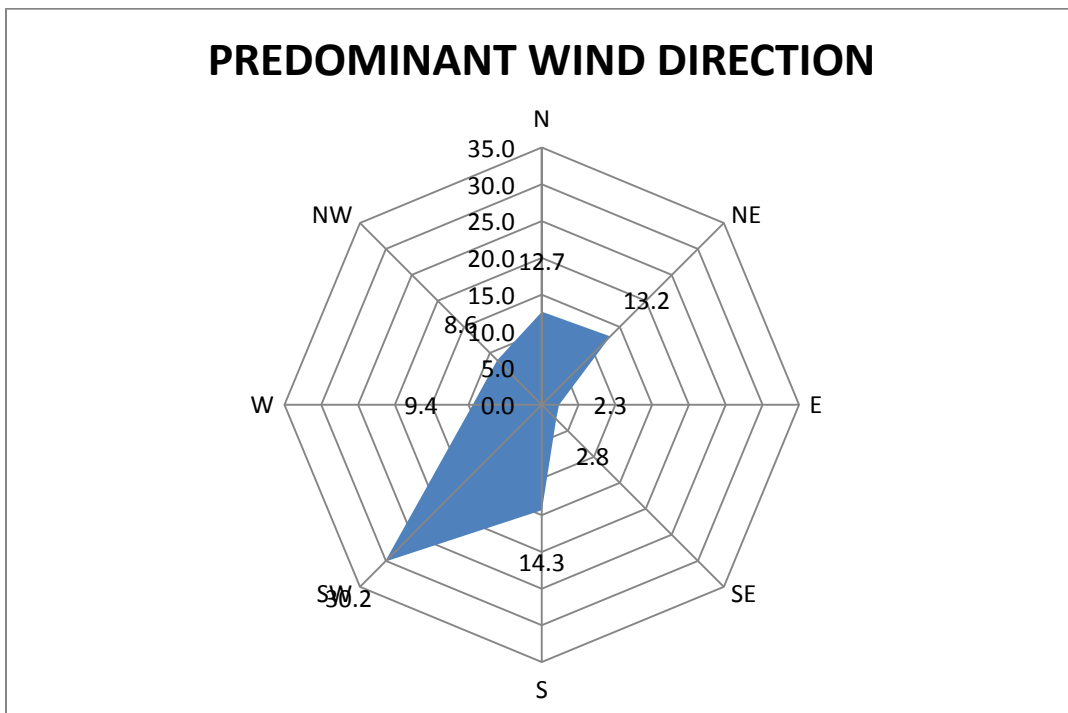


Figure 5.3 : Predominant Wind Direction in the Study Area – Evening Hours (17:30)

Figure 5.4 presents the pictures taken during the establishment of the baseline status of the air environment at the two identified village locations.



Figure 5.4 : Pictures of AAQ Monitoring Locations

Ambient Air monitoring results

The sampling and analysis of ambient air quality parameters was carried out as per the procedures detailed in relevant Parts of IS-5182 (Indian Standards for Ambient Air Quality Parameters). The results of the air monitoring are presented in Table 5.2.

Table 5.2 : Ambient Air Quality Analysis Results

Location		Parameters				
		PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	SO _x (µg/m ³)	NO _x (µg/m ³)	CO (µg/m ³)
NAAQS (Industrial/Residential/Rural and other areas)		100	60	80	80	2000
Bonada	Max	67.5	30.5	7.0	14.0	694
	Min	55.6	24.4	5.6	11.2	582
	Mean	62.0	27.4	6.3	12.4	639
	98 Percentile	67.3	30.4	7.0	13.9	691
Khelana	Max	75.0	36.6	6.1	11.6	618
	Min	60.6	26.2	4.2	9.5	455
	Mean	69.3	30.9	5.1	10.6	536
	98 Percentile	74.8	36.4	6.1	11.6	614

Interpretation of Air quality

PM₁₀

The average highest PM₁₀ level was observed at Khelana (69.3 µg/m³), while the lowest level was observed at Bonada (62.0 µg/m³). The PM₁₀ levels are observed to be lower than the NAAQS level of 100 µg/m³. The graphical representation of PM₁₀ concentrations is provided in Figure 5.5.

PM_{2.5}

The highest mean PM_{2.5} levels were found at Khelana (30.9 µg/m³) while the lowest levels were found in the village of Bonada (27.4 µg/m³). The PM_{2.5} values are within the NAAQS level of 60 µg/m³. The graphical representation of the PM_{2.5} concentrations is provided in Figure 5.6.

SO_x

The highest levels of SO_x were found to be within the prescribed NAAQS standards. The maximum limit was observed at Bonada (6.3 µg/m³) and the lowest level was observed at Khelana (5.1 µg/m³). The graphical representation of SO_x concentrations is provided in Figure 5.7.

NO_x

The highest level of NO_x was found at Bonada (12.4 µg/m³) whereas lowest level was found at Khelana (10.6 µg/m³). NO_x values are within the NAAQS level of 80 µg/m³. The graphical representation of NO_x concentrations is provided in Figure 5.8.

CO

The highest level of CO was found at Bonada (639 µg/m³) whereas lowest level was found at Khelana (536 µg/m³). CO values are within the NAAQS level of 2000 µg/m³. The graphical representation of CO concentrations is provided in Figure 5.9.

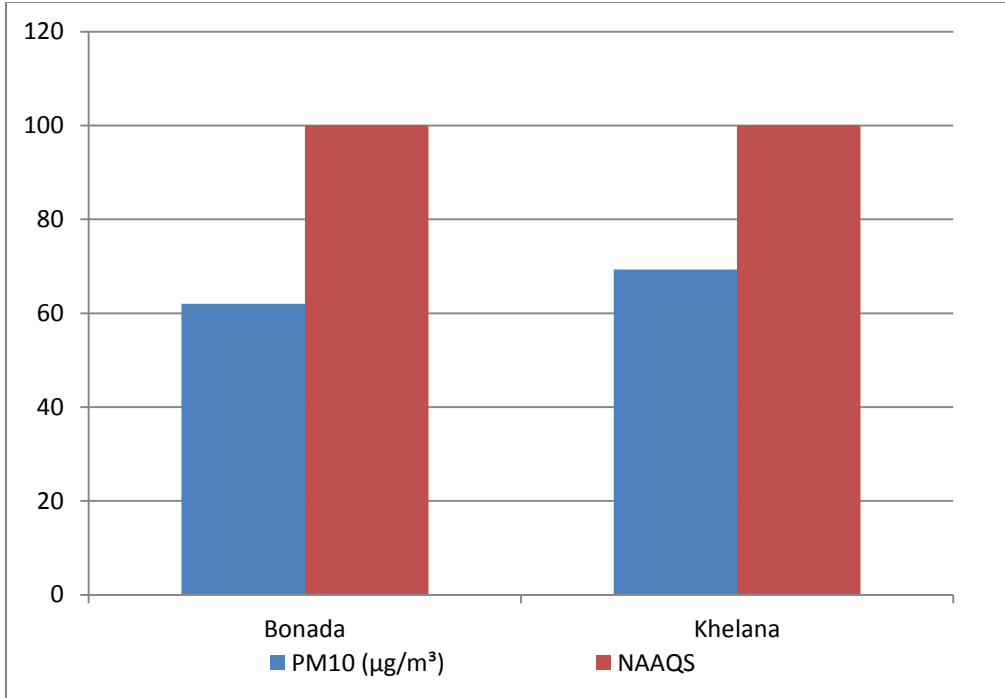


Figure 5.5 : Graphical Representation of PM_{10} Concentrations

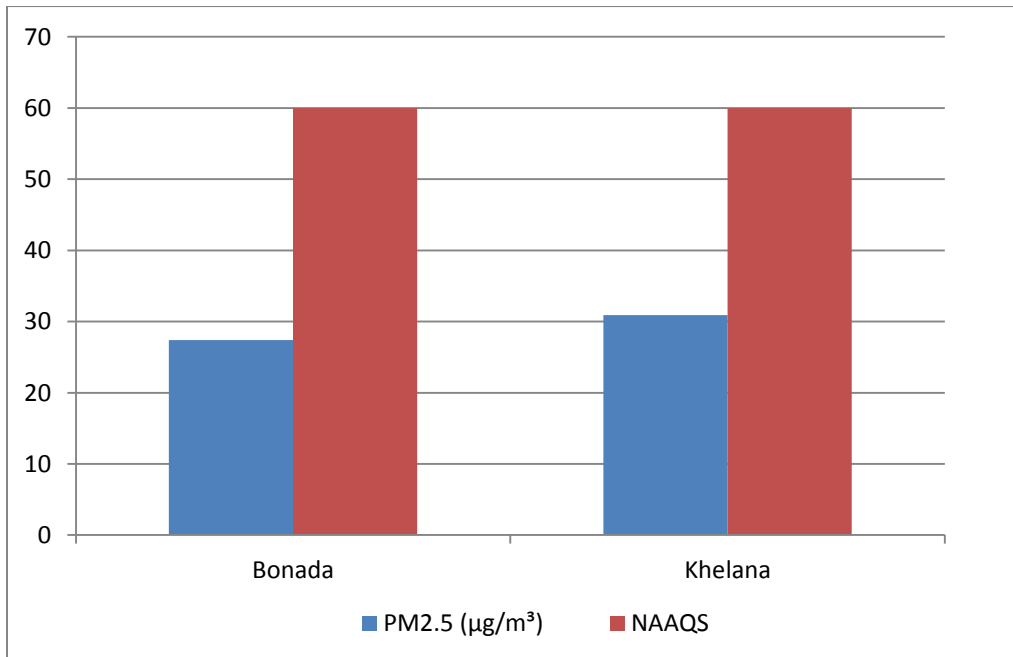


Figure 5.6 : Graphical Representation of $\text{PM}_{2.5}$ Concentrations

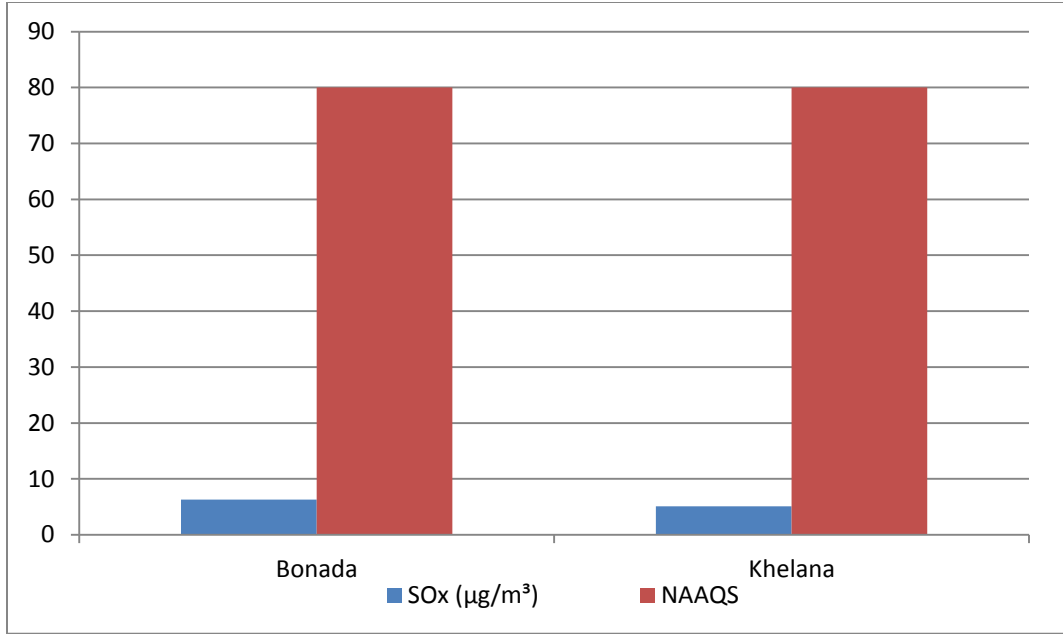


Figure 5.7 : Graphical Representation of SOx Concentrations

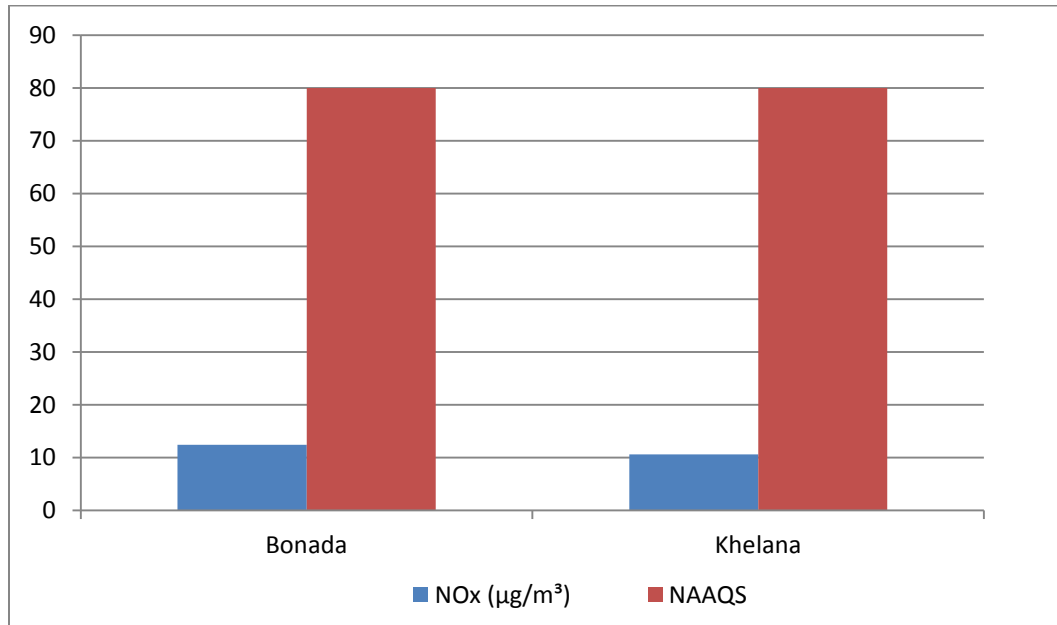


Figure 5.8 : Graphical Representation of NOx Concentrations

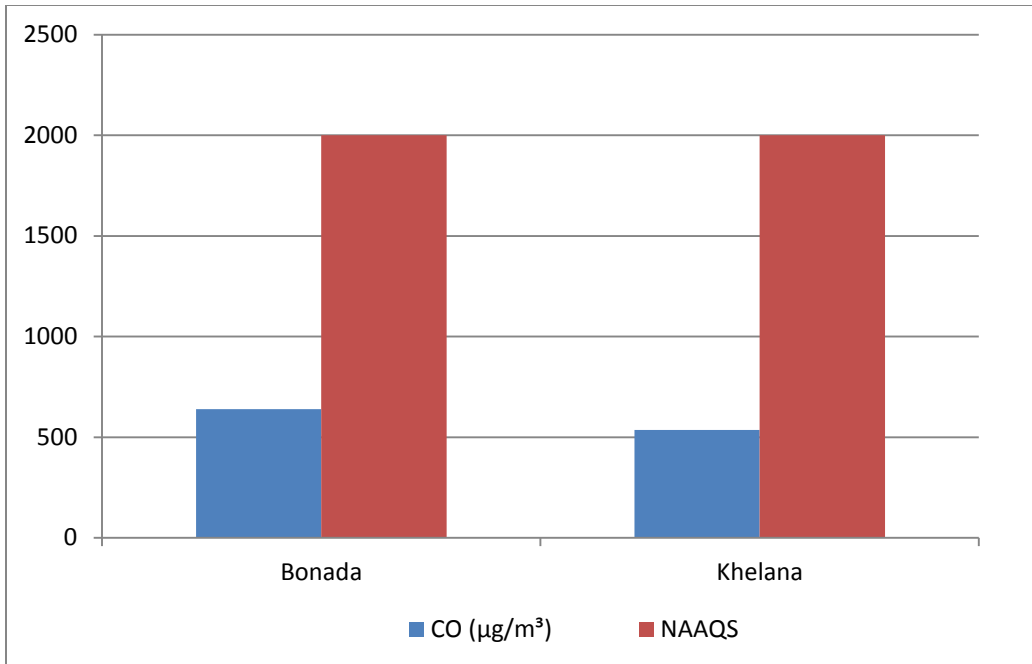


Figure 5.9 : Graphical Representation of CO Concentrations

The ambient air quality observed in the area is good as all the parameters observed are considerably below the required standards and guideline values. The site and surroundings are predominantly rural with no identified major sources of pollution in the area. The movement of traffic was also observed to be limited in the area.

5.2.2 Water Environment

Ground water is the most valuable natural resource of drinking water for the people living in the District of Jaisalmer. The extreme arid climatic conditions are the main factors for the prevalence of highly mineralized ground water in the District. Nitrate occurs within common range of 0-1000 mg/l in ground water. Fluoride concentration remains low in natural ground water due to low solubility of fluoride mineral. Few aquifers comprising of igneous rocks, tertiary & quaternary sediments and other sources contribute significant concentrations of fluoride in ground water. The average value being 2.06 mg/l.

The ground water is hard in nature. High value of hardness is normally associated with saline ground water. In general, hardness varies from 80 to 1250 mg CaCO₃/l. The water analysis reveals that more than 68% ground water is sodium-chloride type. The dominance of sodium & chloride ions in the ground water have increased its salinity to a great extent and thus, the salinity of ground water fall in high to very high class of salinity. The presence of sodium chloride type ground water illustrates the influence of aridity as well as minimum circulation of water in aquifers.

Overall, the various parameters assessed were found to be well within limits as per the drinking water standards IS 10500:1991 and hence declared potable by the CGWB.

Figure 5.10 presents the pictures taken during the water sampling from the three identified village locations.

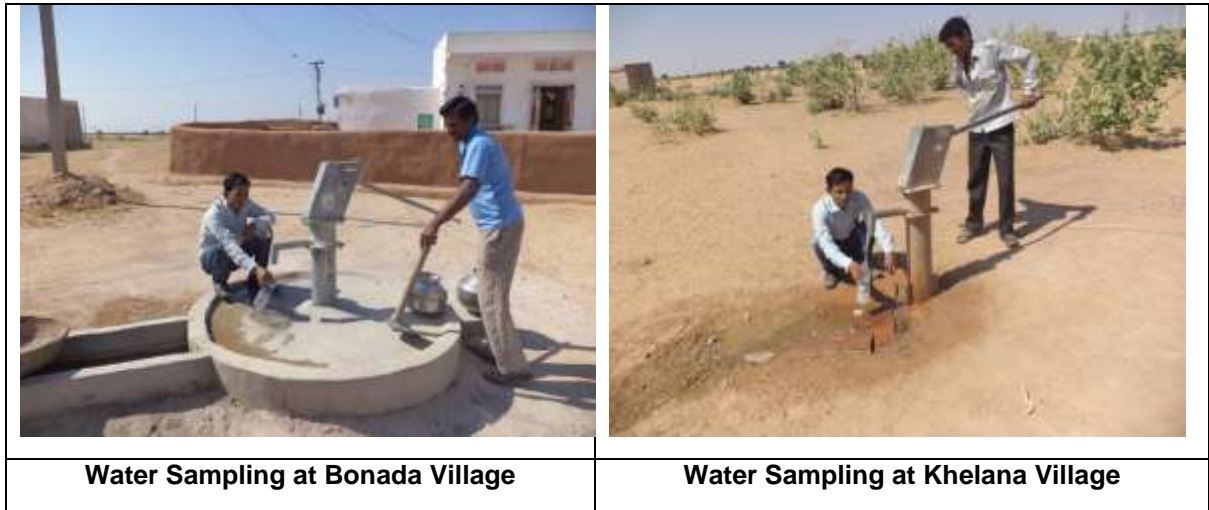


Figure 5.10 : Pictures taken during water sampling

Water monitoring results

The ground water samples were analyzed for parameters as per IS: 10500 standards and the analysis was undertaken as per IS 3025 and relevant American Public Health Association (APHA) standard methods. The results of the analysis are presented in Table 5.3.

Table 5.3 : Water Quality Monitoring Analysis Results

S. No.	Parameters	Measurement Unit	Requirement (Acceptable Limit)	Permissible Limits	GW-1 (Bonada)	GW-2 (Khelana)
1	Colour	Hazen	5	15	Less than 5	Less than 5
2	pH		6.5-8.5	No relaxation	7.45	7.15
3	Turbidity	NTU	1	5	0.2	7.8
4	Total Dissolved Solids	mg/l	500	2000	1526	3560
5	Conductivity	umhos/cm	--	--	2280	5315
6	Total Alkalinity	mg/l	200	600	340	355
7	Total Arsenic (as As)	mg/l	0.01	0.05	<0.01	<0.01
8	Fluoride (as F)	mg/l	1.0	1.5	1.23	1.32
9	Total Hardness (as CaCO ₃)	mg/l	200	600	418	975
10	Calcium (as Ca)	mg/l	75	200	105	199
11	Chlorides (as Cl)	mg/l	250	1000	679	1034
12	Copper (as Cu)	mg/l	0.05	1.5	<0.01	<0.01
13	Cyanide (as Cn)	mg/l	0.05	No relaxation	<0.01	<0.01
14	Sulphate (as SO ₄)	mg/l	200	400	352	768
15	Magnesium (as Mg)	mg/l	30	100	38	146
16	Nitrate (as NO ₃)	mg/l	45	No relaxation	26	40
17	Iron (as Fe)	mg/l	0.3	No relaxation	<0.1	0.83
18	Lead (as Pb)	mg/l	0.01	No relaxation	<0.01	<0.01
19	Manganese (as Mn)	mg/l	0.1	0.3	<0.01	<0.01
20	Mercury (as Hg)	mg/l	0.001	0.001	<0.001	<0.001
21	Aluminum (as Al)	mg/l	0.03	0.2	<0.001	<0.001
22	Phenolic Compounds (as C ₆ H ₅ OH)	mg/l	0.001	0.002	<0.001	<0.001
23	Selenium (as Se)	mg/l	0.01	No relaxation	<0.01	<0.01
24	Total Chromium (as Cr)mg/l	mg/l	0.05	No relaxation	<0.01	<0.01

S. No.	Parameters	Measurement Unit	Requirement (Acceptable Limit)	Permissible Limits	GW-1 (Bonada)	GW-2 (Khelana)
25	Cadmium (as Cd)	mg/l	0.003	No relaxation	<0.001	<0.001
26	Free Residual Chlorine	mg/l	0.2	1.0	<0.01	<0.01
27	Zinc (as Zn)	mg/l	5	15	0.2	0.6
28	Sodium (as Na)	mg/l	-	-	457	689
29	Potassium (as K)	mg/l	-	-	59	67
30	Anionic Detergent (as MBAS)	mg/l	0.2	1.0	<0.1	<0.1
31	Mineral Oil	mg/l	0.5	No relaxation	<0.01	<0.01
32	Boron (as B)	mg/l	0.5	1.0	<0.1	<0.1
33	Pesticides	-	-	0.001	Absent	Absent
34	Chemical Oxygen demand	mg/l	-	-	<5	56

Interpretation of water quality

Ground water of Jaisalmer District has high fluoride and other metal heavy metal contents. Serious problem of hunchback and one related diseases are on rise in district. The number of physically challenged is increasing. People are getting weak, their teeth have turned yellow and they have other one-related problems. As per report of Jaisalmer Ground water- India water Portal, maximum fluoride content is 1.5-3 mg/l in district while at all sampling location fluoride content was measured as 1.23-1.32 mg/l. As per report, conductivity of district lies approximately 36300 umhos/cm while at sampling location EC measured between 2280- 5315 umhos/cm. TDS of area is approximately 29568 while at sampling locations TDS measured between 1526-3560 mg/l. Calcium content is 815 mg/l while at sampling location calcium content was measured as 105-199 mg/l. Magnesium content is approximately 612 mg/l while at sampling location magnesium content was measured as 38-146 mg/l. Total hardness is 4358 mg/l while at sampling location hardness was measured as 418-975 mg/l. Chloride content is 11978 mg/l while at sampling location chloride content was measured as 679- 1034 mg/l. Sulfate content is approximately 4039 mg/l while at sampling location sulfate content was measured as 352-768 mg/l. Nitrate content is less than 50 mg/l while at sampling location nitrate content was measured as 26-40 mg/l.

5.2.3 Soil Quality

Soils may be defined as a thin layer of earth's crust that serves as a natural medium for the growth of plants. It is the unconsolidated mineral matter that has been subjected to and influenced by genetic and environmental factors. Soils serve as a reservoir of

nutrients for plants and crops and also provide mechanical anchorage and favorable tilts. Soil is our most important natural resource and a natural resource is anything that comes from the earth and is used by us. We depend on the soil for food, clothing, shelter, minerals, clay & water. Soil is the seat of many macro and micro flora like algae, fungi, earthworms, bacteria etc. These are very beneficial in promoting soil reactions and decomposing the organic matter by which essential nutrients for plants are liberated. Most of the soil is made-up of two main parts:

- Tiny bits of mineral particles which come from larger rocks, and humus, which is dark brown in color and consists of decaying remains of plants and animals.
- Soil also contains water, air and living organisms, such as fungi, bacteria, earthworms, roundworms, insects, etc. Actually more living organisms live in the soil than above it.

For general characterization of soil a few random samples from the study area to the depth of about 15 cm are sufficient. Deeper soil samples may be needed only for the study of soil profile.

General Characteristics of Soil in Jaisalmer District

The district is located within a rectangle lying between 26°4' to 28°23' North parallel and 69°20' to 72°42' East meridians. Jaisalmer District lies in the Thar Desert, which straddles the border of India and Pakistan. Jaisalmer is almost entirely a sandy waste area, forming a part of the Great Indian Desert. The general aspect of the area is that of an interminable sea of sand hills, of all shapes and sizes, some rising to a height of 150 ft.

Jaisalmer District, a part of the Great Indian Thar Desert, is sandy, dry and scorched. The terrain around, within a radius of about 60-kms is stony and rocky. The area is barren, undulating with its famous sand dunes and slopes towards the Indus valley and the Runn-of-Kutch. The Soil here is grateful even to a little rain and turns lush green during monsoon. There is no perennial river in the district. Joined together, the district of Barmer and Jaisalmer is the Largest Parliamentary constituency in India.

Sand dunes are of frequent occurrence in Jaisalmer district. This is the soil group which occupies the major area under district. These have been grouped separately from desert soil and they are only deposited sand. These soils are pale brown single grained, deep profile developed, texture is sandy type, and these soils belong to aridisols orders.

Soils of the district are classified as follows:

Table 5.4 presents the major type of soil in Jaisalmer District.

Table 5.4 : Major Type of Soil in Jaisalmer District

Major Soils	Area (000) ha.
Deep yellowish brown sandy soils	2190.7
Medium light yellowish brown loamy soils	718.2
Medium yellowish brown sandy soils	224.2
Medium light yellowish brown sandy soils	706.9
Total	3840

(Source-<http://agricoop.nic.in/Agriculture%20contingency%20Plan/Rajasthan/RAJ14-Jaisalmer-9.3.2012.pdf>)

Geology and Minerals:

Jaisalmer is to a large extent covered by dunes of blown sand of the transverse type i.e. the ridges usually parallel to prevailing direction of the wind. Main rock types of Jaisalmer are limestone, sandstone and shale. Geological Survey of India (GSI) has broadly classified into seven groups which are listed in Table 5.5.

Table 5.5 : Geological Classification by GSI

S. No.	Geological Classification	Type
1	Eocene beds	Sandstone
2	Abur beds	Sandstone
3	Parewar beds	Sandstone
4	Bhadesar beds	Sandstone & Gypsum beds
5	Baishakhi beds	Sandstone
6	Jaisalmer beds	Sandstone
7	Lathi beds	Sandstone

(Source-http://www.indiawaterportal.org/sites/indiawaterportal.org/files/jaisalmer_admin.pdf)

Two locations were identified for the assessment of the soil quality. The samples collected from all the locations were homogeneous representatives of each location and were collected from 5 to 15 cm below the surface. It was uniformly mixed before homogenizing the soil samples. The samples (about 500 gm) were packed in polythene bags labeled in the field with location and number and sent to the laboratory for the analysis. The soil samples were examined for various physic-chemical parameters, to determine the existing soil characteristics of the study area.

Figure 5.11 presents the pictures taken during the soil sampling from the two identified village locations.



Figure 5.11 : Pictures taken during soil sampling

Physico-chemical characteristics of soil are presented in Table 5.6.

Table 5.6 : Physico-Chemical Characteristics of Soil

S No.	Parameters	Unit	S-1 (Bonada)	S-2 (Khelana)
Physical Parameters				
1.	Color	--	Reddish Brown	Reddish Brown
2.	Texture	--	Sandy Clay Loam	Sandy Clay Loam
3.	Porosity	%	51.3	59.6
4.	Bulk Density	gm/cc	1.29	1.07
5.	Water Holding Capacity	%	28.9	25.4
6.	Moisture Content	%	3.2	5.4
Chemical Parameters				
7.	pH	--	7.92	7.73
8.	Electrical Conductivity	µmhos/cm	522.6	456.1
9.	Organic Matter	%	0.36	0.67
10.	Organic Carbon	%	0.21	0.39
11.	Calcium (as Ca ⁺)	mg/kg	784	980
12.	Magnesium (as Mg ⁺)	mg/kg	1131	1012
13.	Sulphate as SO ₄	mg/kg	2517	2318
14.	Chloride as Cl	mg/kg	3266	6304

S No.	Parameters	Unit	S-1 (Bonada)	S-2 (Khelana)
15.	Sodium as Na	mg/kg	2994	2315
16.	Cation Exchange Capacity (CEC)	meq/100 gm	12	16
17.	Available Nutrients			
I)	Available Nitrogen (as N)	kg/ha	252.6	276.2
II)	Available Phosphorous (as P)	kg/ha	10.5	12.8
III)	Available Potassium (as K)	kg/ha	126.0	131.0
18.	Manganese as Mn	mg/kg	0.1	0.1
19.	Zinc as Zn	mg/kg	1.2	1.5
20.	Copper as Cu	mg/kg	0.38	0.45
21.	Boron as B	mg/kg	0.1	0.1
22.	SAR	%	1.6	1.4

Interpretation of soil quality

Physical Characteristics of Soil

Physical characteristics of soil greatly influence its use and behavior towards plant growth.

- **Soil Texture**

The mineral components of soil are sand, silt and clay, and their relative proportions determine a soil's texture. Properties that are influenced by soil texture, include porosity, permeability, infiltration, shrink-swell, water-holding capacity, and susceptibility to erosion. The soil in which neither sand & silt nor clay predominates is called "loam". The mineral constituents of a loam soil might be 40% sand, 40% silt and the balance 20% clay by weight. Soil texture affects soil behavior, in particular its retention capacity for nutrients and water. Texturally the soils of study area are observed as Sandy Clay Loam soils.

- **Bulk density**

Bulk density of soil relates to the combined volumes of the solids and pore spaces. Soil with a high pore space with loose solid particles will have lower bulk density than those that are more compact and have less pore space. This is directly related to the movement of air and water through soil thus affecting the productivity. The bulk density of the soils was found in the range of 1.07 to 1.29-gm/cm³.

- **Water Holding Capacity**

Water-holding capacity is usually defined as the amount of water that soil can hold. Soil that have fine particles are able to hold more water than coarse soils while rock fragments cannot hold any water and contribute negatively to soil water-holding capacity. The type and composition of soil are the controlling factors in this case. Water Holding Capacity of study area soils was observed as 25.4 to 28.9%.

Chemical Characteristics of Soil

Soil Reaction Classes and Critical Limits for Macro and Micro Nutrients in Soil

According to Soil Survey Manual (IARI, 1970), the soils are grouped under different soil reaction classes viz; extremely acidic (pH<4.5), very strongly acidic (pH 4.5-5.0), strongly acidic (pH 5.1-5.5), moderately acidic (pH 5.6-6.0), slightly acidic (pH 6.1-6.5), neutral (pH 6.6-7.3), slightly alkaline (pH 7.4-7.8), moderately alkaline (pH 7.9-8.4), strongly alkaline (pH 8.5-9.0). The soils are rated as low (below 0.50 %), medium (0.50-0.75%) and high (above 0.75%) in case of organic carbon, low (<280 kg/ha), medium (280 to 560 kg/ha) and high (>560 kg/ha) in case of available Nitrogen, low (<10 kg/ha), medium (10 to 25 kg/ha) and high (>25 kg/ha) for available Phosphorus, low (<108 kg/ha), medium (108 to 280 kg/ha) and high (>280 kg/ha) for available Potassium and low (<10 mg/kg), medium (10-20 mg/kg) and high (>20 mg/kg) for available Sulphur (Singh et. al. 2004, Mehta et. al.1988). Critical limits of Fe, Mn, Zn, Cu and B, which separate deficient from non-deficient soils followed in India, are 4.5, 2.0, 0.5, 0.2 and 0.5-mg/kg respectively. (*Follet & Lindsay-1970 and Berger & Truog-1940*)

- **Soil Reaction**

Soil pH is an important soil property, which affects the availability of several plant nutrients. It is a measure of acidity and alkalinity and reflects the status of base saturation. The soil pH ranges from 7.73 to 7.92 thereby indicating the soils are slightly alkaline to moderately alkaline in nature.

- **Organic Carbon and Organic Matter**

Any part of a plant or animal, either living or dead; leaves, roots, sticks, fruit, seeds, worms, insects, manure and food scraps are all examples of organic matter. The decomposition of organic matter provides soils with the nutrients required by plants to grow. Organic matter also improves soil structure, and helps the soil to retain more water. The effect of soil organic matter on soil properties is well recognized. Soil organic matter plays a vital role in supplying plant nutrients, cation exchange capacity, improving soil aggregation and hence water retention and soil biological activity. The Organic Carbon content of soil varied from 0.21 to 0.39% (0.36 to 0.67% as Organic Matter) thereby implying that soils are low in organic content.

Macronutrients

Nutrients like nitrogen (N), phosphorus (P) and potassium (K) are considered as primary nutrients and sulphur (S) as secondary nutrient. These nutrients help in proper growth,

development and yield differentiation of plants and are generally required by plants in large quantity.

- **Available Nitrogen**

Nitrogen is an integral component of many compounds including chlorophyll and enzyme essential for plant growth. It is an essential constituent for amino acids which is building blocks for plant tissue, cell nuclei and protoplasm. It encourages aboveground vegetative growth and deep green color to leaves. Deficiency of nitrogen decreases rate and extent of protein synthesis and results into stunted growth and develop chlorosis. Available nitrogen content in the surface soils ranges between 252.6 & 276.2 kg/ha, thereby indicating that soils are low in available nitrogen content.

- **Available Phosphorus**

Phosphorus is an important component of adenosine di-phosphate (ADP) and adenosine tri-phosphate (ATP), which involves in energy transformation in plant. It is essential component of deoxyribonucleic acid (DNA), the seat of genetic inheritance in plant and animal. Phosphorous take part in important functions like photosynthesis, nitrogen fixation, crop maturation, root development, strengthening straw in cereal crops etc. The availability of phosphorous is restricted under acidic and alkaline soil reaction mainly due to P-fixation. In acidic condition it gets fixed with aluminum and iron and in alkaline condition with calcium. Available phosphorus content ranges between 10.5 & 12.8 kg/ha, thereby indicating that soils are having medium available phosphorus.

- **Available Potassium**

Potassium is an activator of various enzymes responsible for plant processes like energy metabolism, starch synthesis, nitrate reduction and sugar degradation. It is extremely mobile in plant and help to regulate opening and closing of stomata in the leaves and uptake of water by root cells. It is important in grain formation and tuber development and encourages crop resistance for certain fungal and bacterial diseases. Available potassium content in these soils ranges between 126.0 & 131.0 kg/ha, thereby is indicating that the soils are medium in potassium content.

Micronutrients

Proper understanding of micronutrients availability in soils and extent of their deficiencies is the pre-requisite for efficient management of micronutrient fertilizer to sustain crop productivity. Therefore, it is essential to know the micronutrients status of soil before introducing any type of land use.

- **Available Manganese**

Manganese is essential in photosynthesis and nitrogen transformations in plants. It activates decarboxylase, dehydrogenize, and oxides enzymes. The available manganese content in surface soils was recorded as 0.1 mg/kg and the critical limit of available manganese is >2.0 mg/kg.

- **Available Zinc**

Zinc plays role in protein synthesis, reproductive process of certain plants and in the formation of starch and some growth hormones. It promotes seed maturation and production. The available zinc in surface soils of the study area ranges from 1.2 to 1.5 mg/kg. As per the critical limit of available zinc (>0.5-mg/kg), most of the study area soils are sufficient in available zinc in the vicinity of the project.

- **Available Boron**

Boron increases solubility and mobility of calcium in the plant and it act as regulator of K/Ca ratio in the plant. It is required for development of new meristematic tissue and also necessary for proper pollination, fruit and seed setting and translocation of sugar, starch and phosphorous etc. It has role in synthesis of amino acid and protein and regulates carbohydrate metabolism. The available boron content in the soils observed as 0.1- mg/kg. The critical limit for deficiency of the available boron is <0.5-mg/kg.

As per the above mentioned detailed soil descriptions indicate poor fertility status or agricultural potential of soil, being low in nitrogen, low to medium in phosphorus and medium in potash, organic matter contents are also very low.

5.2.4 Noise Environment

Noise after a certain level can have a very disturbing effect on the people and animals exposed to it. Hence, it is important to assess the present noise quality of the area in order to predict the potential impact of future noise levels due to the proposed project.

Three locations – one near Barmer Road/40 and two residential locations (Bonada and Khelana) were identified for assessing the noise quality. Figure 5.12 presents the pictures taken during the noise monitoring at the three identified village locations.

The monitored levels were compared against Ambient Noise Standards prescribed under Gazette Notification 643 of Ministry of Environment and Forests, Government of India. The results of the monitoring are provided in Table 5.7 and graphically represented in Figure 5.13.



Figure 5.12 : Pictures taken during Noise Monitoring

Table 5.7 : Ambient Noise Quality in the Study Area

Location	Bonada	Khelana	Barmer Road/40
Category	Residential Area	Residential Area	Industrial Area
Standard (Day)	55	55	75
Standard (Night)	45	45	70
Time	Noise Level (dBA)		
	Hourly Leq		
Day - 06:00-07:00	45.4	41.6	50.5
07:00-08:00	47.7	47.4	53.4
08:00-09:00	48.2	51.3	58.3
09:00-10:00	50.7	48.7	55.1
10:00-11:00	53.0	44.6	47.9
11:00-12:00	51.4	42.6	51.3
12:00-13:00	48.6	47.5	52.6
13:00-14:00	54.0	49.2	56.0
14:00-15:00	55.9	51.6	53.2
15:00-16:00	52.8	52.5	50.5
16:00-17:00	54.4	52.2	47.3
17:00-18:00	51.5	51.3	51.6
18:00-19:00	55.8	56.3	57.0
19:00-20:00	50.2	48.3	55.4
20:00-21:00	47.6	48.6	57.8
21:00-22:00	45.2	47.7	56.1
Night - 22:00-23:00	42.7	43.6	48.9
23:00-00:00	42.3	40.5	47.3
00:00-01:00	40.1	39.4	44.6
01:00-02:00	41.5	40.0	42.5

Location	Bonada	Khelana	Barmer Road/40
02:00-03:00	40.4	38.5	41.8
03:00-04:00	41.6	38.3	40.9
04:00-05:00	41.8	40.1	42.8
05:00-06:00	42.0	41.2	43.2
Leq Day	52.0	50.3	54.5
Leq Night	41.6	40.5	44.9

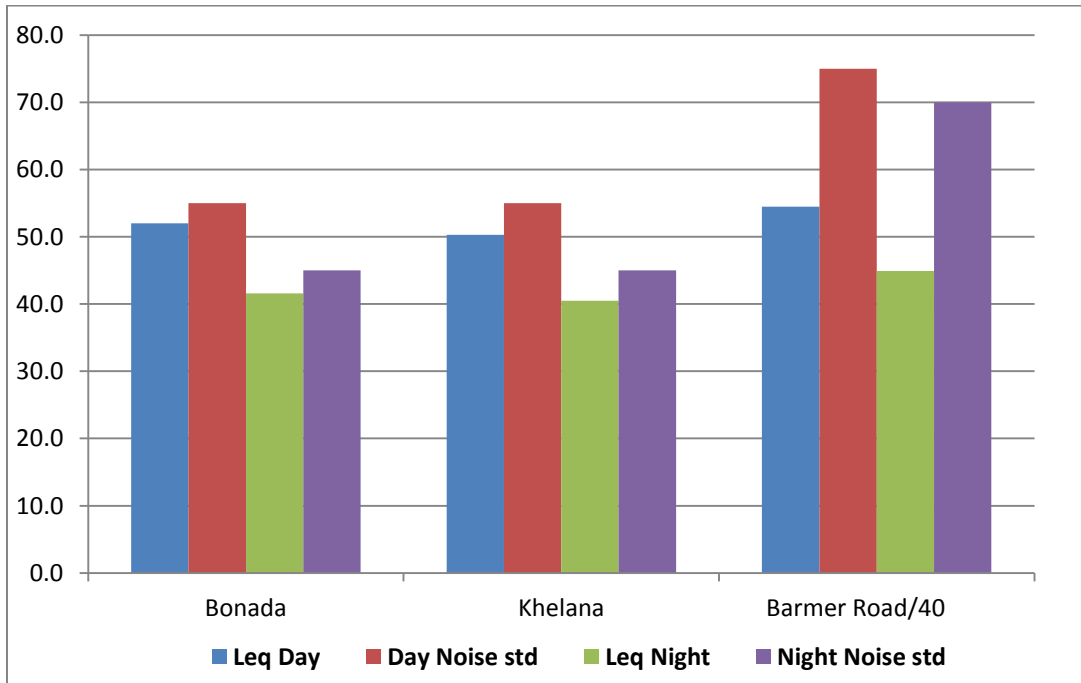


Figure 5.13 : Graphical Representation of Noise Environment

Interpretation of Noise Environment

It was observed that the noise levels at the receptor locations ranged from 50.3 to 54.5 dB (A) during day time and 40.5 to 44.9 dB (A) during night time. The noise levels were observed to be within the prescribed CPCB standards for day time and night time at all the locations. The ambient noise has been undertaken at locations like near village road, on a roof of a house within the village taking into consideration factors like wind induced noise and human activities such as movement of vehicles.

5.2.5 Ecological Environment

Thar Desert occupies about 2 million km² of unique and diverse habitats. Each of the various habitats and landforms in the desert supports distinctive plants (Khan et al., 2003). The whole area of the Desert region has extreme climatic conditions and there is an acute scarcity of water all around the area. Species diversity in dry lands is relatively low and declines with increasing aridity. Low primary production reduces the number of animals at higher trophic levels, thus naturally affecting the biotic interactions with desert ecosystems and thus their species diversity. However, the biodiversity of dry lands is unique with its remarkable adaptations of their fauna and flora to the extreme climatic and physical conditions. The amazing factor is that several life forms representing various taxonomic groups which are adapted to such conditions found in the area. Such type of specialism makes these life forms more sensitive to climatic and habitat changes.

Forest and Forest Types

Flora of Indian desert is classed as Northern Desert Thorn Forest (Champion 1936). A total of 32639 km² forest area recorded in Rajasthan which is 9.54% of the total state's geographical area. Reserve Forests constituted 38.16%, Protected Forests 53.36% and Un-classed Forests 8.48% area. According to Champion and Seth (1968), state has 20 forest types which belong to two forest type groups viz. Tropical Dry Deciduous Forests (88.30%) and Tropical Thorn Forests (6.18%). A 5.52% TOF/Plantation forests is also available in the state.

The present project area falls in the Bhaniyana Tehsil of Jaisalmer District which is the largest district of Rajasthan and third largest in the country in area. The district accounts for a geographical area of 38,401 km² having 167 km² forest cover which is about 0.43% of the district's geographical area.¹ A 34 km² scrub land is also reported from the district. In terms of Forest Density Classes, the district has 47 km² areas under moderately dense forest and 120 km² areas under open forest and there is no forest area of the district comes under the Very Dense Forest Category. The entire area of Forest is hot and sandy and the vegetation in this arid region is sparse comprised of xerophytic adapted plants which are capable to establish themselves in this region.

The study area consists of dry rolling plains of hardened and loose sand, forming various size of shifting sand dunes. Most of the vegetation in and around the study area consists of stunted, thorny, or prickly shrubs and few herbs and trees which are capable of drought resistance. Aak (*Calotropis procera*) found dominates in ground vegetation. In semi-arid areas and village and moist areas, the vegetation mainly consists of dwarf grasses, stunted growing trees, interspersed with few characteristics desert shrubs. The area has sparse vegetation without any true forest and the area is known for the high wind velocity, low relative humidity, with less rainfall.

¹ *India State of Forest Report, 2011*

Flora

In the Thar Desert, a 775 plant species have been recorded belonging to 91 families and 385 genera. 588 species of dicots and 186 species of monocots and one gymnosperm have been recorded (*Shetty and Singh, 1993*). However, growing human and livestock population plants are removed for fuel, fodder and other domestic and commercial purposes leading to extinction of many species.

Flora of the project area has been assessed by using phyto-sociological survey in the month of October, 2014. A total of 20 quadrats (N=20) measuring 10x10 m² were placed in two study sites. Quadrats were regularly placed at an interval of 0.5 km in each of the two sites of the study area. The data on vegetation were quantitatively analyzed for density, frequency and abundance as per Curtis & McIntosh (1950). The Importance Value Index (IVI) for trees was determined as the sum of relative density, relative frequency and relative dominance (Curtis, 1959). Tree individuals with > 31.5 cm CBH (circumference at breast height i.e., 1.37 m from the ground) were individually measured for CBH. Data was collected during monsoon season. The index of diversity was computed by using Shannon Wiener Diversity Index (Shannon Wiener, 1963) as: $H = -\sum (n_i/n) \times \ln (n_i/n)$ Where, n_i is total number of individual of a species and n is total number of individuals of all the species. The Evenness Index (E) was calculated by using Shannon's Evenness formula (*Magurran, 2004*). Evenness Index (E) = $H / \ln (S)$ Where, H is Shannon Wiener Diversity index; S is number of species. Species richness (SR) was calculated by using Margalef index. Margalef Species Richness (SR) = $S-1/\ln (N)$ Where, S is total number of species and N is total number of individuals.

Primary study has been carried out around Bonada and Khelana areas and a total of 8 trees, 7 shrubs and 8 herbs/grasses species were recorded. *Prosopis juliflora*, *Capparis deciduas*, and *Acacia nilotica* were the dominant tree species, *Calotropis procera*, *Acacia jacquemontii* and *Aerva javanica* were the leading shrub's species whereas *Cenchrus biflorus*, *Saccharum spontaneum* and *Cynodon dactylon* has been recorded dominant herb/grass species. The density of tree species was recorded as 15.56 and 20.00 ha⁻¹, shrub's density was recorded as 123.33 and 145.00 ha⁻¹ while density of herb/grasses has been recorded as 553.33 and 555.00 ha⁻¹ around Bonada and Khelana areas respectively.

Tables 5.8 and 5.9 present the phytosociological characteristics of vegetation around Bonada and Khelana villages respectively. Figures 5.14 and 5.15 present the diversity, evenness and species richness of Bonada and Khelana villages respectively.

Table 5.8 : Phytosociological Characters of Vegetation around Bonada Area

Species	Family	Density/ha	Frequency (%)	Abundance	A/F Ratio	IVI
Tree						
<i>Acacia nilotica</i>	Fabaceae	2.22	2.22	1.00	0.45	41.21
<i>Prosopis juliflora</i>	Fabaceae	2.22	2.22	1.00	0.45	47.26

Species	Family	Density/ha	Frequency (%)	Abundance	A/F Ratio	IVI
<i>Prosopis cineraria</i>	Fabaceae	2.22	2.22	1.00	0.45	45.63
<i>Ziziphus sp</i>	Rhamnaceae	2.22	2.22	1.00	0.45	41.90
<i>Salvadora oleoides</i>	Salvadoraceae	2.22	2.22	1.00	0.45	38.62
<i>Capparis decidua</i>	Capparaceae	2.22	2.22	1.00	0.45	44.85
<i>Azadirachta indica</i>	Meliaceae	2.22	2.22	1.00	0.45	40.53
Total		15.56				300.00
Shrub						
<i>Calotropis procera</i>	Apocynaceae	20.00	5.00	4.00	0.80	42.39
<i>Aerva javanica</i>	Amaranthaceae	16.67	11.67	1.43	0.12	52.62
<i>Capparis sp</i>	Capparaceae	18.33	6.67	2.75	0.41	39.33
<i>Acacia jacquemontii</i>	Fabaceae	20.00	5.00	4.00	0.80	47.53
<i>Calligonum polygonoides</i>	Polygonaceae	10.00	3.33	3.00	0.90	20.09
<i>Mimosa rubicaulis</i>	Fabaceae	20.00	10.00	2.00	0.20	44.50
<i>Aerva sp</i>	Amaranthaceae	18.33	11.67	1.57	0.13	53.54
Total		123.33				300.00
Herb						
<i>Leptadenia pyrotechnica</i>	Asclepiadaceae	38.33	10.00	3.83	0.38	24.45
<i>Cenchrus biflorus</i>	Poaceae	73.33	10.00	7.33	0.73	30.77
<i>Cynodon dactylon</i>	Poaceae	111.67	10.00	11.17	1.12	46.29
<i>Saccharum spontaneum</i>	Poaceae	75.00	13.33	5.63	0.42	49.71
<i>Ergamopagan sp</i>	Poaceae	75.00	8.33	9.00	1.08	45.85
<i>Fagonia cretica</i>	Zygophyllaceae	63.33	6.67	9.50	1.43	32.44
<i>Aristida funiculata</i>	Poaceae	61.67	11.67	5.29	0.45	38.86
<i>Tephrosia hookeriana</i>	Leguminosae	55.00	10.00	5.50	0.55	31.63
Total		553.33				300.00

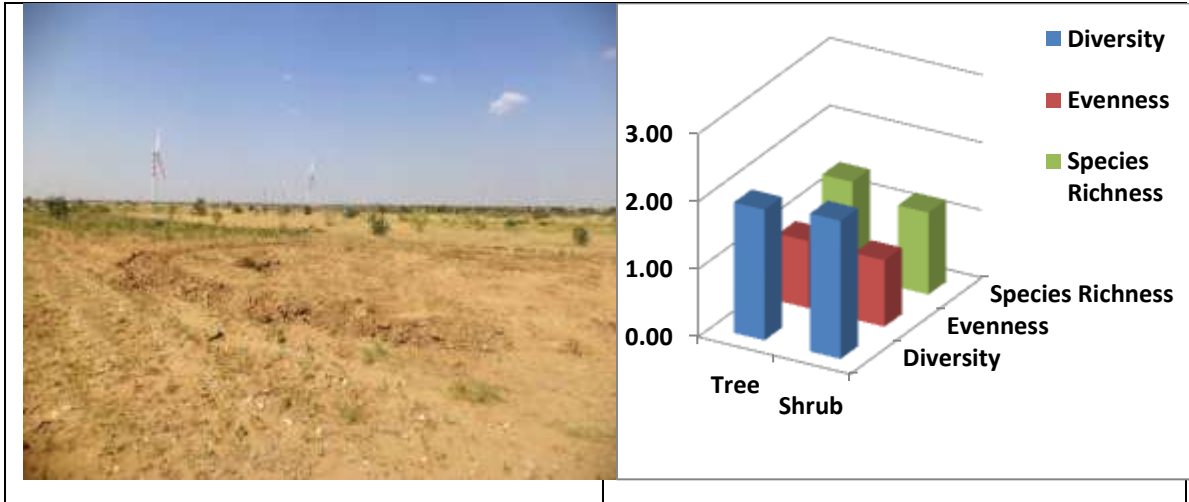


Figure 5.14 : Diversity, Evenness & Species Richness of Bonada Area

Table 5.9 : Phytosociological Characters of Vegetation around Khelana Area

Species	Family	Density/ha	Frequency (%)	Abundance	A/F Ratio	IVI
Tree						
<i>Acacia nilotica</i>	Fabaceae	2.22	2.22	1.00	0.45	29.13
<i>Prosopis juliflora</i>	Fabaceae	4.44	4.44	1.00	0.23	77.32
<i>Prosopis cineraria</i>	Fabaceae	2.22	2.22	1.00	0.45	32.88
<i>Ziziphus sp</i>	Rhamnaceae	2.22	2.22	1.00	0.45	31.38
<i>Salvadora oleoides</i>	Salvadoraceae	2.22	2.22	1.00	0.45	31.87
<i>Capparis decidua</i>	Capparaceae	4.44	4.44	1.00	0.23	66.52
<i>Prosopis sp</i>	Fabaceae	2.22	2.22	1.00	0.45	30.90
Total		20.00				300.00
Shrub						
<i>Calotropis procera</i>	Apocynaceae	23.33	5.00	4.67	0.93	10.60
<i>Aerva javanica</i>	Amaranthaceae	18.33	11.67	1.57	0.13	13.37
<i>Capparis sp</i>	Capparaceae	21.67	6.67	3.25	0.49	10.40
<i>Acacia jacquemontii</i>	Fabaceae	16.67	5.00	3.33	0.67	9.00

Species	Family	Density/ha	Frequency (%)	Abundance	A/F Ratio	IVI
<i>Calligonum polygonoides</i>	Polygonaceae	15.00	3.33	3.02	0.91	7.26
<i>Mimosa rubicaulis</i>	Fabaceae	26.67	10.00	2.67	0.27	12.93
<i>Aerva sp</i>	Amaranthaceae	23.33	11.67	2.00	0.17	13.84
Total		145.00				300
Herb						
<i>Leptadenia pyrotechnica</i>	Asclepiadaceae	55.00	11.67	4.71	0.40	27.51
<i>Cenchrus biflorus</i>	Poaceae	75.00	10.00	7.50	0.75	32.71
<i>Cynodon dactylon</i>	Poaceae	78.33	13.33	5.88	0.44	44.83
<i>Saccharum spontaneum</i>	Poaceae	91.67	11.67	7.86	0.67	46.02
<i>Ergamopagan sp</i>	Poaceae	75.00	13.33	5.63	0.42	39.23
<i>Fagonia cretica</i>	Zygophyllaceae	63.33	15.00	4.22	0.28	33.45
<i>Aristida funiculata</i>	Poaceae	61.67	15.00	4.11	0.27	38.5
<i>Tephrosia hookeriana</i>	Leguminosae	55.00	10.00	5.50	0.55	37.75
Total		555.00				300

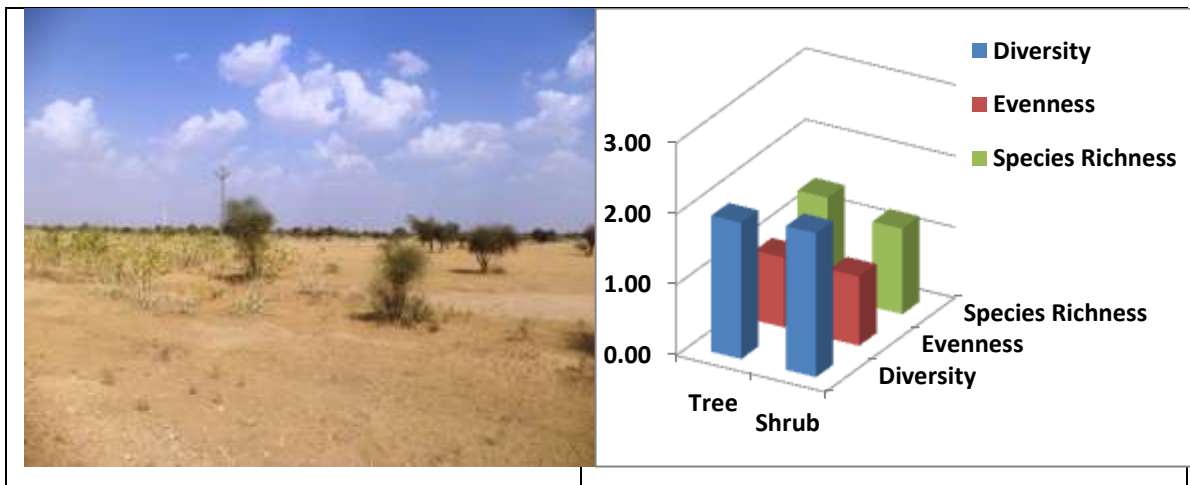


Figure 5.15 : Diversity, Evenness & Species Richness of Khelana Area

Agricultural Crops

Agriculture is not rewarding the project area because of frequent droughts. The agricultural production is mainly from the Kharif crops. The Kharif crops are the crops that are grown in the summer season and are seeded in the months of June and July. These crops are harvested in the months of September and October and include bajra, pulses such as guar, jowar (*Sorghum vulgare*), maize (*Zea mays*), sesame and groundnuts.

Fauna

As far as the Mammalian diversity in the Thar region is concerned, more than 40 species of mammals exist here and some like Desert fox (*Vulpes vulpes pusilla*), Desert Rabbit (*Lepus nigricollis dayanus*), Indin Jird (*Meriones hurrianae*), and antelope like Deert Chinkara (*Gazella bennettii*) are endemic to the Indian desert region. (Menon, 2014) Around 20 species of carnivores exist in this region, with representatives from almost all the terrestrial carnivore families. About 141 species of birds that occur in the western arid part of the region, the most notable are the Great Indian Bustard (*Ardeotis nigriceps*), Macqueen's Bustard (*Chlamydotis macqueenii*) and Black-bellied Sandgrouse (*Pterocle orientalis*).

In order to study the wild mammals, avifauna, herpetofauna and insects of the project area 2-5 km transect trails were carried out in the different locations. The study area was divided into different strata based on vegetation and topography. Sampling for habitat and animals was done in different strata. As the normal systematic transects for mammals and birds were not possible in this study area due to difficult climatic conditions, therefore mostly trails were used for faunal sampling. In addition to the field sampling secondary data and information was also collected as follows:

- Direct sighting and indirect evidences such as calls, signs and trophies of mammals were recorded along the survey routes taking aid from Prater (1980).
- Interviews of local villagers for the presence and relative abundance of various animal species within each locality.
- The Forest Working Plan of the Forest Division falling in the project area was referred to for secondary informations on the wildlife of the area.

Nocturnal surveys for bats were also carried out but there is no bat species sighted within the study zone during primary survey.

Mammals

Around 2-5 km long transects and trails of different habitation were walked to study the wild mammalian fauna of the study area. Direct sighting of animals as well as indirect signs like scat, pellets, pugmarks, scraps, vocalizations, horns etc. were also recorded during the survey walk. Secondary data as well as information elicited from the locals were also noted for the presence or absence of the wild animals in the area. Only 3 mammalian species were directly sighted and indirectly recorded during this survey. Table 5.10 presents the mammal sightings recorded during the survey.

Table 5.10 : Mammals recorded during Primary Survey

S. No.	Name	Scientific Name	Order	Family	CS	Schedule
1	Indian Fox	<i>Vulpes bengalensis</i>	Carnivora	Canidae	LC	II
2	Blue Bull	<i>Boselaphus tragocamelus</i>	Artiodactyla	Bovidae	LC	IV
3	Indian Palm Squirrel	<i>Funambulus pennantii</i>	Rodentia	Sciuridae	LC	IV
CS- Conservation Status (IUCN), LC-Least Concern, Schedule (As per WPA, 1972)						

Avifauna

Birds were also sampled on the same transect and trails marked for mammals. Sampling was carried out on a fixed width trails of 2 km wherever the terrain permits and point counts were carried out at a fixed distances at more or less regular intervals. A prismatic field binocular (10x50) was used for the bird watching during transect walk as well as during the morning and evening hours nearby the habitation of study area. Birds were identified with the help of field guide, Birds of Indian Subcontinent by Grimmett, Inskipp and Inskipp.

Although Forest Working Plan reported various bird species in the study area which is both residents and migrants but a total of 13 bird species were sighted during present primary study. Most of these birds are resident to this area but two of them are migratory. The birds recorded from the study area are presented in Table 5.11.

Table 5.11 : Bird species recorded from the study area

S. No.	Name	Scientific Name	Habit	CS
1	Asian Desert Warbler	<i>Sylvia nana</i>	R	LC
2	Baya Weaver	<i>Ploceus philippinus</i>	R	LC
3	Common Babblar	<i>Turdoides caudata</i>	R	LC
4	Common Pigeon	<i>Columba livia</i>	R	LC
5	Common Sandpiper	<i>Actitis hypoleucos</i>	M	LC
6	Eurasian Collared Dove	<i>Streptopelia decaocto</i>	R	LC
7	Green bee eater	<i>Merops orientalis</i>	R	LC
8	Grey Francolin	<i>Francolinus ondicerianus</i>	R	LC
9	House Crow	<i>Corvus splendens</i>	R	LC
10	House Sparrow	<i>Passer domesticus</i>	R	LC

S. No.	Name	Scientific Name	Habit	CS
11	Indian Silverbill	<i>Euodice malabarica</i>	R	LC
12	Tawny Pipit	<i>Anthus campestris</i>	M	LC
13	White-eared Bulbul	<i>Pycnonotus leucotis</i>	R	LC
R- Resident M-Migratory LC- Least Concerned (IUCN Conservation Status)				

Aquatic Ecology

There is no perennial source of water within the study area (10 Km radius of the project area), and hence proposed project activities are not envisaged to have any adverse effect on aquatic life.

5.2.6 Socio-Economic Environment

Socioeconomics (also known as socio-economics or social economics) is the social science that studies how economic activity affects and is shaped by social processes. In general it analyzes how societies progress, stagnate, or regress because of their local or regional economy, or the global economy.

State Profile

Rajasthan is a "Land of Great Kings" or "Land of Great Kingdoms", is India's largest state by area (342,239 square kilometers (132,139 sq. mi)) or 10.4% of India's total area. It is located on the northern side of the country, where it comprises most of the wide and inhospitable Thar Desert (also known as the "Rajasthan Desert" and "Great Indian Desert") and shares a border with Pakistan along the Sutlej-Indus river valley.

District Profile

Jaisalmer, the largest district of the state (38,401 sq. km. area) is situated in the North-western part of Rajasthan between 26°01' to 28°3' North latitude and 69°30' to 72°20' East longitude.

Jaisalmer District is girdled by Barmer in the south, Jodhpur in the east and Bikaner in north-east. The western boundary of the district is a part of Indo-Pak international border. The district head quarter Jaisalmer is linked from Bikaner (330km) and Barmer (153 km) by National Highway No. 15 and also connected from Jodhpur by road (285 km) as well as broad gauge rail line (297 km) via Pokaran. Jaisalmer has four tehsils viz. Jaisalmer, Pokaran, Bhaniyana and Fatehgarh which is amongst the least populous tehsil.

Area and Administrative Units

Total Area of Jaisalmer District is 38,401 Sq.km. which is 11.22% of the total Area of Rajasthan. For the administrative convenience, Jaisalmer is divided in 4 Tehsils as defined in Table 5.12 and as shown in graphically in Figure 5.16.

Total area of the District is 38,401 sq. km and the population as per 2011 census is approximately 66,99,199. The developmental activities of the district are being looked

after by three Panchayat Samities, i.e. Jaisalmer, Sam and Sankra. There are total 799 revenue villages and 128 Gram panchayats.

Table 5.12 : Area of Tehsils and the respective population - District Jaisalmer

Tehsils	Total Population	Urban Population	Rural Population
Jaisalmer	265237	65471	199766
Pokaran	171810	23554	148256
Fatehgarh	101020	0	101020
Bhaniyana	131852	0	131852

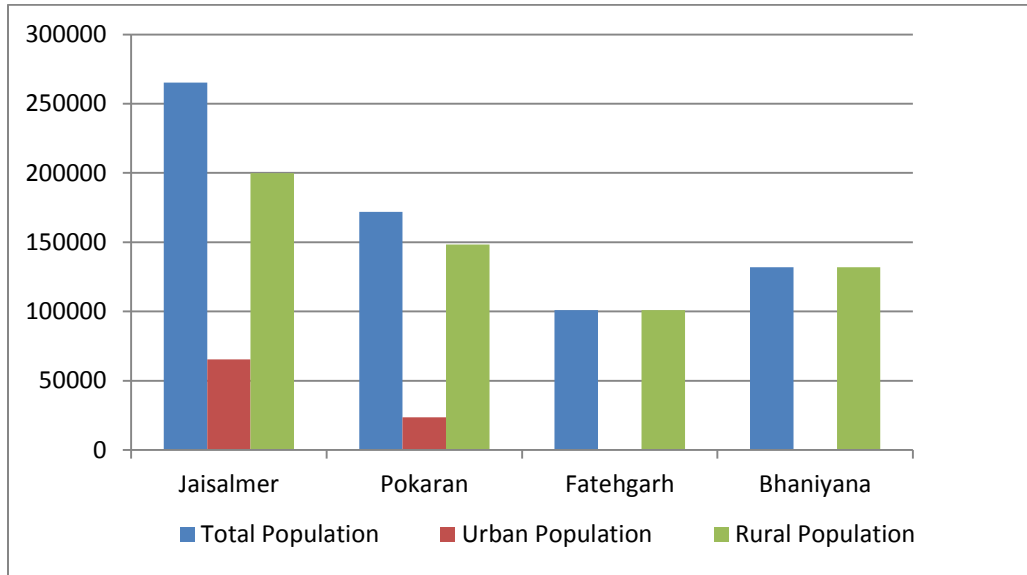


Figure 5.16 : Graph Representation of Tehsil Population of Jaisalmer District

Study Area Details

Socio-Economic Environment

The study area villages mainly fall in Bhaniyana Tehsil of Jaisalmer District. Project site is well connected with road. Geographical Coordinates of the Project site is as follows:

Latitude: 26° 32.117' N

Longitude: 71° 32.787' E

Project Affected Villages

There are 2 Villages which are going to be affected by the project activities namely Bonada and Khelana.

Demographic Profile Project Affected Villages

Population

Total Population of the Study area villages as per Census of India, 2011 is 1499. The total number of Households is 259. Total Male Population of the Study area is 832 and total Female Population of the Study Area is 667. Village-wise details of population are given in Table 5.13.

Table 5.13 : Village-wise Details of Population of Project Affected Villages

Tehsil	Village	No. of Household	Total Population	Male Population	Female Population
Bhaniyana	Bonada	152	911	501	410
	Khelana	107	588	331	257
Total		259	1499	832	667

Sex Ratio

The Sex Ratio of the Bonada is 818 and Khelana is 776. Figure 5.17 presents the graphical representation of the male/female population of the project affected villages in comparison to the total population

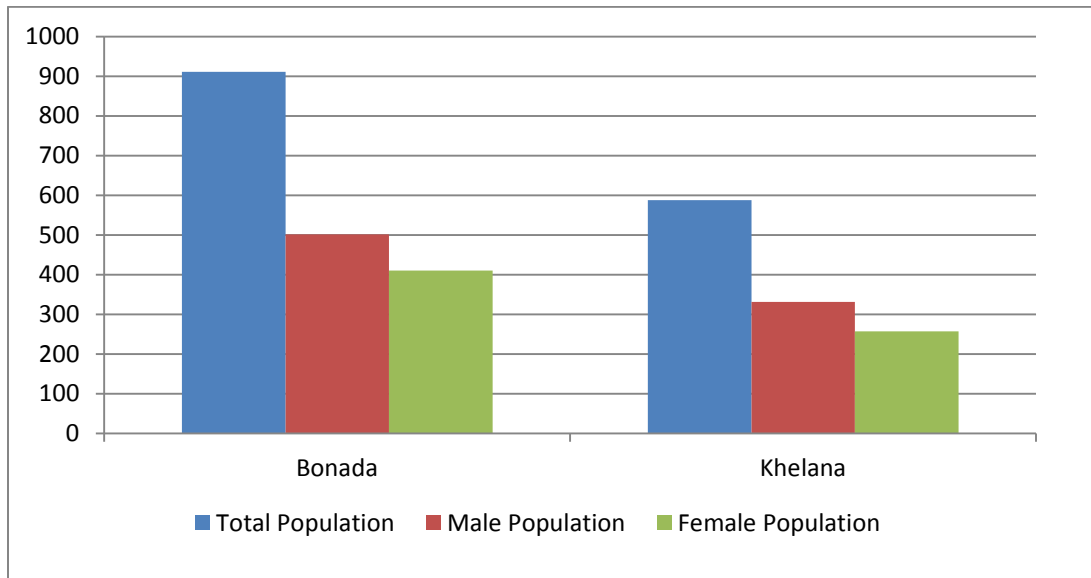


Figure 5.17 : Graphical Representation of Male/Female Population

SC/ST Population

A considerable 26.83% of the total village population in the Study Area villages is constituted by SC whereas there is 0.00% ST population present in the study area villages. A comparative Graphs of SC/ST Population in Study Area (Village wise) is given in Table 5.14. A comparative graph of SC/ST Population in Study Area (village wise) is given in Figure 5.18.

Table 5.14 : Village-wise Details of SC/ST Population of Project Affected Villages

Village Name	SC Population	% SC	ST Population	% ST
Bonada	198	21.73	0	0.00
Khelana	30	5.10	0	0.00
Total	228	26.83	0	0.00

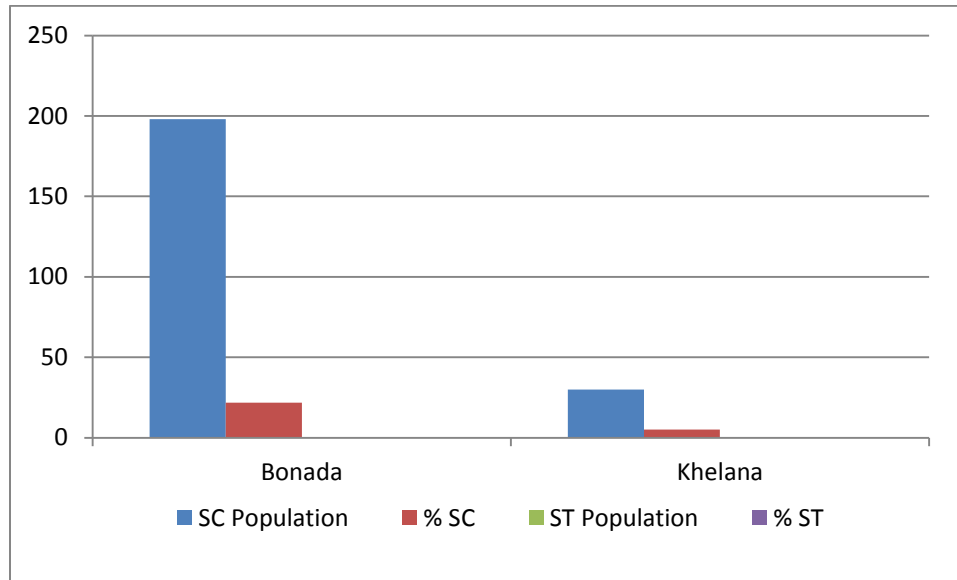


Figure 5.18 : Comparative Graph of SC/ST Population in Study Area

Literacy Rate

The study of the education and literacy profile in the region is relevant in order to have an understanding whether the proposed project can utilize the skilled human resources available within the individual study area. The village-wise male and female literacy status as obtained from Census 2011 is presented in Table 5.15. Gender-wise distribution of literacy in each Patwari Circle of Study Area is given in Figure 5.19.

Table 5.15 : Literacy Profile of Project Affected Villages

Village Name	Total Literate	% age	Male Literate	% age	Female Literate	%age	Illiterates	%age
Bonada	452	49.61	329	36.11	123	13.50	459	50.39
Khelana	244	41.49	165	28.06	79	13.43	344	58.51

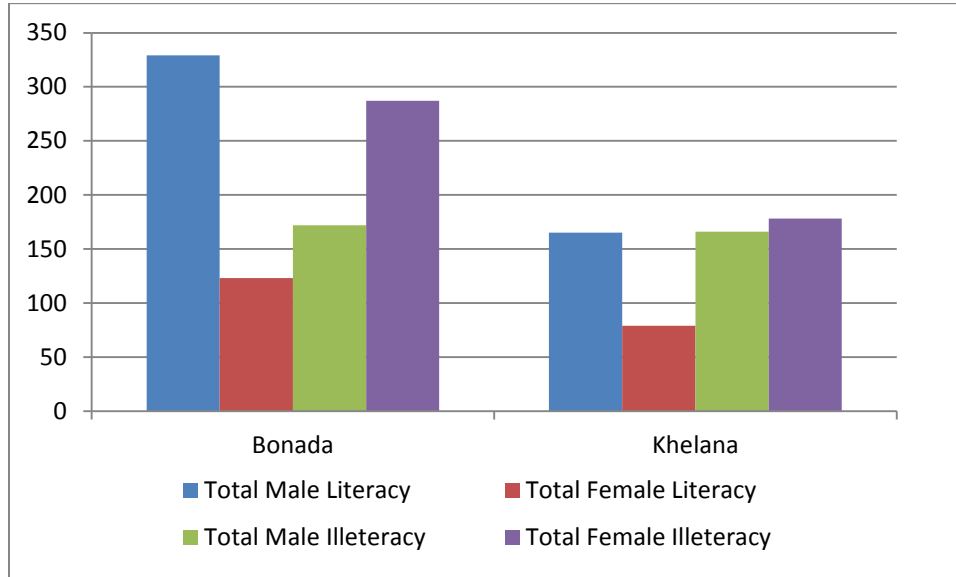


Figure 5.19 : Gender-wise Distribution of Literacy and of Illiteracy in Study Area

Workers Scenario

The relevance of economic activity and livelihood pattern is important in the context of the study depending on the existing situation one can predict the impact of the project activity on the economy of the villages and the region. The village-wise workforce participation as obtained from Census 2011 is presented in Table 5.16.

The workforce participation rate in the study area villages of Jaisalmer district is 43.12%. A very small number of inhabitants (about 16.08%) in the study area village Bonada are cultivators whereas in Khelana village more than 90 % of inhabitants are cultivators. Workers in agricultural labor Category in the study area range from 0.81 to 6.64% of the total workforce. No one is employed in household activities. Non-workers percentage range from 46 to 54%. Figure 5.20 presents the graphical representation of the workforce participation in the study area.

Table 5.16 : Workforce Participation for Study Area Villages

Villages	Total Worker	% Cultivator	% Agriculture Labour	% Household Worker	% Other Worker	Non workers	% Non workers
Bonada	491	16.08	0.81	0.00	8.14	420	46.10
Khelana	271	90.77	6.64	0.00	2.58	317	53.91

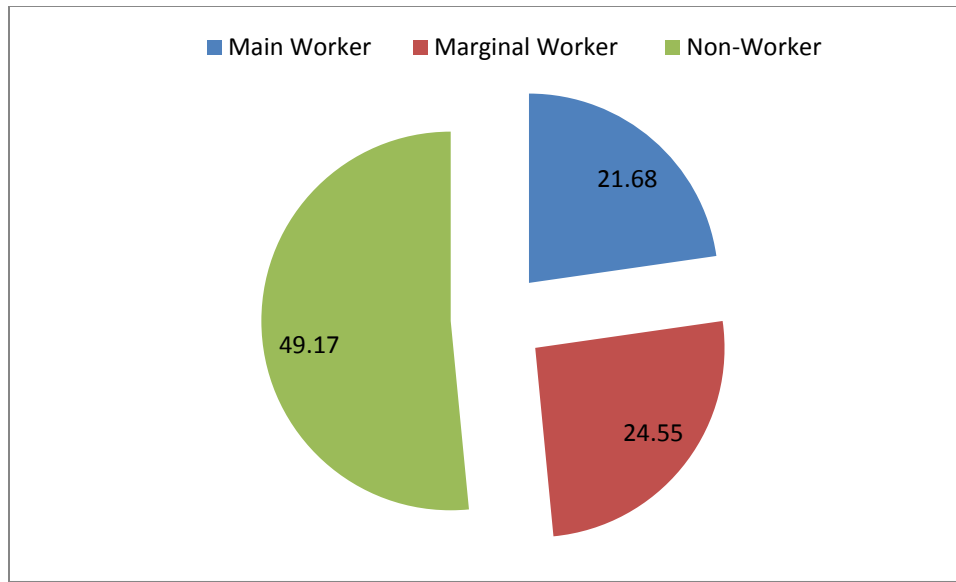


Figure 5.20 : Workforce Participation in Study Area

Main Workers

Study area consist 42.65% of Main Casual Workers, 2.89% of Agricultural labour, 0.00% of Household Population, 6.71% Other Workers and 48.29% of Marginal Workers population. Figure 5.21 presents the graphical representation of the main workers participation in the study area.

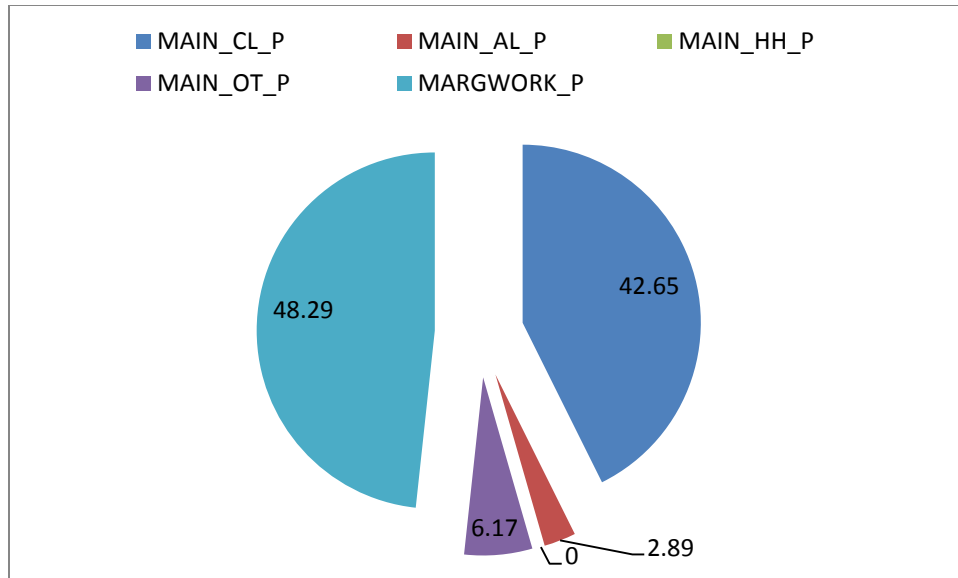


Figure 5.21 : Main Workforce Participation in Study Area

Marginal Workers

Unlike Main Workers, House hold labour constitutes a 98.64% of total Marginal Worker Population. Agricultural Labor constitutes 0.27 % of Total Marginal Worker Population and 1.07% is Other Labour. Figure 5.22 presents the graphical representation of the marginal workers participation in the study area.

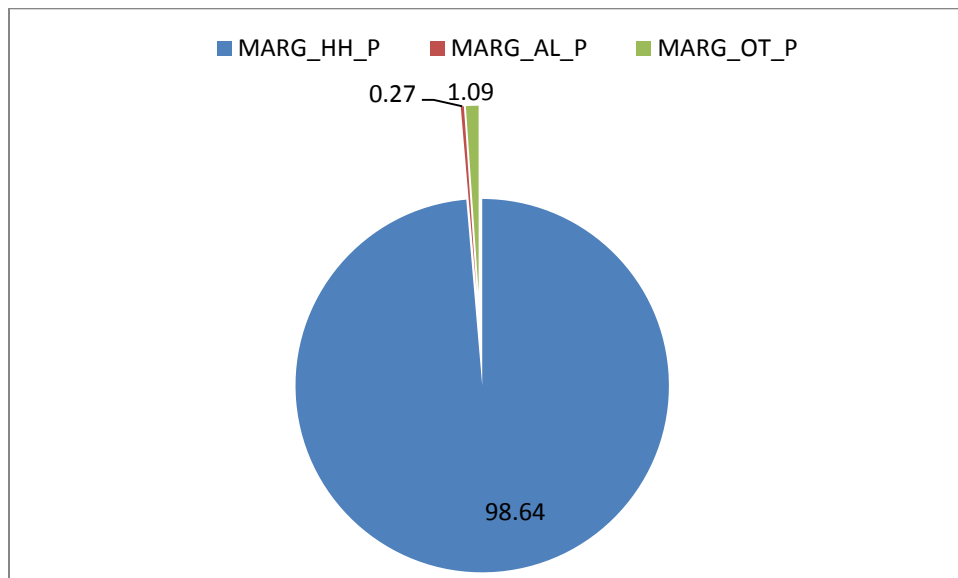


Figure 5.22 : Main Workforce Participation in Study Area

Socio-economic Infrastructure

As per 2001 census, basic amenities available in the study area villages are listed in Table 5.17.

Table 5.17 : Basic Amenities in the study area

Village	Educational Facility	Medical facility	Drinking Water Source	Approach to Village	Power Supply
Bonada	P_SCH (1)	Available(1 PHSC)	W, HP	FP	ED
Khelana	P_SCH (2),	Available(1 PHSC)	W, HP	MR	Not available

Education Facility: P_SCH = Primary School, M_SCH=Middle School
Medical Facility: AYU_DISP=Ayurvedic Dispensary
Drinking Water Facility: W = WELL; TK = TANK; HP=HANDPUMP; TW=Tube Well
Approach Road to Village: MR= Mud Road; FP-Foot Path; PR=Paved Road
Power Supply: EA = Electricity for all purposes, ED = Electricity for domestic use, EAG= Electricity for Agriculture use, EO = Electricity for other purpose

(Source: Census of India 2001)

Stakeholder Consultation

A stakeholder is any group or individual who may affect or be affected by a specific project. They should be prioritized by identifying direct (those who have a direct interest or influence on the project) and indirect stakeholders. It is very important to identify the various stakeholders to analyze and assess any issues while creating management systems and strategies.

Stakeholder consultation comprised of (but not limited to) a social survey of the project affected villages, discussion with the employees of INOX, interview with the local people whose land has been acquired. The main purpose of the stakeholder consultation is summarized below:

- Identification of the relevant stakeholders
- Appraisal of the project information and its impacts on the affected communities
- Exchange of information and concerns through mutual dialogue and discussions
- Responding to the queries/concerns in a neutral manner and pass on the information to the Higher Management

Local Inhabitants/Villagers

The study team conducted a consultation exercise within the project area on 7th September, 2014, where interaction with community members and local villagers was undertaken. The objective of the consultation was to understand the following:

- Socio-economic condition of the people residing in Bonada and Khelana village
- General perception about the proposed project and other solar energy projects proposed among the local community
- Previous dependent of the villagers, if any, on the land taken up for the project site;
- To understand environmental and social concerns of the local community with respect to the proposed project
- Issues related to Solar power project

In the discussion with project proponent and also verified through Public consultation it was found that the proposed solar power project is coming on private lands. During public consultation it was also noted that no properties of cultural, community and religious importance has been purchased for the proposed project. Figure 5.23 presents the pictures taken during the consultation.

The project area is mainly Open scrub and grass land and there is no agricultural practices being carried out. In the surrounding/outside the project area, during the monsoon season agriculture is the main occupation. Agricultural practices in the area are primarily rainfall dependent and practicing seasonal agricultural practices. Major crops cultivated in the area are Bajra and Wheat .In the remaining part of the year, people are depend on labour work and taxi driving as the major occupation in the area. During group as well as individual discussion with villagers, labors and onsite employed local people, it was recorded that people are not aware of the solar power projects. Our team has updated them about the upcoming solar project.

The area is characterized by humid subtropical climate. It was also observed that drinking water (Wells and Hand pump) is available in the study area villages. Electricity supply is available in the area for both agricultural and domestic activities. Primary level education facility was observed in the Bonada village while higher education facility is available at Khelana.

Below mentioned issues have been observed during Public Consultation:

- The proposed project is developing on the private land. Land use of the project site is Open shrub and grass land which legally allows the utilization of purchased land to develop solar power project. It was also found that purchased land was free from any encroachment and involuntary settlement.
- Based on the discussion with local people, onsite employed villagers it was found that people are very much aware of the project & when we told them and they were favoring the solar power development with some considerations.

- Proposed project is providing employment opportunity for the local people
- Cultural heritage, historical monuments and any religious activities on project site was not found.
- Local villagers are not using domestic animals for any economic activities so this will not have any effect on their livelihood.



Figure 5.23 : Pictures taken during Stakeholder Consultation

Conclusion

It can be concluded that the local residents are content with the negotiation procedures followed for land procurement and the compensation they have received. The general perception of the local community regarding the proposed Wind Farm is very positive.

CWP-Devgarh will ensure that majority of the labor will be hired locally and only skilled workers will be brought from outside. It will be further ensured that all the non-resident workers are briefed about the code of conduct so as not to create any nuisance in the local villages. CWP-Devgarh will also ensure that the local residents are offered the job of security.

5.3 Corporate Social Responsibility

Corporate Social Responsibility (CSR, also called corporate conscience, corporate citizenship or sustainable responsible business/Responsible Business) is a form of corporate self-regulation integrated into a business model. CSR policy functions as a self-regulatory mechanism whereby a business monitors and ensures its active compliance with the spirit of the law, ethical standards and international norms. In some models, a firm's implementation of CSR goes beyond compliance and engages in "actions that appear to further some social good, beyond the interests of the firm and that which is required by law." CSR aims to embrace responsibility for corporate actions and to encourage a positive impact on the environment and stakeholders including consumers, employees, investors, communities, and others. Table 5.18 presents the list of CSR activities identified in line with the local requirements.

Table 5.18 : Identifying CSR initiatives in line with local requirements

Area	Community Requirement
Health	Non-availability of adequate health related infrastructure. Low awareness on hygiene, sanitation and dietary issues.
Education	Facilities for higher secondary education are inadequate and distant Higher education and counseling for youth missing Technical skill building institutions far and few and have poor infrastructure

Below are the few areas which should be focused.

- There should be an improvement in the medical facilities in the vicinity of the project area.
- There should be awareness and providing sufficient training in hygiene, sanitation and proper diet.
- Encouraging people to send children to school and also educate themselves through adult literacy programs.
- Building skills among villagers as per skills requirements of the project during the operations phase.
- Creating awareness about long term financial planning.

6. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

This chapter details the inferences drawn from the environmental impact assessment of the proposed project. It describes the overall impacts of the project activities and underscores the areas of concern, which need mitigation measures.

6.1 Approach

Assessment of the proposed Jaisalmer Wind Farm has been done taking into consideration the impacts due to project sitting, land preparation, construction and operation. The ESIA Study has taken into consideration the following:

- Applicable National Regulations
- IFC's Performance Standards
- Equator Principle
- Outcomes of the community consultation and baseline environmental monitoring
- IFC General EHS and wind energy specific Guidelines

6.2 Community Consultation

CWP-Devgarh is committed to undertake its business with the approach of sustainable development; hence concerns of all stakeholders shall be taken into account as per the law and IFC's Guidelines.

Before commissioning of the proposed project, a free prior and informed consultation was already carried out by CWP-Devgarh with local people in the presence of Village Head/Sarpanch to discuss about the proposed wind farm project. In the meeting, the stakeholders were informed that proposed project will generate green and clean power using wind energy, as opposed to power produced from fossil fuels. The basic concept of wind power and its benefits were also discussed in detail with villagers. Further, comments, suggestion and concerns of stakeholders regarding the project activities were also recorded during the meeting.

During the ESIA study, one to one interaction as well as group discussion with local people and Village Head/Sarpanch was done for the following objectives:

- To discuss the Wind Farm projects
- To know the perception of the project among local people
- To record the concerns, suggestions and comments of villagers

During interaction, the basic objective of wind farm project i.e. to produce electricity from wind energy was discussed with the local people and Village Head/Sarpanch and it was found that villagers were already aware of the wind power project. It was also recorded that wind power projects are having good perception among local people due to very low requirement of land.

During consultation, it was found that socio-economic status of the area is low due to limited source of income. It was also recorded that agriculture, labor and livestock owned by farmer's viz., bullocks, cows, sheep, poultry and buffaloes are the major livelihood pattern in the area.

As a result of public consultation carried out during ESIA study, it was concluded that socio-economic status of the area is low where more employment opportunities and infrastructural amenities have scope of improvement and need to be focused.

6.3 Impact Assessment

The environmental impacts associated with the wind power project are almost negligible in comparison to the traditional energy projects. No air emissions are emitted during the operation of the wind farms. Typical activities during the wind energy facility construction, operation and decommissioning phase include construction, excavation, turbine and facility removal, breaking up of concrete pads and foundations, re-contouring the surface, and re-vegetation. The potential impacts from these activities during construction and operation phase are presented in the sections below.

6.3.1 Construction Phase

The various impacts anticipated during the construction phase are discussed below.

Land

20 WTGs have been proposed for Jaisalmer Wind Farm on private land. During construction, a small area comprising of the WTG and the DP yard will be occupied. The land use of the project area will not be altered to a large extent as only a small area comprising of the WTG and the DP yard will be fenced and the remaining area will be left open. Therefore, no significant impact on land use is expected.

Activities that cause land disturbance include installation of tower foundations, road preparation, excavation, etc. Excavation will be carried out to the minimum. The soil will be mainly excavated for laying foundation of towers, site leveling and road work. The top soil excavated during construction, will be stock piled and will be used for plantation. The cranes used for construction activities will be placed on hard, flat surface area and if required, ground leveling will be done.

Mitigation measure

The following mitigation measures must be incorporated in the construction process:

- The land use in the Project area shall not be altered since only a small area is occupied by WTGs.
- The layout for access roads and transmission lines shall be developed considering the minimum land requirement.

Soil Quality

The following potential impacts on soil quality during the construction phase have been identified:

- Site preparation activities may involve blasting for laying down the turbine foundations and access road construction. This can lead to loss of soil and generation of significant amount of dust since the area lies in a windy zone;
- Top soils and sub soils will be extracted during excavation which will lead to loose soil generation and its subsequent dispersal by wind. Excavation can disturb the original topography of the area and consequently lead to soil erosion;
- Heavy vehicle movement can lead to soil compaction and disturbance to site topography which can result in further soil erosion;
- The construction material can disperse due to the high wind speed conditions in the areas which can lead to soil contamination;
- Random disposal of excavated soil and construction debris in nearby fields and private land;
- Accidental oil leaks/spillages from vehicles and machinery operations at site can cause soil and groundwater contamination.

Mitigation Measures

The following measures shall be taken to avoid/reduce the impact on the soil quality during the construction phase:

- Construction activities shall be restricted to dry months of the year thereby excluding the months of heavy rainfall;
- All construction material shall be stored in a designated/demarcated storage area within the site and covered with tarpaulin sheet to avoid dispersal with wind;
- Construction debris and excavated material shall be cleared up at regular intervals and used for filling up low lying areas and/or road construction purposes; and
- Temporary paved areas shall be constructed to be used while refueling the machineries. In case of any accidental spill, the soil will be cut and stored securely for disposal with hazardous waste.
- The intensity of blasting (if any) shall be kept at an optimum level such that it causes no/minimum disturbance to the local topography. The Geology and Mining Department shall be consulted for the same and an approval and No Objection Certificate (NOC) shall be obtained from the department prior to blasting; and
- Re-vegetation shall be done in the area after the completion of construction, in order to reduce the risk of soil erosion.
- Excavated material will be stock piled and used for backfilling of foundations, trenches etc.

Air Quality

The following impacts on air quality have been identified during the construction phase:

- Dust generation and subsequent dispersal by wind during site preparation activities;
- Pollutant (SO_x, NO_x, PM) discharge into surrounding air from exhaust emission of construction vehicles.

Given the short term nature of the construction period and limited nature of emissions, the impact has been assessed to be minor.

Mitigation Measures

The following mitigation measures shall be incorporated:

- Localized sprinkling of water at areas if possible shall be undertaken for the entire duration of construction;
- Loose excavated soils shall be kept covered or kept wet in designated storage areas to prevent dust generation.
- Regular maintenance of vehicles shall be carried out and Pollution under Control (PUC) certificates shall be maintained.
- Idling time of vehicles will be reduced the extent possible.

Water Quality

The quantity of water used during the construction phase is very less. Water required for plant civil works, will be supplied to the site via water tankers by contractors.

Only negligible quantity of wastewater will be generated during the construction phase and since there are no surface water bodies near the proposed wind farm, there will be no impact on surface water due to the construction activity. Mobile toilets will be used during the construction phase.

Mitigation measures

The following mitigation measures shall be incorporated to avoid/reduce the potential impacts:

- Temporary paved areas shall be constructed to be used while refueling the machineries
- Machinery and vehicles shall be thoroughly checked for the presence of leaks, if any
- Drip pans shall be provided with vehicles with leaks to prevent soil contamination
- Storage of oil shall be undertaken on paved impervious surface and secondary containment shall be provided for fuel storage tanks.

Noise Quality

Project construction involves activities such as road construction, grading, excavating and drilling of tower foundations, concrete batching, tower erection, construction of ancillary structures, operation of diesel generators, concreting, material movement and site cleanup. The above mentioned activities will generate noise and vibration.

Noise levels generated by construction equipment will vary significantly depending on the type and condition of equipment, operation methods and schedule. However, the noise levels will be generally in the range of 85–110 dB(A).

The construction activities will be temporary in nature and will not last for more than 15-20 days for a particular WTG site. Since the nearest settlement is approximately 400-600 m from KBS-T-26, noise generated during the construction phase will not have a significant impact on existing ambient noise levels. Therefore, the impact from construction noise is deemed to be negligible.

Mitigation measures

The following measures will be incorporated during construction phase for minimizing increase in noise levels:

- Adequate precautions and information will be provided prior to execution of any blasting activity
- Regular maintenance of construction machinery and equipment shall be carried out to ensure noise emissions are maintained at design levels
- Integral noise shielding to be used where practicable and fixed noise sources to be acoustically treated, for example with silencers, acoustic louvers and enclosures
- Provision of rubber paddings/noise isolators at equipment/machinery used for construction
- Construction vehicles shall be well maintained and idling time will be minimized for vehicles when not in use
- Noise prone activities will be restricted to the extent possible during night time (10 pm – 6am) to reduce the noise impact
- Site workers working near high noise equipment use personal protective equipment's (PPEs) to minimize their exposure to high noise levels
- Noise generated during loading and unloading to be minimized to the extent possible

Ecology

The construction activities for the Project will involve site clearance which may lead to direct loss or disturbance of habitat. Construction requires access roads and on-site access tracks, temporary site compounds, and turbine bases, cabling, grid connection. However, the land between the turbines and access roads is unaffected.

Field surveys for this ESIA study has shown that vegetation cover of the project area (activity zone) has been subjected to human and climatic influence over a long period of time and the ecological value of the vegetation resources in the project area is very poor. The forest produces are insignificant. The core area bears negligible density and species composition of forest vegetation and there will be no loss of any tree individual. There are some shrubs and seasonal grasses which will be cleared during site preparation and infrastructure development. No potential shrub and herb species are involved in the clearing.

As the proposed project is wind power project where land requirement is low, therefore, impacts due to site clearance activities in terms of loss of vegetation would be limited. Moreover, absence of site boundary and fencing in the wind project (excluding transformers) is beneficial and would not pose any restrictions on movement of animals especially for grazing. The clearance of vegetation shall be restricted along a radius of 20 m around each WTG site and the entire area procured shall not be cleared. The project area is associated with open grass and shrub land and hence the habitat loss risks associated with the project is minimal.

Economically/Ecologically/RET flora and fauna

Low arable land tends to have minimal ecological value though there are some economically important flora and fauna recorded from the study area. As far as the floral species of the study area is concerned, only *Salvadora oleoides*, *Prosopis cineraria* and *Capparis decidua* are the economically important species distributed all over the study area. Recorded mammalian species are not so important as all these come under the Least Concerned (LC) category of IUCN Red Data Book (ver. 3.1). The Indian Wildlife Protection Act (1972) also scheduled the animals in various categories for given them varying degree of protection and among recorded mammals, no species has been found under Schedule-I category. Although the recorded avifaunal species from the study area come under the Least Concerned category of IUCN but Common Sandpiper and Tawny Pipit are some important bird species due to their migratory habit.

The ecological effects of a wind power project are very limited as compared to the environmental effects of traditional energy sources. Wind power consumes no fuel, and emits no air pollution, unlike fossil fuel power sources. Thus the impact on ecological environment during construction phase of the Project is assessed to be minor.

Mitigation Measures

The following mitigation measures shall be adopted:

- Site clearance for tower erection, access road and ancillary facilities shall be restricted to the necessary footprint areas
- Vegetation shall not be removed from areas falling in land not required for any construction
- Avoiding construction activities during bird's breeding season

- There will be an adequate space between two turbines for movement of birds which would reduce the potential for accidental collision
- Organize various afforestation (area around the turbine shall be re-vegetated at the earliest) and biodiversity conservation programs in project area villages
- Indigenous and economically important species (*Salvadora oleoides*, *Prosopis cineraria*, *Azadirachata indica* and *Capparis decidua*) shall be encouraged under re-vegetation and afforestation program.
- The crane staging area, intervening areas, overhead clearance for suspended turbine components shall be planned in such a way that minimum tree felling is required

Socio-economic Environment

INOX purchased the land parcels for the siting of the WTGs directly from the private owners from each of the respective villages. The Project comprises of 20 WTGs and hence there are 20 land parcels involved. The land procurement process has been done in an amicable manner on willing seller-buyer basis. Each of the stakeholders of the private parcel land and the Gram Panchayats had been briefed of the project before negotiations for the land procurement started.

No resettlement of population is required. Land requirement will be restricted to a relatively small area under WTG, project access roads, transmission lines etc. The villagers will be compensated for any structure that is affected by project, if any.

CWP-Devgarh is committed to providing employment to locals in the project but due to the skilled and highly skilled manpower requirements for the setting up and operation of the WTG, local labor requirement may be limited to unskilled construction work and security staff. The project will provide direct employment where ever possible in the form of casual labor, skilled labor, office staff, primarily during project construction and operation, thus helping improvement of local economic conditions. No impact on the health and culture of local residents is predicted as the scale of construction is small and for a short duration of time.

The labor for the construction works for the development of wind farm works will be hired locally and no significant influx of migrant population is envisaged. The Project will not involve setting up of labor camps. Only skilled workers required for crane operation and electrical works will be brought in from outside, which will be limited to 20-25 persons. The basic issues related with migrant labor may include:

- Conflict among workers based on cultural, religious or behavioural practices;
- Discontent amongst local community for engagement of outsiders;
- Workers who have worked in different places and acquired communicable disease such as AIDS, tuberculosis, etc. can inflict the community;
- Use of community facilities such as health centres, temples, transport facility etc. by migrant labour may lead to discontent with local community.

It was reported during site visit that, locals are given preference for unskilled jobs and limited number of workers from outside will be engaged for technical jobs. The workers coming from outside are lodged in rented accommodation in nearby towns and villages and therefore the issues related to migrant labor are not expected to be significant for the project.

The following impacts are identified that would impact the living standards of neighboring community and local villagers from nearby villages:

- Dust emissions and noise and vibrations from construction vehicle transit
- Traffic congestion along the village/minor roads due to movement of heavy vehicles and other construction related vehicles
- Disturbance from traffic movement during night time
- Potential for accidents to livestock and people
- Damage to village roads and related structures
- Parking of vehicles in open fields and other non-project locations
- Movement of vehicle along transmission line through land not designated as ROW
- Emissions due to idling of vehicles
- Use of common property resources

However, the construction of roads will be a short duration activity spread over 1-2 months and therefore the impact due to disturbance is assessed to be minor.

The site does not contain any archaeological monuments or sites as per the Archaeological Survey of India. No historical and cultural monuments will be affected by the project.

Erection of the wind turbines will create significant built features in the landscape that will either be considered pleasing architectural additions or detractions from the appearance of the local landscape, depending upon the perception of the viewer. These turbines will be about 80 m high.

Mitigation Measures

The following mitigation measures will however be incorporated:

- All land procurements for associated facilities considers the increase in land rates and compensate proportionate to the increase in price.
- Project transportation through community areas shall be avoided to the extent possible;
- The routes for transport of construction material for road development shall be done based after a survey of the existing road conditions.
- Routes shall be planned along wider and less-restrictive roads. Where road widths are insufficient, either temporary widening of the road with gravel or full depth widening of the pavement structure will be undertaken.
- Widening of shoulders and development of new roads will be discussed with the community and undertaken only after all concerns are addressed;

- Any incidence of breakdown shall be attended immediately to ensure smooth flow of vehicle along the road. Movement of vehicle shall be restricted to the identified routes and only trained drivers shall be employed.
- High noise generating construction activities shall not be carried out during night time; and
- All public utilities like power transmission cables, telephone cables, water/sewerage lines, drains, tube wells etc. falling within road land width shall be inventoried, and arrange for relocation /shifting to adjacent areas in consultation with the respective agencies/authorities and community.
- Community expectations for employment and other local benefits need to be addressed and managed by CWP-Devgarh and INOX. Regular updates on opportunities and skill requirements shall be provided to the community.
- To the extent possible sourcing of construction labour to be done from local region
- Ensure local contracting and vendor opportunities as far as possible;
- Avoid using any community infrastructure facilities like water bodies, electricity etc.
- CWP-Devgarh shall ensure that the construction contractors as engaged by INOX commit and adhere to social obligations including community relations, handling complaints and grievances, adherence to labour laws and international commitments etc.
- The contractor shall provide adequate training on social behaviour and community interaction to the workers engaged by them. The contractor shall undertake medical test of the workers engaged for the project to identify any communicable disease prior to engagement
- The water usage shall be monitored and controlled to minimise the wastewater generation
- CWP-Devgarh shall ensure that no child labour and non-discrimination, payment of wages shall be complied by the contractors

6.3.2 Operation Phase

The various impacts anticipated during the operation phase are discussed below.

Land/Soil Quality

The range of potential project impacts on land include land disturbance (creating erosion and sedimentation), disposal of excess spoil, and soil contamination. The following potential impacts have been identified for the operational phase:

- During the operational phase of the project, small quantities of hazardous waste in the form of waste/used oil will be generated. This waste requires adequate disposal as per the requirements mandated under the Hazardous Waste (Management, Handling and Trans-boundary Movement) Rules, 2008.

- Any other hazardous waste like waste oil, paint containers will be disposed off to authorized vendors. Other waste will be disposed to local waste disposal area with permission of concerned authority/body.
- Very small quantity of solid waste will be generated by workers during project operation, and this material will be handled and disposed of in an approved manner; therefore no soil contamination will result.

Mitigation Measures

The following mitigation measures shall be incorporated in the operational phase of the project:

- Waste oil generated shall be stored separately in containers in a secured location in the maintenance room. The storage location and the containers shall be properly marked.
- The waste/used waste oil from the WTGs shall be disposed off to a CPCB/SPCB authorized vendor.
- A hazardous waste inventory shall be maintained as per the provisions of the Hazardous Waste (Management, Handling and Trans-boundary Movement) Rules, 2008.
- Care will be taken with regard to possible changes in soil quality due to human activities, such as disposal of waste material and domestic effluents on soil of the surrounding area. Waste water holding tanks / septic tank will be located at more than 500 m away from bore wells or any other underground water holding tanks in surrounding areas.

Air Quality

Emissions during this phase will be limited to exhaust emissions and dust generation from limited number of vehicle movements for maintenance purposes. However, the proposed Wind Farm will benefit the environment by replacing the conventional fossil fuel energy with wind energy. Overall the project will have a positive beneficial impact on air quality.

Water Quality

The proposed Jaisalmer Wind Farm will have 20 personnel at site including maintenance, monitoring and security staff during the operation phase. Hence at the rate of 45 liters per capita per day, it is estimated that 900 liters of water per day will be required for the site office when Jaisalmer Wind Farm will be in operation. Since cleaning of blades is not done, hence there is no separate water requirement for the same.

Groundwater contamination can occur if chemicals are not properly handled or are incorrectly disposed of and leach into the water table or if wastewater from site office is not properly disposed off. Very small volume of waste will be produced from the operation of the Wind Farm (e.g., used oil, paint cans), which will be disposed to authorized vendors.

Minor volumes of sewage will be generated from toilet facilities at the site office. This will be disposed to septic tank, thus no significant impact is anticipated to surface or groundwater.

Mitigation Measures

The water requirement during the operation phase of the project shall be met through authorized water tankers. It is recommended not to use bore well water for any of the project related activities. The drinking water requirement for the site personnel shall be met through packaged drinking water. With respect to generation of waste water from site office, adequate number of septic tanks shall be provided.

Noise Environment

Noise from a wind turbine is typically made up of three distinct elements:

- a reasonably steady, broad-band noise of aerodynamic origin, which depends on the blade tip speed
- a tonal noise element from mechanical components within the nacelle
- a regular, pulsed element resulting from interaction between the mast and blades

During operation phase, the noise impact assessment was conducted by predicting the sound pressure level (noise) from the wind turbines at each receptor location, and comparing to a specified noise limit. A noise modeling exercise was carried to estimate the incremental and resultant noise levels at the identified receptor locations using EMD's WindPRO v2.9 software available for the design and planning of wind farms.

WindPRO contains pre-configured noise calculation models in order to calculate predicted noise levels at each of the selected noise receptor plus a ready built catalogue of wind turbines and noise emission data. The ISO 9613-2 noise calculation model was used which considers frequency dependent attenuation due to geometric divergence, atmospheric absorption, and ground effect. The model is valid for downwind propagation under a well-developed moderate ground based temperature inversion, which are conditions favorable to noise propagation from source to receiver.

Modeling was undertaken to evaluate the resultant noise levels with the prescribed noise limit of 45 dB(A) for night time. Ground attenuation is mainly the result of sound reflected by the ground surface interfering with the sound propagating directly from the source to the receiver. Hard ground, such as pavement, rock, concrete, water, ice, and tamped ground, has a ground factor $G = 0$. Porous ground results in lower noise levels at the receiver.

The data available for the equivalent INOX DF 93 wind turbines (Hyundai HQ2000-WT93 60Hz 2000) from the WindPRO wind catalogue was used for the noise assessment. The results of the noise modeling analysis are presented in Table 6.1 and Figures 6.1 and 6.2.

Table 6.1 : Resultant Noise Levels at Receptor Locations

Receptor	Baseline dB(A)		Incremental due to Project dB(A)	Resultant dB(A)		Additional Exposure dB(A)		Distance at which MoEFCC guideline will be surpassed (m)	
	Day	Night		Day	Night	Day	Night	Day	Night
A (Bonada Receptor 1)	52.0	41.6	40.6	52.3	44.1	0.3	2.5	1058	504
B (Bonada Receptor 2)	52.0	41.6	40.1	52.3	43.9	0.3	2.3	1140	560
C (Bonada Receptor 3)	52.0	41.6	38.5	52.2	43.3	0.2	1.7	1240	856
D (Bonada Receptor 4)	52.0	41.6	40.5	52.3	44.1	0.3	2.5	963	474
E (Khelana)	50.3	40.5	26.7	50.3	40.7	0.0	0.2	2194	1871
F (Barmer Road/40)	54.5	44.9	24.5	54.5	44.9	0.0	0.0	-	-
MoEFCC guideline for Day (dB(A))				55.0 for residential areas 75.0 for industrial areas					
MoEFCC guideline for Night (dB(A))				45.0 for residential areas 70.0 for industrial areas					
Incremental noise is estimated at a wind speed of 8 m/sec which represents the worst case scenario.									

The incremental noise level due to the operation of the proposed WTGs is in the range of 24.5 – 40.6 dB(A). The resultant noise levels are well within the stipulated levels for residential (45 dB(A) for day time and 55 dB(A) for night time) and industrial areas (75 dB(A) for day time and 70 dB(A) for night time). The additional exposure due to the proposed WTGs is in the range of 0.0-0.3 during day time and 0.0-2.5 during night time. The output files of the modeling analyses are enclosed in Annexure I.

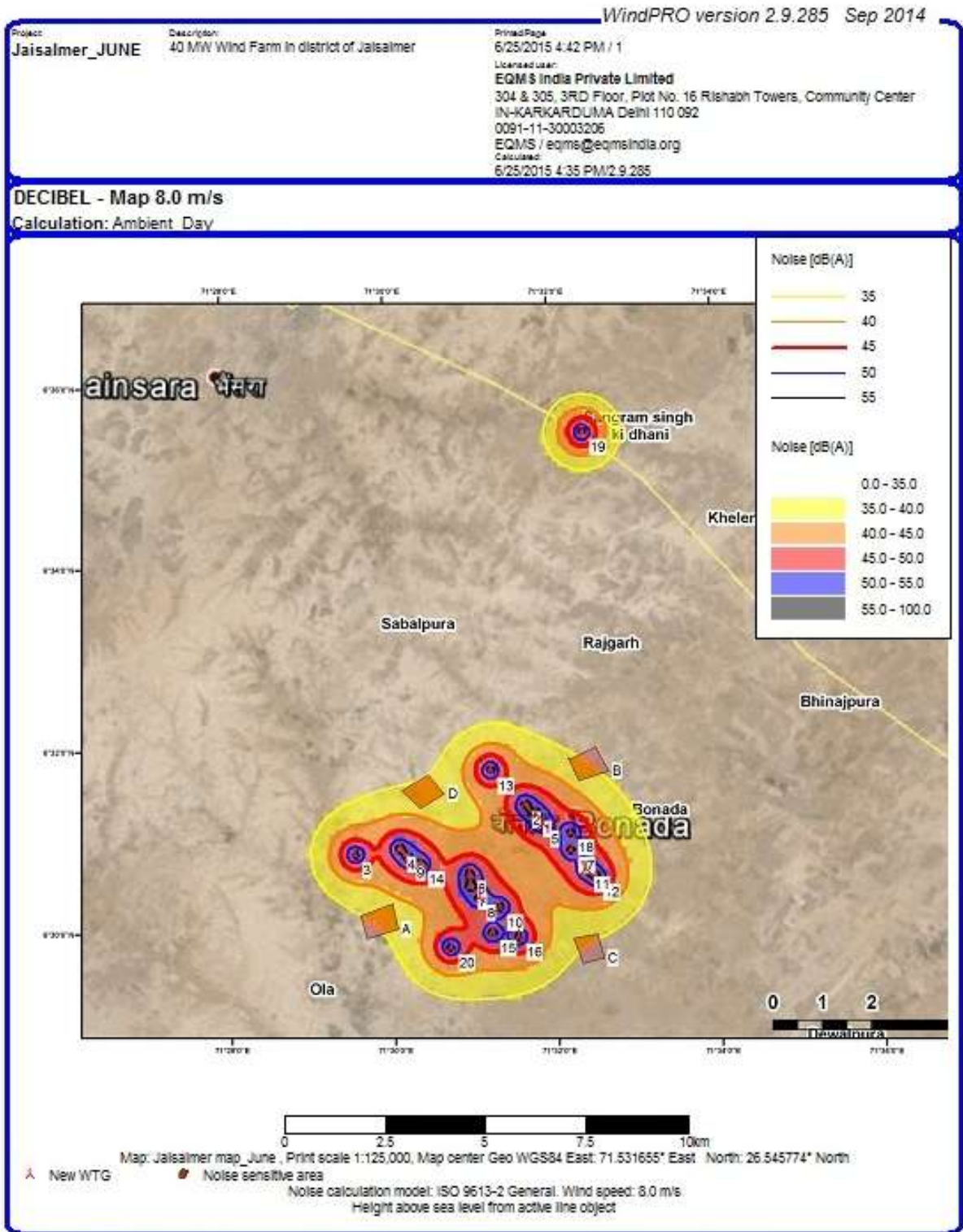


Figure 6.1 : Noise Level generated due to operation of WTGs with ambient noise during day time

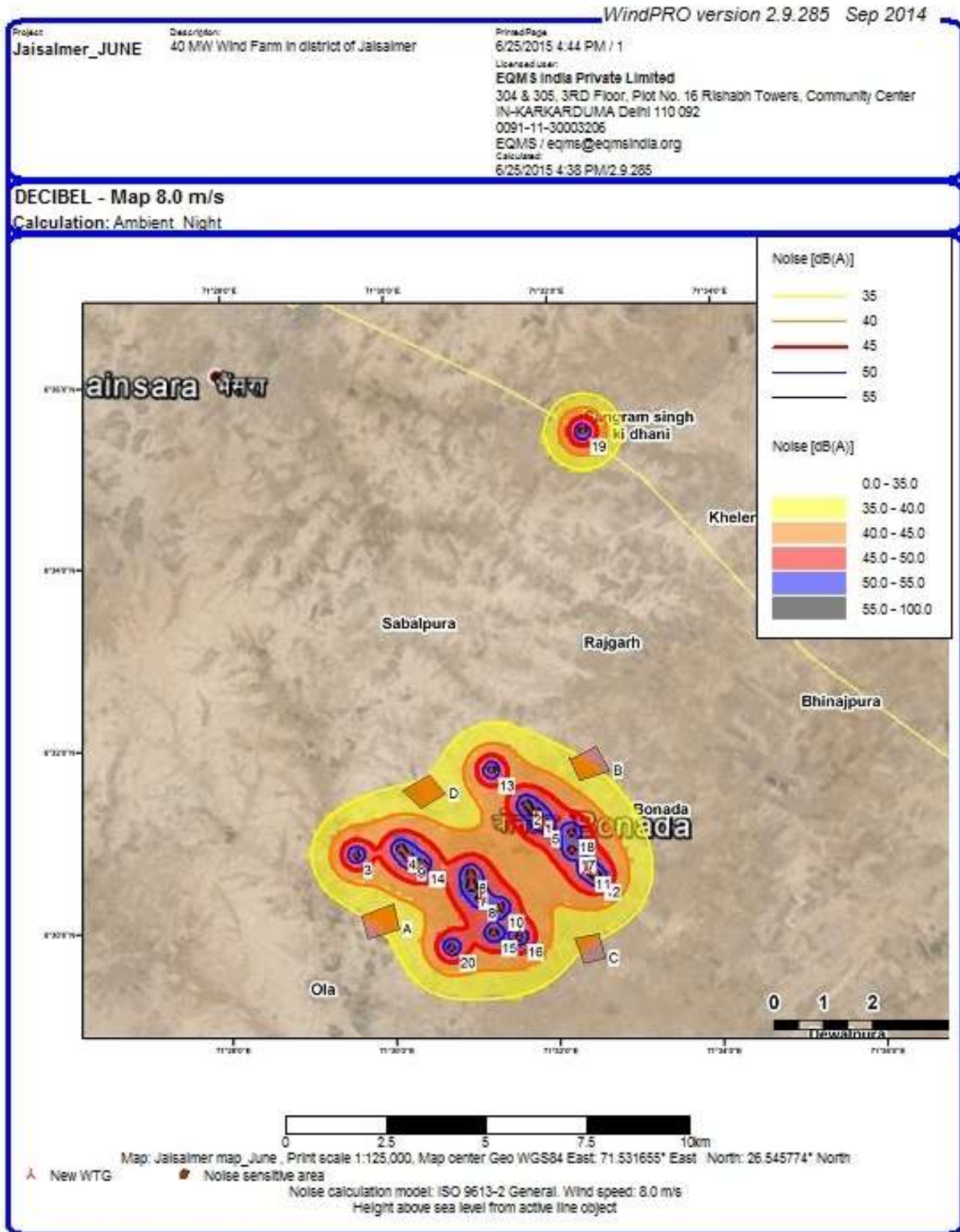


Figure 6.2 : Noise Level generated due to operation of WTGs with ambient noise during night time

Noise from Transmission lines

Once operational, noise from energized overhead lines can be produced by a phenomenon known as 'Corona Discharge' (a limited electrical breakdown of the air). Conductors are designed and constructed to minimize corona effects, although, under certain conditions this can be audible as a 'hissing' sound, sometimes accompanied by a low frequency hum. However, noise due to Corona Discharge is negligible.

Mitigation Measures for reducing noise from operation of WTGs

Although impacts due to noise emissions are anticipated to be minor, based on the location and model output, the following mitigation measures shall be considered to further limit any concerns of habitations in the vicinity:

- Siting of WTGs to ensure that there is a minimum setback distance of 140 m from built structures and settlements as per IREDA guidelines. The first cluster of WTGs is located at a distance of 520 m from the village of Bonada. The nearest habitant settlement (single or clusters of house) is located at a distance of 300 m from WTG.
- WTGs shall be designed in accordance with the international acoustic design standards.
- Minimize the ground vegetation being cleared during site clearance activities and ensure re-vegetation of cleared areas.
- WTGs shall be maintained in good running conditions throughout the operational life of the project through routine maintenance.
- Implement a complaint resolution procedure to assure that any complaints regarding operational noise are promptly and adequately investigated and resolved.
- Consult with the locals periodically to assess noise generation and set up a procedure to locate source of noise and steps taken to minimize them.
- Undertake ambient noise level monitoring on an annual basis in order to understand the increase in noise levels due to the project operation.

As is evident from Figures 6.1 through 6.3, noise from the operation of WTGs would not cause any discomfort to the neighboring settlements as these do not exceed the Leq limits for day and night time. The nearest habitant settlement is located at a distance of 300 m from WTG and noise levels are well in the range of 40-45 dB(A) in the vicinity.

Ecology

The ecological effects of a wind power project are very limited as compared to the environmental effects of traditional energy sources. Wind power consumes no fuel, and emits no air pollution, unlike fossil fuel power sources. Potential impacts from present project are presented below:

- Present wind farm effects may include habitat loss or disturbance but when assessed this effect against the sensitivity of the habitat, it was found to be insignificant as the present habitat is not rare and found abundantly all over the district. As the proposed project is wind power project where land requirement is low, therefore, impacts due to site clearance activities in terms of loss of vegetation would be limited. Moreover, absence of site boundary and fencing in the wind project (excluding transformers) is beneficial and would not pose any restrictions on movement of animals especially for grazing. The present wind mills' areas are associated with barren and cleared agriculture lands and hence the habitat loss risks associated with these mills is minimal.
- Evidence suggests that bird collisions caused by wind turbines (bird strike) cause relatively low levels of mortality (Drewitt and Langston, 2006). Concern is most likely to occur if the wind turbines are on a migration path (e.g. Navarra, Spain) or where high concentrations of particular bird's species occur (for e.g. feeding such as the Golden eagles in Altamont pass). Large birds with poor manoeuvrability (such as swans and geese) and those that habitually fly at dawn and dusk or at night are generally at greater risk of collision with structures (Drewitt and Langston, 2006). There is also concern over wildfowl having to change course during migration (barrier effects) due to offshore wind farms (ETSU, 2001). Under present study none of the above mentioned avifauna has been recorded and there is no migratory flyway corridor and high concentration of particular bird's species occurs in the study area and the project area does not have any micro habitats to attract large population of bird. Moreover, there is a sufficient flying space (for birds) is available between two adjacent wind turbines hence proposed project activities are not envisaged to have any adverse effect on avifauna.
- The effects on bats has also been a concern, but only where there are known concentrations of bat activity such as summer roosts, swarming sites, and hibernacula (over-wintering sites). Some fatalities are also observed on migration routes of bats. Secondary data revealed few bat species in the study area but not a single individual of any bat's species has been recorded during primary study therefore the impact on the bat fauna is negligible.
- Those areas that require very careful assessment and may result in significant impacts are: a high density of wintering or migratory waterfowl and waders, high level of raptor activity, breeding, wintering or migratory populations of less abundant species. There are only two migratory bird species found in this study which are similarly distributed all over the area and these species are not less abundant species. No high level raptor activities have been recorded in the study area therefore such kinds of impacts are negligible.

There are no National Park, Wildlife Sanctuary, Conservation Reserve and found in and around project site. Since present project have relatively (compared to other energy options) lower ecological footprint hence it should not be treated at par with conventional

infrastructure projects. In view of the above appraisal, the project is not expected to any significant impact on flora and habitat of fauna, birds, bats and their movement.

Measures to be used for conservation of Biodiversity

The following measures have been considered in the Project design and a few additional mitigation measures have also been recommended:

- There will be an adequate space between two turbines for movement of birds which would reduce the potential for accidental collision
- Any dead animals/carcass shall be removed in time from the site so that it does not attract movement of scavenger birds.
- Organize various afforestation (area around the turbine shall be re-vegetated at the earliest) and biodiversity conservation programmes in project area villages
- Indigenous and economically important species (*Salvadora oleoides*, *Prosopis cineraria*, *Azadirachata indica* and *Capparis decidua*) shall be encouraged under re-vegetation and afforestation programme.
- A systematic data collection system will be introduced at the farm site that could capture the actual damage to the fauna and a periodic reporting system on biodiversity conservation will also be developed.

Socio-Economic Environment

Visual Aesthetics

Visual and aesthetic impacts are among the most commonly expressed concerns about the development of wind energy projects. Determination of what constitutes an adverse visual impact is highly subjective because it depends on the values, beliefs, and experiences of individual viewers. Opinions about the aesthetic qualities of wind energy facilities can vary greatly among different segments of the population and from one location to another.

An adverse visual impact is defined as an unwelcome visual intrusion that diminishes the visual quality of an existing landscape. Changes that can be perceived as visual intrusions generally result from the introduction of visual contrast to the existing scene, based on differences in form, line, color, and/or texture. Visual contrast with the existing landscape is often unavoidable because of the size and typical location of wind farms. Nevertheless, there are some measures that can be incorporated into the design of the project facilities to limit the degree of visual contrast and reduce the prospect that the contrast would be widely perceived as an adverse visual effect, or at least reduce the degree of the effect.

To avoid conflicts and problems with acceptance, visual aspects should play an important part in the planning and communication in the realization phase of wind parks. It is critical to recognize that wind turbines cannot be adjusted to meet visual criteria alone. The turbines must be located in the areas with appropriate wind resources in order for the project to be viable.

The layout for the wind turbines has been finalized based on a siting exercise which has accounted for visual impacts. All the wind turbines will have uniform visual characteristics such as color, size, and design of turbine. A visual assessment for the proposed project was also carried out. The settlements in the region are located at a sufficient distance from the WTGs.

Electromagnetic Fields (EMF) Effects

Electro Magnetic Fields (EMF) surrounds us in modern society. All electronic devices, power lines, and generating stations produce EMFs. WTGs convert wind energy into electricity. The electricity is carried from the WTG by a cable, either underground or overhead, to the main electricity transmission grid for distribution, creating a small magnetic field. When a charged object, such as an animal, crosses the path of this magnetic field, a very small, momentary electric field may be created. There are four potential sources of electric and magnetic fields associated with the wind farm project. These are:

- Transmission line
- Wind turbine generator
- Generator transformer
- Underground cable

Possible effects associated with the electric and magnetic fields from transmission lines (or similar electrical sources) fall into two categories:

- short-term effects that can be perceived and may represent a nuisance
- possible long-term health effects.

Though wind power produces EMFs like any other source of power and power transmission there are two major benefits to wind power in respect to safety. Wind turbines are approximately 80 m above the ground, the EMF² created by the production of energy is generally well above any people who may be in the area.

The electromagnetic fields produced by the generation and export of electricity from a wind farm do not pose a threat to public health. Grid connection is normally made at no more than 132 kilovolts (kV)³, similar to the voltages used by utilities in existing residential distribution networks. In addition, project developers would design the entire electrical system to adhere to applicable state guidelines and industry standards to minimize EMF exposure from any new overhead transmission lines.

The grid connection lines are similar to other power lines and generate low levels of EMF, comparable to those generated by household appliances. Thus, it can be

² Rideout, Karen & Constance Bos. January 2010. Wind Turbines and Health. National Collaborating Centre for Environmental Health. Vancouver, Canada & Sustainable Energy Australia (SEA) Pty. Ltd. The electromagnetic compatibility and electromagnetic field implications for wind farming in Australia. Melbourne and Canberra: Australian Greenhouse Office & Australian Wind Energy Association; 2004 [cited 2009 July 21].

³ The Real Truth About Wind Energy, An Analysis of the Potential Impacts of Wind Turbine Development in Ontario. Sierra Club Canada, June 2010

concluded that the electromagnetic fields produced by the generation and export of electricity from a wind farm do not pose a threat to public health.⁴

The issue of whether there are long-term health effects associated with exposure to fields from transmission lines and other sources has been investigated for several decades. There is little evidence that electric fields cause long-term health effects. Estimates of magnetic-field exposures have been associated with certain health effects in studies of residential and occupational populations. Research in this area is continuing to determine whether such associations might reflect a causal relationship. The lists of exposure limits for general public/occupational exposure to electric and magnetic fields published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) is provided in Table 6.2 and 6.3.

Table 6.2 : ICNIRP Exposure Limits for General Public Exposure

Frequency Range	Electric Field (V/m)	Magnetic Field (A/m)
25-50 Hz	5000	160
50-400 Hz	4150	83

Source: ICNIRP (2010): Guidelines for limiting exposure to time-varying electric and magnetic fields (1 Hz-100 KHz)

Table 6.3 : ICNIRP Exposure Limits for Occupational Exposure

Frequency Range	Electric Field (V/m)	Magnetic Field (A/m)
8-25 Hz	20,000	20000/f
25-300 Hz	500/f	800
f- Frequency in Hz		

Source: ICNIRP (2010): Guidelines for limiting exposure to time-varying electric and magnetic fields (1 Hz-100 KHz)

There are no specific standards or guidance on EMF in India however the Indian Electricity Act and Rules early stipulate the minimum clearances required. Hence the ICNIRP standards and guidelines have been considered. The EMF generated by 220KV unit will be lesser than the suggested value.

Shadow Flicker Effects

Shadow flicker refers to the shadows that a wind turbine casts over structures and is observe red at times of the day when the sun is directly behind the turbine rotor from an observer's position. The shadow flicker effects usually occur during periods after sunrise and before sunset. During intervals of sunshine, wind turbine generators will cast a shadow on surrounding areas as the rotor blades passing front of the sun, causing a flickering effect while the rotor is in motion. Shadow flicker does not occur when the sun is obscured by clouds or fog, or when wind turbines are not operating, or when the

⁴ Evidence Review Wind Turbines and Health: A Rapid Review of the Evidence, National Health & Medical Research Council, Govt. of Australia

blades are at a 90° angle to the receptor. While shadow flicker can be perceived outdoors, it tends to be more noticeable in rooms with windows oriented to the shadows. A turbine's shadow flicker impact area is generally located within 300 meters of the turbine and typically lasts for less than 30 minutes.

The distance between a wind turbine and a potential shadow flicker receptor affects the intensity of the shadows cast by the blades, and therefore the intensity of flickering. Shadows cast close to a turbine will be more intense, distinct and focused. The flickering effect is important only for receptors located along East-West axis of the wind turbine.

For the assessment of shadow flicker due to the proposed project, a modeling exercise was carried out taking into account the WTGs dimensions and the movement of the sun throughout the year. This modeling was carried out using EMD's WindPRO v2.9 software. Data which are input to the WindPRO software are as follows:

- Geographic locations and characteristics of the proposed WTGs
- Locations of identified receptors (villages)
- Topography was assumed to be flat as a worst case scenario

The WindPRO software calculates the position of the sun throughout the day in accordance to the curvature of the earth, the time of year and the project site's position. The software calculates the occurrences of shadow flicker at each of the identified receptor. Analysis was conducted to represent a worst case scenario, with the following conditions:

- The sun is shining all day, from sunrise to sunset with clear skies
- There are no obstructing features such as trees and vegetation
- The wind turbines are always operating i.e. there is continuous wind of sufficient speed and no maintenance or down time

As a result of the scenario described above, the shadow flicker calculations represent a worst case scenario. The identified receptors are listed in Table 6.4 with the corresponding results. Figure 6.4 presents the results of the shadow flicker assessment map. The detailed output results of the shadow flicker assessment are attached as Annexure II.

Table 6.4 : Impacts of Shadow Flicker effects

Receptor ID	Description/name of settlement	Shadow hours/year	Shadow days per year	Maximum shadow hours per day
		Hour/year	Days/year	Hour/day
A	Bonada (Receptor 1)	1:41	19	0.07
B	Bonada (Receptor 3)	8.42	34	0.21
C	Barmer Road	0:00	0	0:00

Receptor ID	Description/name of settlement	Shadow hours/year	Shadow days per year	Maximum shadow hours per day
		Hour/year	Days/year	Hour/day
D	Khelana	0:00	0	0:00
E	Bonada (Receptor 2)	0.00	0	0.00

The shadow flicker assessment indicates that the shadows will not exceed for more than 9 hours in a year which is well within the threshold of significant impact, i.e. 30 hours per year, as per the international guidelines. Therefore the effects of shadow flicker are negligible at the project site.

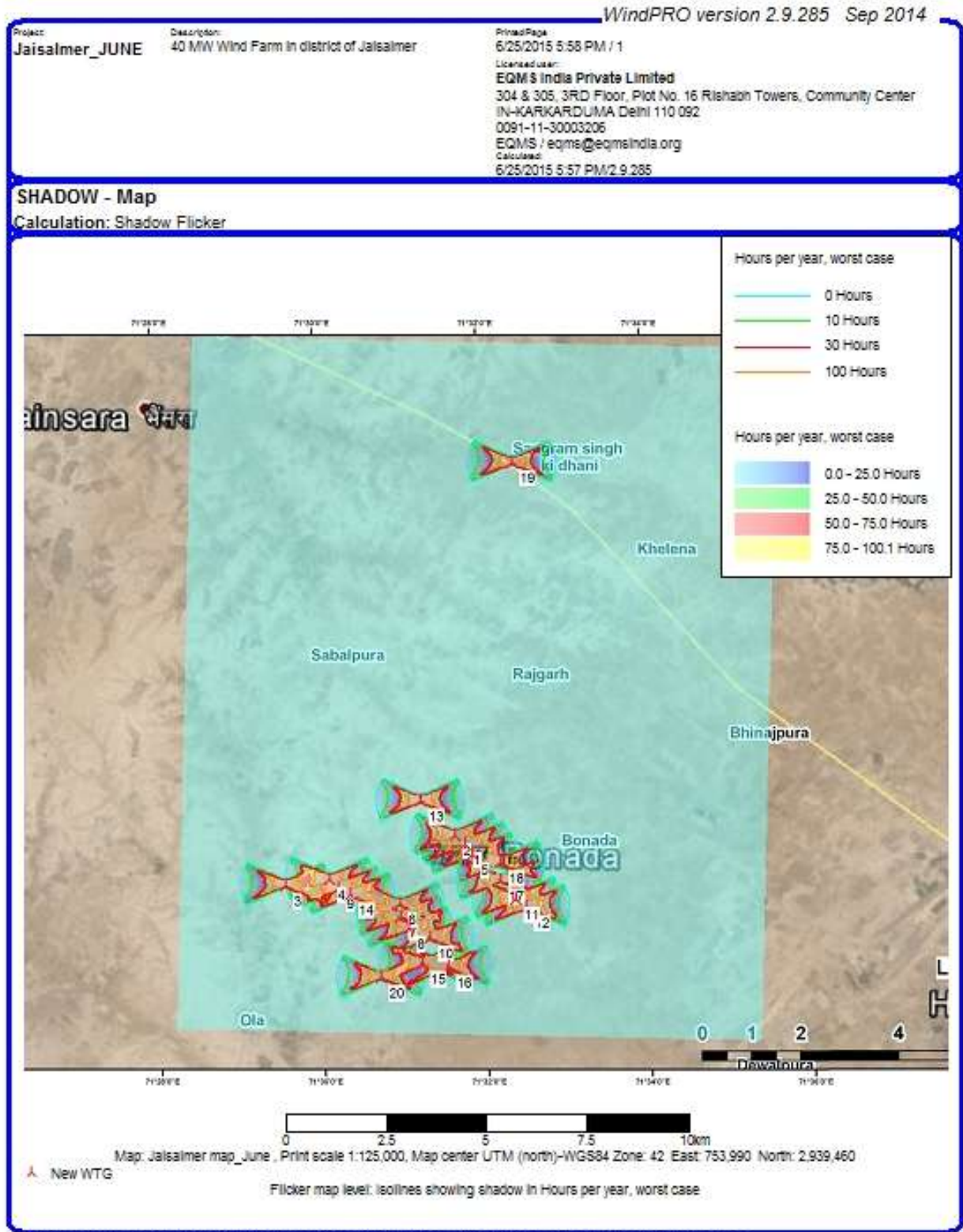


Figure 6.3 : Shadow Flicker Assessment Map

Impact on Communication Facilities

Wind projects may impact communications signals in two ways. Wind turbines and their associated transmission lines can generate electromagnetic noise, which can interfere with telecommunications services, or, more commonly, wind turbines create physical obstructions that distort communications signals. The types of communications systems that may be affected include off-air TV broadcast signals, and mobile telephone services.

Off-air stations are television broadcasters that transmit signals that can be received from terrestrially located broadcast facilities on a television receiver. Off-air television signals are subject to distortion by the reflections from the turbine blades and by the attenuation of the signal passing through the wind turbines. The reflections may cause multipath distortion and ghosting. Blade motion may cause the contrast and brightness of the signal to vary.

These effects on off air television apply to analog modulated television signals and do not affect digital signals in the same way. Almost all of the television operators including the national broadcast makes use of digital signals and hence will have little impact due to wind farm.

These effects on off air television apply to analog modulated television signals and do not affect digital signals in the same way. Almost all of the television operators including the national broadcast makes use of digital signals and hence will have little impact due to wind farm.

Effect on Rainfall

Wind farms by their very design do not act as a solid obstruction to cloud. Therefore, they do not induce enough vertical velocities to result in any appreciable change in precipitation. The flow computations past the WTG blades show no perceptible change in temperature field. Hence, there would be no change in cloud morphology. Thus WTGs have no effect on rainfall.

Aviation Hazard

No aviation hazard will be created by the Project.

7. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

This chapter addresses the requirement of IFC PS1 which highlights the importance of managing the social and environmental performance throughout the life of a project by implementing an effective ESMS.

7.1 Introduction

This chapter addresses the requirement of IFC's PS1 which highlights the importance of managing the social and environmental performance throughout the life of the project. An effective Environmental and Social Management System (ESMS) is of paramount importance to continuously manage and communicate the potential social and environmental impacts and risks imposed on the project employees (direct and indirect) and the local communities residing in the immediate vicinity of the project area. CWP-Devgarh is committed for such a system.

7.2 Environmental and Social Management System (ESMS)

The ESMS describes the mitigation measures for all the identified potential impacts associated with the proposed project during its construction and operation phases. The environment and social management plan (ESMP) shall delineate the monitoring and management measures to avoid and/or minimize such impacts by allocating management responsibility and suggesting skill requirement for implementation of these measures. An effective ESMP also ensures continuous communication process between CWP-Devgarh, their workers (including sub-contractors), local community and other stakeholders.

CWP-Devgarh has to make sure to comply with all the components of mitigation measures towards Environment, Social, Health and Safety Standards during the construction and operation of the proposed Wind Farm. This ESMP shall be applicable to all the employees of CWP-Devgarh and its sub-contractors. CWP-Devgarh shall also have to ensure that the EPC and O&M contractor (INOX) also complies and implements all the provisions of ESMP.

7.3 Organizational Structure

Environmental and social management plan will be managed by the proposed team as depicted in Figure 7.1. The contractors shall work in coordination with the Site-In-Charge & EHS Supervisor and be part of the Project Management Team.

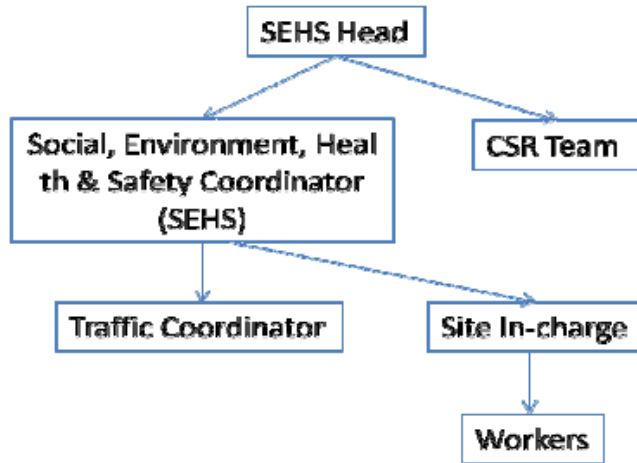


Figure 7.1 : Organizational Chart

7.4 Roles and Responsibilities

Site-in-Charge/EHS Supervisor

The Site In-Charge/EHS Supervisor along with the appointed team shall have the following responsibilities:

- Ensuring Compliance with the applicable legislations and IFC requirements
- Ensuring availability of resources and appropriate institutional arrangements for smooth implementation of ESMP
- Carrying impromptu and regular audits and rectify non-compliances, if any
- Preparation of necessary documents and maintain the record keeping system
- Regular reviewing and updating of ESMP for the effective implementation

CSR/Social Team

The CSR/social team shall have the following responsibilities:

- Implementing, monitoring and updating the ESMP
- Undertaking community development initiatives in the project influenced villages
- Managing all the human resource issues, contractor and training issues
- Addressing training needs of contractors and other employees for social and community issues
- Planning, implementing and recording all the CSR activities done for the project

- Conducting periodic meetings with local community for understanding their grievances and outcomes of the CSR activities
- Informing the local community about the Grievance Redressal Mechanism and ensuring effective implementation
- Managing all grievances of the project and recording the actions taken

Training of Personnel and Contractors

CWP-Devgarh shall ensure that the job specific training and EHS Induction Training needs are identified based on the specific requirements of ESMS and existing capacity of site and project personnel (including the Contractors and Sub-contractors) to undertake the required actions and monitoring activities. Special emphasis shall be placed on traffic management and operation of cranes.

General environmental awareness shall be increased among the project's team to encourage the implementation of environmentally sound practices and compliance requirements of the project activities. This will help in minimizing adverse environmental impacts, ensuring compliance with the applicable regulations and standards, and achieving performance beyond compliance. The same level of awareness and commitment shall be imparted to the contractors and sub-contractors prior to the commencement of the project.

An environmental and social management training program shall be conducted to ensure effective implementation of the management and control measures during construction and operation of the project. The training program shall ensure that all concerned members of the team understand the following aspects:

- Purpose of action plan for the project activities
- Requirements of the specific Action Plans
- Understanding of the sensitive environmental and social features within and surrounding the project areas
- Aware of the potential risks from the project activities

A basic occupational training program and specialty courses shall be provided, as needed, to ensure that workers are oriented to the specific hazards of individual work assignments. Training shall be provided to management, supervisors, workers, and occasional visitors to areas of risks and hazards.

Workers with rescue and first-aid duties must receive dedicated training so as not to inadvertently aggravate exposures and health hazards to themselves or their co-workers. Through appropriate contract specifications and monitoring, the employer shall ensure that service providers, as well as contracted and subcontracted labor, are trained adequately before assignments begin.

7.5 Monitoring and Audit

In order to implement the ESMP, the on-site team shall develop a time-bound and action-oriented Environmental and Social Action Plan to implement the mitigation measures provided for each of the identified environmental and social impacts. Since the construction phase is relatively a few days, it has to be ensured that the ESMP is monitored on a regular basis and all key issues shall be addressed in accordance with existing EHS commitments.

The monitoring process shall include all stakeholders - contractors, laborers, suppliers and the local community impacted by the project activities and associated facilities. The entire process of inspections and audits shall be documented and key findings shall be implemented by the contractors in their respective areas.

7.6 Documentation and Record Keeping

Documentation and record keeping system has to be established to ensure updating and recording of requirements specified in ESMP. Responsibilities have to be assigned to relevant personnel for ensuring that the ESMP documentation system is maintained. The following documents shall be maintained for smooth functioning:

- Environment Management System
- Legal Compliance
- Standard Operating Procedures (SOPs)
- Incident reports
- Emergency preparedness and response procedures
- Training records
- Monitoring reports
- Audit reports
- Complaints register and issues attended/closed

7.7 Proposed Environment and Social Management Plan

An ESMP has been developed following the delineation of impacts and mitigation measures. These measures shall be adopted by CWP-Devgarh and imposed as conditions of contract of the sub-contractor(s) employed for respective phases of the proposed wind power project. The mitigation measures suggested during operation will be made part of the regular maintenance and monitoring schedule.

The ESMP specifies measures for addressing the limited negative risks and impacts and for enhancing the beneficial impacts. In addition, organizational capacity and training requirements, required to check and ensure effectiveness of the plan throughout the lifecycle of the project, have also been discussed. The ESMP includes the following:

- Mitigations suggested for adverse environmental and social impacts and associated risks
- Institutional arrangement-management tools and techniques for the implementation of environmental impacts and risk mitigations
- Monitoring and reporting of requirements and mechanisms for the effective implementation of the suggested mitigations
- Monitoring arrangements for effective implementation of suggested mitigations for the proposed project
- Reporting requirement to the regulatory agencies and funding institutes

The ESMP is presented in Table 7.1.

Table 7.1 : Proposed Environmental and Social Management Plan (ESMP)

S. No.	Environmental Issues	Potential Impacts	Significance without mitigation measures	Mitigation Measures	Significance with mitigation measures	Responsibility
Construction Phase						
1.	Land	<ul style="list-style-type: none"> • Change in land use due to construction of turbines 	<i>Minor</i>	<ul style="list-style-type: none"> • The land use in the Project area shall not be altered since only a small area is occupied by WTGs. • The layout for access roads and transmission lines shall be developed considering the minimum land requirement. 	<i>Insignificant</i>	Site Manager – INOX/ CWP- Devgarh
2.	Soil Quality	<ul style="list-style-type: none"> • Site preparation activities may involve blasting for laying down the turbine foundations and access road construction. This can lead to loss of soil and generation of significant amount of dust since the area lies in a windy zone; • Top soils and sub soils will be extracted during excavation which will lead to loose soil generation and its subsequent dispersal by wind. Excavation can disturb the original topography of the area and consequently lead to soil erosion; • Heavy vehicle movement can lead to soil compaction and disturbance to site topography which can result in further soil erosion; • The construction material can disperse due to the high wind speed conditions in the areas which can lead to soil contamination; • Random disposal of excavated soil and construction debris in nearby fields and private land; 	<i>Minor</i>	<ul style="list-style-type: none"> • Construction activities shall be restricted to dry months of the year thereby excluding the months of heavy rainfall; • All construction material shall be stored in a designated/demarcated storage area within the site and covered with tarpaulin sheet to avoid dispersal with wind; • Construction debris and excavated material shall be cleared up at regular intervals and used for filling up low lying areas and/or road construction purposes; • Temporary paved areas shall be constructed to be used while refuelling the machineries. In case of any accidental spill, the soil will be cut and stored securely for disposal with hazardous waste. • The intensity of blasting (if any) shall be kept at an optimum level such that it causes no/minimum disturbance to the local topography. The Geology and Mining Department shall be consulted for the same and an approval and No Objection Certificate (NOC) shall be obtained from the department prior to blasting; and • Re-vegetation shall be done in the area after the completion of construction, in order to reduce the risk of soil erosion. • Excavated material will be stock piled and used for 	<i>Insignificant</i>	Site Manager – INOX/ CWP- Devgarh

S. No.	Environmental Issues	Potential Impacts	Significance without mitigation measures	Mitigation Measures	Significance with mitigation measures	Responsibility
		<ul style="list-style-type: none"> Accidental oil leaks/spillages from vehicles and machinery operations at site can cause soil and groundwater contamination. 		backfilling of foundations, trenches etc.		
3.	Air Quality	<ul style="list-style-type: none"> Dust generation and subsequent dispersal by wind during site preparation activities; Pollutant (SO_x, NO_x, PM) discharge into surrounding air from exhaust emission of construction vehicles. 	Minor	<ul style="list-style-type: none"> Localized sprinkling of water at areas if possible shall be undertaken for the entire duration of construction; Loose excavated soils shall be kept covered or kept wet in designated storage areas to prevent dust generation. Regular maintenance of vehicles shall be carried out and Pollution under Control (PUC) certificates shall be maintained. Idling time of vehicles will be reduced the extent possible. 	Insignificant	Site Manager – INOX/ CWP-Devgarh
4.	Water Quality	<ul style="list-style-type: none"> Possibility of contaminated runoff from the site entering the nearby water bodies. Domestic water runoff from the portable toilets into neighbouring water bodies can lead to degradation of water quality. 	Minor	<ul style="list-style-type: none"> Temporary paved areas shall be constructed to be used while re-fuelling the machineries Machinery and vehicles shall be thoroughly checked for the presence of leaks, if any Drip pans shall be provided with vehicles with leaks to prevent soil contamination Storage of oil shall be undertaken on paved impervious surface and secondary containment shall be provided for fuel storage tanks. 	Insignificant	Site Manager – INOX/ CWP-Devgarh
5.	Noise Quality	<ul style="list-style-type: none"> Vehicular noise from heavy vehicles utilised to deliver construction materials and WTG parts Noise from DG sets Construction noise from using mobile equipment, cranes and concrete mixing 	Minor	<ul style="list-style-type: none"> Adequate precautions and information will be provided prior to execution of any blasting activity Regular maintenance of construction machinery and equipment shall be carried out to ensure noise emissions are maintained at design levels Integral noise shielding to be used where practicable and fixed noise sources to be acoustically treated, for example with silencers, acoustic louvers and enclosures Provision of rubber paddings/noise isolators at equipment/machinery used for construction Construction vehicles shall be well maintained and 	Minor	Site Manager – INOX/ CWP-Devgarh

S. No.	Environmental Issues	Potential Impacts	Significance without mitigation measures	Mitigation Measures	Significance with mitigation measures	Responsibility
				idling time will be minimized for vehicles when not in use • Noise prone activities will be restricted to the extent possible during night time (10 pm – 6am) to reduce the noise impact • Site workers working near high noise equipment use personal protective equipment's (PPEs) to minimize their exposure to high noise levels • Noise generated during loading and unloading to be minimized to the extent possible		
6.	Ecology	<ul style="list-style-type: none"> • The construction activities may lead to loss of such natural resources. • Disturbance to local livestock population 	Minor	<ul style="list-style-type: none"> • Site clearance for tower erection, access road and ancillary facilities shall be restricted to the necessary footprint areas • Vegetation shall not be removed from areas falling in land not required for any construction • Avoiding construction activities during bird's breeding season • There will be an adequate space between two turbines for movement of birds which would reduce the potential for accidental collision • Organize various afforestation (area around the turbine shall be re-vegetated at the earliest) and biodiversity conservation programs in project area villages • Indigenous and economically important species (Salvadora oleoides, Prosopis cineraria, Azadirachata indica and Capparis decidua) shall be encouraged under re-vegetation and afforestation program. • The crane staging area, intervening areas, overhead clearance for suspended turbine components shall be planned in such a way that minimum tree felling is required. 	Insignificant	Site Manager – INOX/ CWP- Devgarh
7.	Socio-Economic	<ul style="list-style-type: none"> • Dust emissions and noise and vibrations from construction vehicle transit • Traffic congestion along the 	Moderate	<ul style="list-style-type: none"> • All land procurements for associated facilities considers the increase in land rates and compensate proportionate to the increase in price. 	Minor	Site Manager – INOX/ CWP-

S. No.	Environmental Issues	Potential Impacts	Significance without mitigation measures	Mitigation Measures	Significance with mitigation measures	Responsibility
	Environment	<p>village/minor roads due to movement of heavy vehicles and other construction related vehicles</p> <ul style="list-style-type: none"> • Disturbance from traffic movement during night time • Potential for accidents to livestock and people • Damage to village roads and related structures • Parking of vehicles in open fields and other non-project locations • Movement of vehicle along transmission line through land not designated as ROW • Emissions due to idling of vehicles • Use of common property resources 		<ul style="list-style-type: none"> • Project transportation through community areas shall be avoided to the extent possible; • The routes for transport of construction material for road development shall be done based after a survey of the existing road conditions. • Routes shall be planned along wider and less-restrictive roads. Where road widths are insufficient, either temporary widening of the road with gravel or full depth widening of the pavement structure will be undertaken. • Widening of shoulders and development of new roads will be discussed with the community and undertaken only after all concerns are addressed; • Any incidence of breakdown shall be attended immediately to ensure smooth flow of vehicle along the road. Movement of vehicle shall be restricted to the identified routes and only trained drivers shall be employed. • High noise generating construction activities shall not be carried out during night time; and • All public utilities like power transmission cables, telephone cables, water/sewerage lines, drains, tube wells etc. falling within road land width shall be inventoried, and arrange for relocation /shifting to adjacent areas in consultation with the respective agencies/authorities and community. • Community expectations for employment and other local benefits need to be addressed and managed by CWP-DEVGARH and INOX. Regular updates on opportunities and skill requirements shall be provided to the community. • To the extent possible sourcing of construction labour to be done from local region • Ensure local contracting and vendor opportunities as far as possible; • Avoid using any community infrastructure facilities like water bodies, electricity etc. 		Devgarh

S. No.	Environmental Issues	Potential Impacts	Significance without mitigation measures	Mitigation Measures	Significance with mitigation measures	Responsibility
				<ul style="list-style-type: none"> • CWP-DEVGARH shall ensure that the construction contractors as engaged by INOX commit and adhere to social obligations including community relations, handling complaints and grievances, adherence to labour laws and international commitments etc. • The contractor shall provide adequate training on social behaviour and community interaction to the workers engaged by them. The contractor shall undertake medical test of the workers engaged for the project to identify any communicable disease prior to engagement • The water usage shall be monitored and controlled to minimise the wastewater generation • CWP-DEVGARH shall ensure that no child labour and non-discrimination, payment of wages shall be complied by the contractors 		
8.	Occupational Health and Safety	<ul style="list-style-type: none"> • Material handling and storage • Possible injuries associated with working at height (≥ 2m) • Electrical work injuries (eye injuries, shocks, burns, fires/explosion) • Other occupational hazards 	Moderate	<ul style="list-style-type: none"> • All material will be arranged in a systematic manner with proper labelling and without any protrusion or extension onto the access corridor. The construction material for transmission tower will be kept at site and carried to individual towers as per requirement. • Loading and unloading operation of equipment shall be done under the supervision of a trained professional. • All work at height to be undertaken during daytime with sufficient sunlight. • The labour engaged for working at height shall be trained for temporary • Fall protection devices and use of personal fall arrest systems shall be ensured. • Proper PPEs shall be provided to workers handling welding, electricity and related components. • Fire extinguishing equipment shall be provided in adequate number on site to handle any possible fire outbreaks. • Effective work permit system for hot work, electrical work, working at height shall be ensured. 	Minor	Site Manager – INOX/ CWP-Devgarh

S. No.	Environmental Issues	Potential Impacts	Significance without mitigation measures	Mitigation Measures	Significance with mitigation measures	Responsibility
				<ul style="list-style-type: none"> Excess waste debris and liquid spills shall be cleaned up regularly to avoid slips and falls. 		
Operation Phase						
9.	Land/Soil Quality	<ul style="list-style-type: none"> During the operational phase of the project, small quantities of hazardous waste in the form of waste/used oil will be generated. This waste requires adequate disposal as per the requirements mandated under the Hazardous Waste (Management, Handling and Trans-boundary Movement) Rules, 2008. Any other hazardous waste like waste oil, paint containers will be disposed off to authorized vendors. Other waste will be disposed to local waste disposal area with permission of concerned authority/body. Very small quantity of solid waste will be generated by workers during project operation, and this material will be handled and disposed of in an approved manner; therefore no soil contamination will result. 	Minor	<ul style="list-style-type: none"> Waste oil generated shall be stored separately in containers in a secured location in the maintenance room. The storage location and the containers shall be properly marked. The waste/used waste oil from the WTGs shall be disposed off to a CPCB/SPCB authorized vendor. Transformer oil shall be returned to the manufacturers as per the agreement of purchase. A hazardous waste inventory shall be maintained as per the provisions of the Hazardous Waste (Management, Handling and Trans-boundary Movement) Rules, 2008. Care will be taken with regard to possible changes in soil quality due to human activities, such as disposal of waste material and domestic effluents on soil of the surrounding area. Waste water holding tanks / septic tank will be located at more than 500 m away from bore wells or any other underground water holding tanks in surrounding areas. 	Minor	Site Manager – INOX/ CWP- Devgarh
10.	Water Quality	<ul style="list-style-type: none"> Burden on local ground/surface water resources due to water demand of onsite personnel. Wastewater generated from site office. 	Minor	<ul style="list-style-type: none"> The water requirement during the operation phase of the project shall be met through authorised water tankers. It is recommended not to use bore well water for any of the project related activities. The drinking water requirement for the site personnel shall be met through packaged drinking water. Adequate number of septic tanks shall be provided for treatment of wastewater generated. 	Minor	Site Manager – INOX/ CWP- Devgarh
11.	Noise Environment	<ul style="list-style-type: none"> Noise generation due to operation of wind turbines. 	Moderate	<ul style="list-style-type: none"> Siting of WTGs to ensure that there is a minimum setback distance of 140 m from built structures and settlements as per IREDA guidelines. 	Minor	Site Manager – INOX/ CWP-

S. No.	Environmental Issues	Potential Impacts	Significance without mitigation measures	Mitigation Measures	Significance with mitigation measures	Responsibility
				<ul style="list-style-type: none"> • Wind turbines shall be designed in accordance with the international acoustic design standards. • Minimize the ground vegetation being cleared during site clearance activities and ensure re-vegetation of cleared areas • The wind turbines shall be maintained in good running conditions throughout the operational life of the project through routine maintenance • Implement a complaint resolution procedure to assure that any complaints regarding operational noise are promptly and adequately investigated and resolved; • Consult with the locals periodically to assess noise generation and set up a procedure to locate source of noise and steps taken to minimize them. 		Devgarh
12.	Ecology	<ul style="list-style-type: none"> • Bird Collision • Barrage effect • Modification of habitat 	Moderate	<ul style="list-style-type: none"> • There will be an adequate space between two turbines for movement of birds which would reduce the potential for accidental collision • Any dead animals/carcass shall be removed in time from the site so that it does not attract movement of scavenger birds. • Organize various afforestation (area around the turbine shall be re-vegetated at the earliest) and biodiversity conservation programmes in project area villages • A systematic data collection system process will be introduced at the farm site that could capture the actual damage to the fauna and a periodic reporting system on biodiversity conservation will also be developed. 	Minor	Site Manager – INOX/ CWP- Devgarh
13.	Socio-Economic Environment	<ul style="list-style-type: none"> • Visual Aesthetics • Electromagnetic Field (EMF) interference • Shadow flicker 	Minor	<ul style="list-style-type: none"> • The wind turbines shall be painted in light colour (white) to reduce the visibility of the turbine when seen from farther distances as they tend to appear to merge more with the surrounding area than if they were a darker colour. • Maintaining uniform size and design of turbines by 	Insignificant	Site Manager – INOX/ CWP- Devgarh

S. No.	Environmental Issues	Potential Impacts	Significance without mitigation measures	Mitigation Measures	Significance with mitigation measures	Responsibility
				having same direction of rotation, type of turbine and height. • Maintaining a minimum distance based on the formula prescribed by MEDA. • Reducing the occurrence of impacts due to blade glint by application of non-reflective paints. • Ensuring absence of any auxiliary structures except the required ones such as access roads and transformer yards which accompany the turbines.		
14.	Occupational Health and Safety	<ul style="list-style-type: none"> • Possible injuries associated with working at height ($\geq 2m$) • Electrical work injuries (eye injuries, shocks, burns, fires/explosion) • Other occupational hazards 	Moderate	<ul style="list-style-type: none"> • Work permit system shall be implemented for working at height (typically when working over 2m) and for hot jobs. • The use of safety belt and need for safety net as required shall be ensured. • All work at height shall be undertaken during daytime with sufficient sunlight • Integrity of structures shall be checked prior to undertaking work. • Fixtures shall be installed on tower components to facilitate the use of fall protection systems. • Only those workers who are trained in climbing techniques and use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment shall be engaged for work at height. • Wind turbines shall be equipped with an earthing system. • Personal Protective Equipment (PPEs) e.g., shock resistant rubber gloves, shoes, other protective gear etc. should be provided to workers handling electricity and related components. • The transformer yard should be provided with fire extinguishers and sand buckets at all strategic locations to deal with any incident of fire 	Minor	Site Manager – INOX/ CWP-Devgarh
Adequate budgetary provision shall be made by CWP-Devgarh for proper execution of Environmental Management Plan (EMP). The budget for ESMP implementation is covered under						

S. No.	Environmental Issues	Potential Impacts	Significance without mitigation measures	Mitigation Measures	Significance with mitigation measures	Responsibility
capital and operating cost of the project.						

7.8 Management Plans and Procedures

The section below gives an overview of the various management plans/procedures required to manage the key aspects of the proposed project. These management plans sets out the actions for monitoring and evaluation of the project during its various phases of life cycle. Following plans and procedures are described in detailed below:

- Occupational Health and Safety Management Plan
- Road Safety and Traffic Management Plan
- Emergency Management Plan
- Crane Safety Plan
- Community Liaison Plan
- Grievance Redressal Mechanism
- Community Property Replacement Plan

7.8.1 Occupational Health and Safety Management Plan

Scope and Purpose

The occupational health and safety (OHS) plan is formulated to address the key occupational health and safety related concerns of contractor workers and site personnel during both construction and operational phase. The plan will also be serving as a reference document for finalization of safety procedures with respect to construction and operational activities. The mitigation measures to be implemented both during construction and operational phase have been discussed below:

- The onsite workers shall be provided with proper personal protective equipment (PPEs) i.e. safety shoes & goggle, helmet, coverall, gloves, ear plugs, safety harness in case working at height etc. during construction related activities to ensure health and safety of the workers at workplace.
- The contractor workers during construction phase, in case of non-local workers, will be housed in labor camps with provision of cooking fuel, sanitation facilities, potable water supply and medical health care center.
- First aid and onsite sanitation arrangements will be made for drivers and other contractor workers during construction phase.
- Periodic health surveillance will be undertaken for personnel operating near high noise generating equipment viz. turbines, compressors etc. The audiometric records will be maintained for treatment for hearing loss, if any.
- All high noise generating areas and equipment will be identified and rotation of workers/site personnel including provision of proper PPEs for those operating in such areas.

- All the workers involved in working at height should be provided with safety harness.
- Adequate light and ventilation shall be provided for the workers working in confined spaces.
- Passageways for pedestrians and vehicles within and outside buildings should be segregated and provide for easy, safe, and appropriate access
- Equipment and installations requiring servicing, inspection, and/or cleaning should have unobstructed, unrestricted, and ready access
- Hand, knee and foot railings should be installed on stairs, fixed ladders, platforms, permanent and interim floor openings, loading bays, ramps, etc.
- Provision of first-aid kits at all work-areas onsite. Appropriately equipped first-aid stations should be easily accessible throughout the place of work
- Eye-wash stations will be provided close to all workstations where immediate flushing with water is the recommended first-aid response
- Safety signage and posters will be displayed at strategic locations within the site. Hazardous areas (electrical rooms, compressor rooms, etc.), installations, materials, safety measures, and emergency exits, etc. should be marked appropriately.
- Monitoring weather forecasts for outdoor work to provide advance warning of extreme weather and scheduling work accordingly
- Providing temporary shelters onsite for protection of workers against extreme weather condition during working activities or for use as rest areas.
- Provisions should be made to provide OHS orientation training to all new employees to ensure they are apprised of the basic site rules of work at / on the site and of personal protection and preventing injury to fellow employees.
- Training should consist of basic hazard awareness, site specific hazards, safe work practices, and emergency procedures for fire, evacuation, and natural disaster, as appropriate. Any site-specific hazard or color coding in use should be thoroughly reviewed as part of orientation training.
- Establishment of procedures and systems for reporting and recording occupational accidents and diseases. All reported occupational accidents; occupational diseases together with near misses should be investigated with the assistance of a person knowledgeable/competent in occupational safety.

CWP-Devgarh will comply with all the EHS guidelines of IFC.

7.8.2 Road Safety and Traffic Management Plan

Scope and Purpose

The plan encompasses the addressal of community safety related impacts that may arise from the increased vehicular traffic due to movement of heavy equipment/machinery and vehicles along the site access and approach roads particularly during construction phase. The plan will be regularly updated by the contractor with the project progress and as vehicle movement requirements are identified in detail. Designated traffic coordinator will be responsible for overall coordination of traffic management.

Construction Phase

The following mitigation measures will be implemented during this phase:

- Project vehicular movement will be restricted to defined access routes.
- Proper signage will be displayed at important traffic junctions along the vehicular access routes to be used by construction phase traffic. The signage will serve to prevent any diversion from designated routes and ensure proper speed limits are maintained near residential areas.
- Any road diversions and closures will be informed in advance to the project vehicles accessing the above route. Usage of horns by project vehicles will be restricted near sensitive receptors viz. schools, settlements etc.
- Traffic flows will be timed wherever practicable during period of increased commuter movement in the day.
- Temporary parking facilities shall be provided within the work areas and the construction sites to avoid road congestion.
- Vehicular movement to be controlled near sensitive locations viz. schools, colleges, hospitals identified along designated vehicular transportation routes.
- Routine maintenance of project vehicles will be ensured to prevent any abnormal emissions and high noise generation.
- Adequate training on traffic and road safety operations will be imparted to the drivers of project vehicles. Road safety awareness programs will be organized in coordination with local authorities to sensitize target groups viz. school children, commuters on traffic safety rules and signages.
- The contractor(s) shall frame and implement a “No Drug No Alcohol” Policy to prevent road accidents/incidents.

Operational Phase

Since limited vehicular movement is anticipated during operational phase considering the daily movement of project personnel any impacts arising from the same can be

effectively addressed through implementation of mitigation measures as discussed during the construction phase. In addition, the following measures will be emphasized:

- Use of horns near the villages along the access road to villages, main plant and internal roads shall be restricted.
- The vehicular movements along the access roads and highways shall be restricted during the night time.
- All the vehicles entering the access roads and plant shall have Pollution under Control (PUC) certificates.
- The speed limit in the internal roads shall be restricted to 20 km/hr. Proper warning signs and road safety awareness posters shall be displayed to create road safety awareness among the personnel accessing the site.
- Periodic Road Safety and Traffic Management campaigns and awareness sessions shall be carried out among the villagers and the plant workers/personnel to develop road safety awareness among the people likely to be impacted by the project.
- An emergency road safety plan shall be framed by the Proponent to combat any emergency conditions/accidents along the highways, access roads and within plant area.
- The Proponent shall frame and implement a “No Drug No Alcohol” Policy to prevent road accidents/incidents.
- The drivers shall be given an induction on road safety and traffic management policy.
- A permanent parking lot shall be provided within the main plant site (in individual work areas) and the associated facilities.
- Use of seat belts for both drivers and passengers shall be made compulsory to minimize death & injuries in the event of an accident.

7.8.3 Emergency Management Plan

Purpose

CWP-Devgarh will develop a site specific Emergency Management Plan for implementation at the proposed site in the event of an emergency situation so that the loss of life and damage to properties and natural resources are minimized. This plan will outline a series of emergency actions that will be executed by the CWP-Devgarh and INOX and other sub-contractors to ensure preparedness and response to emergency situations throughout the life-cycle of the project.

Emergencies

The emergency situations that are probable to occur at the site and the probable causes are listed below:

- Fire at site during temporary construction phase which cannot be doused by fire extinguishers. Also fire due to short circuit at the project site and equipment during both construction & operation phase.
- Collapse of any structure
- Outbreak of endemic disease among a large section of construction workers due to contaminated drinking water, unhygienic conditions that have developed at workplace etc.
- Protests by the local community or other stakeholders at any point of the project lifecycle due to grievances
- Flood at the project site stranding staff or contracted workers at the site and earthquake in the region
- Serious injury or death of employee or sub-contracted worker at work, due to non-work related illness or work-related accident.

Emergency Management

The following steps shall be taken to ensure proper management of emergency or crisis situations:

- The nearest civil hospital, private health care centers or practitioner clinic shall be identified and an agreement shall be made with the aforesaid medical centers/practitioners to provide prompt health care services (including ambulance services) in the event of an emergency situation at site.
- A list of important telephone numbers such as fire brigade, health care facility/practitioner, police station, EHS and Social Coordinator, project office, head offices etc. shall be displayed at all the prime locations at site and the worker's camp (during construction phase).
- Regular networking with the police, Gram Panchayat, district administration shall be carried out to ensure that prompt assistance is readily available in the event of an emergency.

An Emergency Management (including Disaster Management) team comprising of 4-6 professionals both from CWP-Devgarh and INOX's side, during construction phase and 2-3 professionals during operation of the proposed project, shall be formed to combat any emergency situation arising at site and ensure safety of the life and property at site. For this purpose, 2-3 personnel employed at the site shall be trained on Emergency scenarios and their management measures including their roles and responsibilities in case of an emergency situation.

In case of an emergency, all site personnel shall be trained to follow the communication lines given below:

- Personnel at site affected by the emergency situations immediately inform the project office and the external agencies (such as police, fire brigade, ambulance

services); In case, project office cannot be reached, the Coordinator will be informed directly;

- The Social, Environment, Health & Safety Coordinator (SEHS) on being informed about the emergency by project offices or by the employee directly; reaches site if necessary, and also follows-up with the aforesaid external agencies for aid;
- The SEHS Coordinator takes charge of the emergency response and direct further action and co-ordination, including escalating the matter to the CEO or other top-level managers as required.

Responsibilities

The SEHS Coordinator will be responsible for implementing this procedure, which includes:

- Ensuring that the emergency preparedness measures are in place;
- Providing training to the personnel at site regarding reporting of the emergencies, and to site office personnel regarding response to emergency calls from the site personnel,
- Direct action-and co-ordination at the time of an emergency.

7.8.4 Crane Safety Plan

Introduction

A crane is a type of machine, generally equipped with a hoist, wire ropes or chains, and sheaves, that can be used both to lift and lower materials and to move them horizontally. It's mainly used for lifting heavy things and transporting them to other places. In the proposed wind farm project cranes will be used during the erection and commissioning phase of the WTG's and for installing the turbine components while erecting the towers.

Cranes are designed and tested for lifting heavy loads to great height. Hence, they involve a risk of catastrophic accidents if safe operating practices are not adhered to. The possible consequences of a crane failure include:

- Loss of life
- Short/Long term disruption in the project
- Payment of insurance and compensation costs by the project proponent/crane manufacturer
- Litigation costs (if any)

Crane safety measures are project specific and the safety measures/guidelines that must be implemented with respect to this project have been described in the following section.

Safety Measures

Table 7.2 presents the components of the crane safety plan.

Table 7.2 : Crane Safety Plan

S. No.	Safety Aspect	Precautions/Safety Measures to be taken
1.	Equipment Requirements	<ul style="list-style-type: none"> It shall be ensured that every crane is equipped with a legible, durable load chart that shows the manufacturer's recommended load configurations and maximum load weights. The chart must be securely attached to the cab and easily visible to operators when they are seated at the control station. The crane shall be equipped with an automatic safe load indicator and every crane shall be clearly marked for its safe working load. Crane operator cabin shall be provided with suitable seat, foot rest and protection from vibration. The cabin shall have adequate ventilation and be equipped with a suitable fire extinguisher.
2.	Operator Training and Certification	<ul style="list-style-type: none"> The crane operators must be physically fit and thoroughly trained and competent enough to operate the specific type of crane. The operators must possess certificates indicating their competence or they shall be trained/tested for the operation of the specific crane used in the project prior to commencement of construction.
3.	Wind/Weather Considerations	<ul style="list-style-type: none"> It shall be ensured that recommendations pertaining to wind (speed, direction) as mentioned in component/crane manufacturer's chart is strictly adhered to. Wind speeds at the time of operation shall be determined using a boom tip anemometer. A lightning safety plan shall also be in place.
4.	Communication	<ul style="list-style-type: none"> It shall be ensured that qualified, designated people are assigned the responsibilities required to safely and properly signal the crane to components into place. Proper methods/ tools (e.g. hand signals, radio) shall be used for signalling purposes.
5.	Ground Pressures and Travel Routes	<ul style="list-style-type: none"> The bearing capacity of the ground shall be determined prior to lifting of heavy loads. During all major component lifts, crane mats shall be placed on top of the crane pad to minimise the damages to be incurred.

S. No.	Safety Aspect	Precautions/Safety Measures to be taken
6.	Crane Travel Limits	<ul style="list-style-type: none"> All cranes shall have a published chart indicating the operating guidelines for moving the crane. Considerations for the maximum percent grade, side slope and boom position shall be accounted for when planning the roadways and especially when moving the crane. All overhead obstacles shall be discussed prior to marking the safe travel route for the cranes.
7.	Lift Area Control	<ul style="list-style-type: none"> A safe zone for all non-essential personnel shall be established once the crane is ready to make a lift. Essential personnel operations shall be planned and supervised so that no one is working under the boom or lifting component.
8.	Lift Plans	<ul style="list-style-type: none"> Lift plans shall be provided for each major component lift to the crane operator prior to performing the work. Operator shall keep the lift plans on hand to ensure that each lift falls within the plans made. Lift plans shall have basic information such as crane configuration, component weights, rigging requirements and weights, crane capacities, crane pad requirements etc.

Employer's Responsibility

The employer/construction contractor has the following responsibilities with respect to crane safety:

- Implement all the safety measures as mentioned in the crane safety plan.
- Supervise the crane operations to ensure that the safety measures are strictly adhered to.
- Conduct periodic inspection of the cranes employed in the project

During inspection, the inspecting officer must check that:

- All the cranes deployed in the project have a valid Certificate of Fitness as prescribed under Section 56 of The Central Motor Vehicles Rules, 1989.
- The certificates of fitness are as per the format prescribed under Form 38 of the aforementioned rules.
- The crane has been provided with a Load Safety Certificate.
- The equipment/components of the deployed cranes are in good condition and not subjected to loads greater than the limits mentioned in the load chart.
- The safety measures mentioned in the plan are strictly adhered to.

7.8.5 Community Liaison Plan

Introduction

The Community Liaison Plan is a critical element of the overall Social Management Plans. Regular transparent communication between the project proponent and the communities and vice versa is crucial in building positive relationships between the two parties. This relationship should be crucial for managing unexpected situations which might arise during the course of the project.

This plan should be read with other social management plan because the liaison which needs to be done for the individual plan is detailed within the plan. The communication plan mainly focuses on the communication issues during the construction stage however it also includes some community Liaison measures for the operation phase as well.

Objectives

The Performance Standards mandates continuous communication between project and the different stakeholders, i.e. workers, local community, etc. The onus of initiating the process of communication rests on the project proponent. The project proponent should ensure that disclosure of relevant project information that would help the affected communities understand the risks, impacts and opportunities of the project. The Community Liaison Plan is developed to ensure a clear communication channel between the project and the local community.

Community Liaison Plan

The community liaison plan would concentrate on the following aspects:

- **Communication with the Community:** As mandated in the Performance standards, CWP-Devgarh should disclose the project details to make the community aware of the important features of the project. A Project Information Booklet should be prepared and distributed in the project affected villages. This booklet should preferably be presented in local language. The booklet in addition to containing the salient features of the project should have a map depicting the boundaries of the plant and its ancillary facilities. The important landmarks e.g. the settlement, schools and the roads, etc. should also be demarcated so that it becomes easy for the people in the villages to relate to the ground conditions. In addition to the project information, the booklet should also highlight the impacts on the community as presented in the ESIA document and the commitments for the safeguards including the entitlement matrix. To ensure wide circulation of the Project Information Booklet, the booklet should be made available at all the schools, Anganwadi centers, and other public facilities in the project affected village.
- To ensure continuity of the flow of information to the community, it is suggested that a quarterly Community Information Booklet should be published. During the construction phase, the booklet should contain the information about the progress of the project and also information which are pertinent to community

e.g. disruption of the transportation links, outcome of consultation process on community development etc. It is proposed that the Community Information Booklet be continued even during the operation stage.

7.8.6 Grievance Redressal Mechanism

The IFC requires that the client will establish a grievance mechanism to receive and address specific concerns about compensation and relocation that are raised by displaced persons or members of host communities, including a recourse mechanism designed to resolve disputes in an impartial manner. If the client anticipates ongoing risks to or adverse impacts on affected communities, the client will establish a grievance mechanism to receive and facilitate resolution of the affected communities' concerns and grievances about the client's environmental and social performance. The grievance mechanism should be scaled to the risks and adverse impacts of the project. It should address concerns promptly, using an understandable and transparent process that is culturally appropriate and readily accessible to all segments of the affected communities, and at no cost and without retribution. The mechanism should not impede access to judicial or administrative remedies. The client will inform the affected communities about the mechanism in the course of its community engagement process.

In efforts to develop an effective two way communication a Grievance Redressal Mechanism would be developed by proponent. The broad outline of the mechanism is as follows:

- The decision on the grievance would be communicated to the aggrieved person within a timeframe to be stipulated during the preparation of the ESMP.
- There should be a single point of contact between the community and proponent for the Redressal of grievance.
- All grievances should be documented and indexed for future reference. The proceeding and actions against each of the grievance should be documented and should also carry this index number for easy traceability.
- If required the aggrieved community member can also be made a part of the Redressal process so he is able to place his point of view.
- The Grievance Redressal committee should meet at regular interval and discuss on the grievance and take necessary action.

Communication with Contractor Staff: During the construction phase, there would be an influx of people into the project area. As these people would have cultural differences with the resident population, there is a potential of conflicts arising because of issues related to safety and privacy issues of the women in the surrounding villages, spread of various communicable diseases, nuisance caused by workers due to improper sanitation facilities, etc. It is thus proposed a **Community Interaction Brochure** be prepared specifically stating the 'Dos' and 'Don'ts' and requesting proper behavioral actions and discipline amenable with the local customs and traditions during their association with the project. This Community Interaction Brochure should be made available to all

employees during their induction into the project and also when they report back to the project after leave or absence. A record of the induction or refresher on the community interaction should be maintained.

Responsibility

CWP-Devgarh in association with INOX should prepare all the information disclosure booklets as discussed above. They would also ensure circulation of the booklet among the community in the project affected villages.

CWP-Devgarh would also ensure that the Grievance Redressal Mechanism is developed. It would also ensure that the system is made community friendly so that the people who have grievance are encouraged to come forward and register their grievance. It would also ensure that the grievance of the community is discussed and recorded. It would ensure that the issues are closed to the satisfaction of the community members.

During construction, CWP-Devgarh and its contractors should ensure that each of the people working on the project is aware of the Do's and Don'ts of community interaction. CWP-Devgarh and the contractors should ensure that the record of the induction and refresher is maintained as well. All the resources required for the implementation of the different sub-components of the plan should also be provided by CWP-Devgarh and its contractors.

7.8.7 Community Property Replacement Plan

Introduction

In addition to the land requirement and associated direct impacts due to the project, there would be some community properties/resources⁵ which may get impacted either directly or indirectly due to the project during the construction activities. CWP-Devgarh should take responsibility of all such damages to community property and should replace/ repair such property.

Objective

The Community Property Replacement Plan is directed towards replacing property which has already been identified would be affected due to this project and also lay down a guideline for replacement of all community property which might be affected due to the project.

Plan for Replacement of Community Property

During the development of project, some of village roads may get affected due to heavy machinery. CWP-Devgarh has planned and is in process of development of roads in consultation with concerned villages so that the community will not get affected. Further, it is suggested that the plans for the proposed road should be developed through a participatory process with the involvement of villages.

⁵ Common Property Resources cover all types of natural resources which are shared by a group of people or communities,

Common Property Resource: During the construction phase, there might be some sharing of resources by the villagers and the workers working on the project. To an extent feasible, this should be avoided to prevent potential conflicts between the project and the community. The movement of heavy vehicles and machineries might lead to conditions like disruption of electric wires and telephone wires in the project area and along transportation routes. All these damage utilities should be repaired / replaced to normal conditions, at the earliest. An account of the damage to the community resource should be documented and the root cause analysis carried out. The findings of the root cause analysis should also be documented and discussed with the agency/agencies found responsible for the incident. No water should be extracted from surface water bodies which are used by the community for drinking or domestic purpose. Any vacant or barren land, not assigned for project, should not be used for storage of fill/construction material, wastes, etc.

Responsibility

CWP-Devgarh should take responsibility for construction of the road before the existing road is diverted / closed for use by villagers. CWP-Devgarh (through the implementing agency) should start the process of dialogue with the community to decide on the alignment of the road and also fix up the likely time line for the construction.

CWP-Devgarh and its contractors should ensure that the sharing of community resource is minimized by organizing necessary support infrastructure/facilities within premises. However, in case where sharing would be essential, CWP-Devgarh (including contractors) should have an agreement with the Gram Panchayats for the sharing of the resource. In case of damage to community property, CWP-Devgarh (including its contractors) should ensure that it is repaired or replaced to the satisfaction of the community at the earliest. CWP-Devgarh should maintain documentation of all incidents of damages to the community property. All cost for repair/replacement should be borne by CWP-Devgarh /Contractor.

As part of the ESMS proposed, a system should also be developed for recording such incidents and tracking the incident till it is closed to the satisfaction of the community.

8. SUMMARY AND CONCLUSIONS

This chapter concludes on the findings that emerged from the environmental assessment study and summarizes the key points to be addressed to ensure the environmental sustainability of the project during the construction and operation phases.

The environmental and social impacts due to the construction and operation of 40 MW Jaisalmer Wind Farm have been assessed for the ESIA study. The impacts due to the project is minimal, site specific and has reversible impacts on the micro environment of the project site owing to the construction activities and noise generation from the WTGs.

Mitigation measures for potential impacts on physical, social and biological aspects of the environment have been specified through:

- Adequate arrangements for construction safety, stakeholder engagement and grievance redress mechanism
- Stringent adherence to Health and Safety requirements
- Obtaining requisite permits required for the proposed project

The proposed ESMP describes implementation mechanism for recommended mitigation measures together with monitoring to verify overall project performance.

Based on the ESIA study conducted, the proposed Wind Farm can be categorized as Category B (as per IFCs categorization of projects), which specifies that this project does not have any potential significant adverse social or environmental risks or/and impacts. The rationale for categorization being:

- The project being a wind power project does not have significant adverse impacts associated with the construction or operation activities
- The private land being procured for the project comprises of open grass and shrub land and there is no physical or economic displacement associated with the project
- The private land involved for the project is procured on willing seller-willing buyer basis with individual negotiation with the land owners
- There are no settlements/receptors within 300 m of the WTGs and hence issues due to shadow flicker or noise generation are assessed to be minor

Annexure I – Output Files of the Noise Analysis

Project: **Jaisalmer_JUNE** Description: **40 MW Wind Farm in district of Jaisalmer** Printed/Page: **6/25/2015 4:35 PM / 1**
 Licensed user: **EQMS India Private Limited**
 304 & 305, 3RD Floor, Plot No. 16 Rishabh Towers, Community Center IN-KARKARDUMA Delhi 110 092
 0091-11-30003206
 EQMS / eqms@eqmsindia.org
 Calculated: **6/25/2015 4:35 PM/2.9.285**

DECIBEL - Main Result

Calculation: Ambient Day (Bonada)

Noise calculation model:

ISO 9613-2 General

Wind speed:

4.0 m/s - 10.0 m/s, step 2.0 m/s

Ground attenuation:

General, Ground factor: 0.0

Meteorological coefficient, C0:

2.0 dB

Type of demand in calculation:

2: WTG plus ambient noise is compared to ambient noise plus margin (FR etc.)

Noise values in calculation:

All noise values are mean values (Lwa) (Normal)

Pure tones:

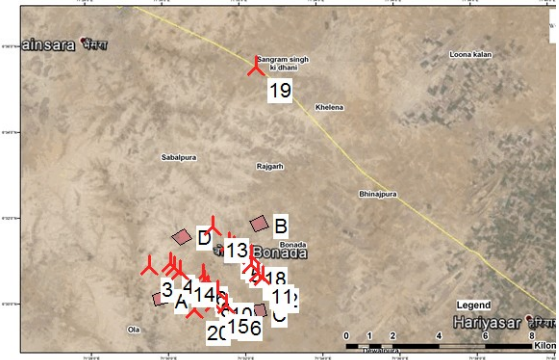
Pure and Impulse tone penalty are added to WTG source noise

Height above ground level, when no value in NSA object:

4.0 m Don't allow override of model height with height from NSA object

Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:

0.0 dB(A)



Scale 1:400,000
 New WTG Noise sensitive area

WTGs

Geo [deg]-WGS84 Longitude	Latitude	Z [m]	Row data/Description	WTG type			Noise data										
				Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Creator	Name	First wind speed [m/s]	LwaRef [dB(A)]	Last wind speed [m/s]	LwaRef [dB(A)]	Pure tones	
1	71.546570° East	26.517700° North	290.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
2	71.543925° East	26.519642° North	290.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
3	71.501479° East	26.508319° North	300.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
4	71.512562° East	26.509659° North	293.6	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
5	71.548484° East	26.515347° North	290.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
6	71.530213° East	26.504095° North	287.4	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
7	71.530362° East	26.501268° North	286.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
8	71.532480° East	26.498640° North	283.4	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
9	71.514827° East	26.507742° North	291.4	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
10	71.537719° East	26.496508° North	280.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
11	71.559342° East	26.505172° North	281.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
12	71.561811° East	26.503413° North	284.8	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
13	71.535308° East	26.527394° North	294.7	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
14	71.517904° East	26.506262° North	290.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
15	71.535886° East	26.490702° North	280.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
16	71.542376° East	26.489855° North	280.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
17	71.555455° East	26.509420° North	287.1	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
18	71.555423° East	26.513436° North	287.5	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
19	71.558078° East	26.604077° North	298.5	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
20	71.525477° East	26.487484° North	282.1	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a

a) Generic data based on turbine power (very uncertain)

Calculation Results

Sound Level

Noise sensitive area No.	Name	Geo [deg]-WGS84		Z [m]	Demands		Sound Level				Distance to noise demand [m]	Demands fulfilled ?
		Longitude	Latitude		Imission height [m]	Max Additional exposure [dB(A)]	Max Noise demand [dB(A)]	Max From WTGs [dB(A)]	Max Ambient+WTGs [dB(A)]	Max Additional exposure [dB(A)]		
A	Bonada Receptor 1	71.510818° East	26.497235° North	290.0	4.0	0.0	55.0	40.6	52.3	0.3	1,058	Yes
B	Bonada Receptor 2	71.557371° East	26.524981° North	283.9	4.0	0.0	55.0	40.1	52.3	0.3	1,140	Yes
C	Bonada Rec 3	71.556186° East	26.489376° North	277.0	4.0	0.0	55.0	38.5	52.2	0.2	1,240	Yes
D	Bonada Rec 4	71.517648° East	26.518677° North	294.7	4.0	0.0	55.0	40.5	52.3	0.3	963	Yes

Project:

Jaisalmer_JUNE

Description:

40 MW Wind Farm in district of Jaisalmer

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Calculated:

6/25/2015 4:35 PM/2.9.285

DECIBEL - Main Result**Calculation:** Ambient Day (Bonada)**Distances (m)**

WTG	A	B	C	D
1	4226	1346	3283	2326
2	4131	1465	3571	2030
3	1481	5828	5846	1952
4	1388	4765	4897	1121
5	4259	1388	2979	2575
6	2078	3563	3061	2031
7	2000	3763	2893	2307
8	2138	3832	2578	2666
9	1231	4652	4600	1244
10	2592	3715	2004	3138
11	4911	2204	1655	4010
12	5106	2431	1435	4318
13	4140	1951	4700	1301
14	1225	4449	4252	1376
15	2349	4362	2030	3595
16	3000	4171	1378	4009
17	4652	1735	2193	3456
18	4797	1294	2630	3299
19	12745	7922	12599	9421
20	1382	5233	3070	3544

Project: Jaisalmer_JUNE	Description: 40 MW Wind Farm in district of Jaisalmer	Printed/Page: 6/25/2015 4:32 PM / 1
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		Calculated: 6/25/2015 4:32 PM/2.9.285

DECIBEL - Main Result

Calculation: Ambient Day (Khelana)

Noise calculation model:

ISO 9613-2 General

Wind speed:

4.0 m/s - 10.0 m/s, step 2.0 m/s

Ground attenuation:

General, Ground factor: 0.0

Meteorological coefficient, C0:

2.0 dB

Type of demand in calculation:

2: WTG plus ambient noise is compared to ambient noise plus margin (FR etc.)

Noise values in calculation:

All noise values are mean values (Lwa) (Normal)

Pure tones:

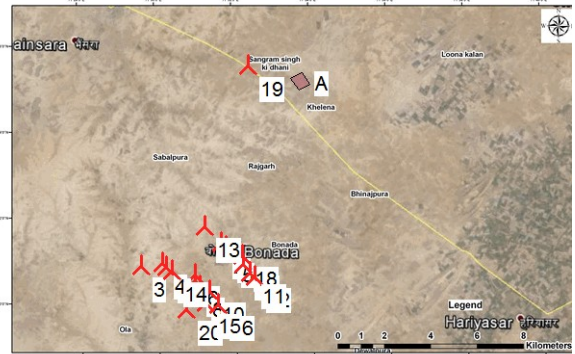
Height and Impulse tone penalty are added to WTG source noise

Height above ground level, when no value in NSA object:

4.0 m Don't allow override of model height with height from NSA object

Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:

0.0 dB(A)



Scale 1:400,000

New WTG

Noise sensitive area

WTGs

Geo [deg]-WGS84 Longitude	Latitude	Z [m]	Row data/Description	WTG type			Noise data									
				Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Creator	Name	First wind speed [m/s]	LwaRef [dB(A)]	Last wind speed [m/s]	LwaRef [dB(A)]	Pure tones
1	71.546570° East	26.517700° North	290.0 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	
2	71.543925° East	26.519642° North	290.0 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	
3	71.501479° East	26.508319° North	300.0 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	
4	71.512562° East	26.509659° North	293.6 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	
5	71.548484° East	26.515347° North	290.0 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	
6	71.530213° East	26.504095° North	287.4 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	
7	71.530362° East	26.501268° North	286.0 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	
8	71.532480° East	26.498640° North	283.4 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	
9	71.514827° East	26.507742° North	291.4 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	
10	71.537719° East	26.496508° North	280.0 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	
11	71.559342° East	26.505172° North	281.0 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	
12	71.561811° East	26.503413° North	284.8 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	
13	71.535308° East	26.527394° North	294.7 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	
14	71.517904° East	26.506262° North	290.0 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	
15	71.535886° East	26.490702° North	280.0 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	
16	71.542376° East	26.489855° North	280.0 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	
17	71.555455° East	26.509420° North	287.1 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	
18	71.555423° East	26.513436° North	287.5 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	
19	71.558078° East	26.604077° North	298.5 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	
20	71.525477° East	26.487484° North	282.1 Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a	

a) Generic data based on turbine power (very uncertain)

Calculation Results

Sound Level

Noise sensitive area No.	Name	Geo [deg]-WGS84		Z [m]	Demands			Sound Level			Distance to noise demand [m]	Demands fulfilled ? Noise
		Longitude	Latitude		Imission height [m]	Max Additional exposure [dB(A)]	Max Noise demand [dB(A)]	Max From WTGs [dB(A)]	Max Ambient+WTGs [dB(A)]	Max Additional exposure [dB(A)]		
A	Khelana Receptor	71.580441° East	26.598378° North	290.0	4.0	0.0	55.0	26.7	50.3	0.0	2,194	Yes

Distances (m)

WTG	A
1	9144
2	9065
3	12514
4	11691
5	9305
6	11229

To be continued on next page...

Project: **Jaisalmer_JUNE** Description: 40 MW Wind Farm in district of Jaisalmer

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DECIBEL - Main Result

Calculation: Ambient Day (Khelana)

...continued from previous page

WTG	A
7	11497
8	11657
9	11723
10	11648
11	10023
12	10153
13	8763
14	11676
15	12311
16	12156
17	9679
18	9257
19	2316
20	13076

Project: Jaisalmer_JUNE	Description: 40 MW Wind Farm in district of Jaisalmer	Printed/Page: 6/25/2015 5:14 PM / 1
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		Calculated: 6/25/2015 5:14 PM/2.9.285

DECIBEL - Main Result

Calculation: Ambient Day (Barmer Road)

Noise calculation model:

ISO 9613-2 General

Wind speed:

4.0 m/s - 10.0 m/s, step 2.0 m/s

Ground attenuation:

General, Ground factor: 0.0

Meteorological coefficient, C0:

2.0 dB

Type of demand in calculation:

2: WTG plus ambient noise is compared to ambient noise plus margin (FR etc.)

Noise values in calculation:

All noise values are mean values (Lwa) (Normal)

Pure tones:

Pure and Impulse tone penalty are added to WTG source noise

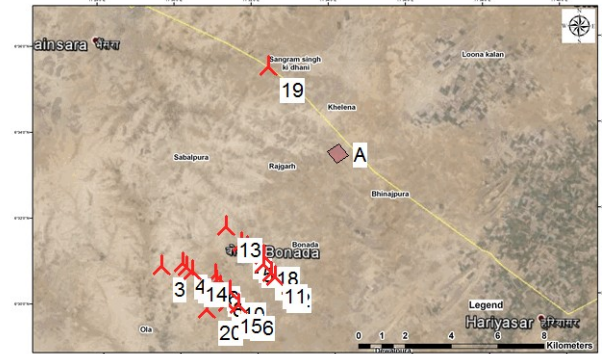
Height above ground level, when no value in NSA object:

4.0 m Don't allow override of model height with height from NSA object

Deviation from "official" noise demands. Negative is more restrictive,

positive is less restrictive.:

0.0 dB(A)



Scale 1:400,000
▲ New WTG
 Noise sensitive area

WTGs

Geo [deg]-WGS84 Longitude	Latitude	Z [m]	Row data/Description	WTG type			Noise data									
				Valid	Manufact.	Type-generator	Creator	Name	First wind speed [m/s]	LwaRef [dB(A)]	Last wind speed [m/s]	LwaRef [dB(A)]	Pure tones			
1 71.546570° East	26.517700° North	290.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
2 71.543925° East	26.519642° North	290.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
3 71.501479° East	26.508319° North	300.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
4 71.512562° East	26.509659° North	293.6	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
5 71.548484° East	26.515347° North	290.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
6 71.530213° East	26.504095° North	287.4	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
7 71.530362° East	26.501268° North	286.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
8 71.532480° East	26.498640° North	283.4	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
9 71.514827° East	26.507742° North	291.4	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
10 71.537719° East	26.496508° North	280.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
11 71.559342° East	26.505172° North	281.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
12 71.561811° East	26.503413° North	284.8	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
13 71.535308° East	26.527394° North	294.7	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
14 71.517904° East	26.506262° North	290.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
15 71.535886° East	26.490702° North	280.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
16 71.542376° East	26.489855° North	280.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
17 71.555455° East	26.509420° North	287.1	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
18 71.555423° East	26.513436° North	287.5	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
19 71.558078° East	26.604077° North	298.5	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
20 71.525477° East	26.487484° North	282.1	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a

a) Generic data based on turbine power (very uncertain)

Calculation Results

Sound Level

Noise sensitive area No.	Name	Geo [deg]-WGS84		Z [m]	Imission height [m]	Demands		Sound Level			Demands fulfilled ? Noise
		Longitude	Latitude			Max Additional exposure [dB(A)]	Max Noise demand [dB(A)]	Max From WTGs [dB(A)]	Max Ambient+WTGs [dB(A)]	Max Additional exposure [dB(A)]	
A	Barmer Road Receptor	71.594177° East	26.557817° North	280.0	4.0	0.0	75.0	24.5	54.5	0.0	Yes

Distances (m)

WTG	A
1	6504
2	6558
3	10660
4	9681
5	6551
6	8725

To be continued on next page...

Project: **Jaisalmer_JUNE** Description: 40 MW Wind Farm in district of Jaisalmer

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DECIBEL - Main Result

Calculation: Ambient Day (Barmer Road)

...continued from previous page

WTG	A
7	8932
8	8993
9	9638
10	8824
11	6791
12	6839
13	6686
14	9504
15	9440
16	9134
17	6609
18	6255
19	5498
20	10378

Project: **Jaisalmer_JUNE** Description: **40 MW Wind Farm in district of Jaisalmer**

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 Calculated:
6/25/2015 4:38 PM/2.9.285

DECIBEL - Main Result

Calculation: Ambient Night (Bonada)

Noise calculation model:

ISO 9613-2 General

Wind speed:

4.0 m/s - 10.0 m/s, step 2.0 m/s

Ground attenuation:

General, Ground factor: 0.0

Meteorological coefficient, C0:

2.0 dB

Type of demand in calculation:

2: WTG plus ambient noise is compared to ambient noise plus margin (FR etc.)

Noise values in calculation:

All noise values are mean values (Lwa) (Normal)

Pure tones:

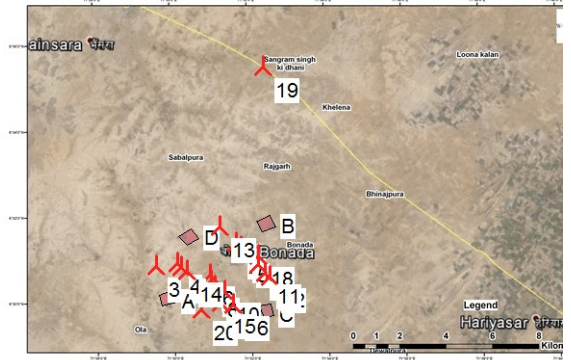
Pure and Impulse tone penalty are added to WTG source noise

Height above ground level, when no value in NSA object:

4.0 m Don't allow override of model height with height from NSA object

Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:

0.0 dB(A)



Scale 1:400,000

New WTG

Noise sensitive area

WTGs

Geo [deg]-WGS84 Longitude	Latitude	Z [m]	Row data/Description	WTG type			Noise data										
				Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Creator	Name	First wind speed [m/s]	LwaRef [dB(A)]	Last wind speed [m/s]	LwaRef [dB(A)]	Pure tones	
1	71.546570° East	26.517700° North	290.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
2	71.543925° East	26.519642° North	290.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
3	71.501479° East	26.508319° North	300.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
4	71.512562° East	26.509659° North	293.6	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
5	71.548484° East	26.515347° North	290.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
6	71.530213° East	26.504095° North	287.4	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
7	71.530362° East	26.501268° North	286.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
8	71.532480° East	26.498640° North	283.4	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
9	71.514827° East	26.507742° North	291.4	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
10	71.537719° East	26.496508° North	280.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
11	71.559342° East	26.505172° North	281.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
12	71.561811° East	26.503413° North	284.8	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
13	71.535308° East	26.527394° North	294.7	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
14	71.517904° East	26.506262° North	290.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
15	71.535886° East	26.490702° North	280.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
16	71.542376° East	26.489855° North	280.0	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
17	71.555455° East	26.509420° North	287.1	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
18	71.555423° East	26.513436° North	287.5	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
19	71.558078° East	26.604077° North	298.5	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
20	71.525477° East	26.487484° North	282.1	Hyundai HQ2000-WT93 60Hz ...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a

a) Generic data based on turbine power (very uncertain)

Calculation Results

Sound Level

Noise sensitive area No.	Name	Geo [deg]-WGS84		Z [m]	Demands		Sound Level				Distance to noise demand [m]	Demands fulfilled ?
		Longitude	Latitude		Imission height [m]	Max Additional exposure [dB(A)]	Max Noise demand [dB(A)]	Max From WTGs [dB(A)]	Max Ambient+WTGs [dB(A)]	Max Additional exposure [dB(A)]		
A	Bonada Receptor 1	71.510818° East	26.497235° North	290.0	4.0	0.0	45.0	40.6	44.1	2.5	504	Yes
B	Bonada Receptor 2	71.557371° East	26.524981° North	283.9	4.0	0.0	45.0	40.1	43.9	2.3	560	Yes
C	Bonada Rec 3	71.556186° East	26.489376° North	277.0	4.0	0.0	45.0	38.5	43.3	1.7	856	Yes
D	Bonada Rec 4	71.517648° East	26.518677° North	294.7	4.0	0.0	45.0	40.5	44.1	2.5	474	Yes

Project:

Jaisalmer_JUNE

Description:

40 MW Wind Farm in district of Jaisalmer

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Calculated:

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DECIBEL - Main Result**Calculation:** Ambient Night (Bonada)**Distances (m)**

WTG	A	B	C	D
1	4226	1346	3283	2326
2	4131	1465	3571	2030
3	1481	5828	5846	1952
4	1388	4765	4897	1121
5	4259	1388	2979	2575
6	2078	3563	3061	2031
7	2000	3763	2893	2307
8	2138	3832	2578	2666
9	1231	4652	4600	1244
10	2592	3715	2004	3138
11	4911	2204	1655	4010
12	5106	2431	1435	4318
13	4140	1951	4700	1301
14	1225	4449	4252	1376
15	2349	4362	2030	3595
16	3000	4171	1378	4009
17	4652	1735	2193	3456
18	4797	1294	2630	3299
19	12745	7922	12599	9421
20	1382	5233	3070	3544

Project: **Jaisalmer_JUNE** Description: **40 MW Wind Farm in district of Jaisalmer**

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 Calculated:
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DECIBEL - Main Result

Calculation: Ambient Night (Khelana)

Noise calculation model:

ISO 9613-2 General

Wind speed:

4.0 m/s - 10.0 m/s, step 2.0 m/s

Ground attenuation:

General, Ground factor: 0.0

Meteorological coefficient, C0:

2.0 dB

Type of demand in calculation:

2: WTG plus ambient noise is compared to ambient noise plus margin (FR etc.)

Noise values in calculation:

All noise values are mean values (Lwa) (Normal)

Pure tones:

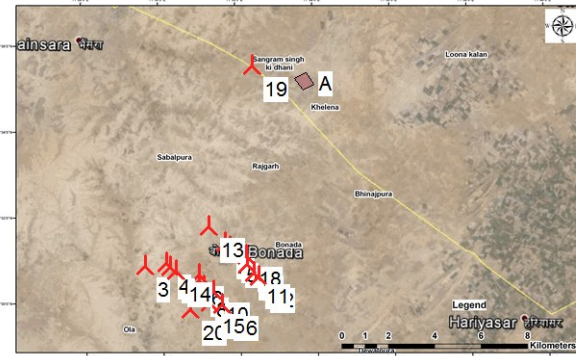
Height and Impulse tone penalty are added to WTG source noise

Height above ground level, when no value in NSA object:

4.0 m Don't allow override of model height with height from NSA object

Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:

0.0 dB(A)



Scale 1:400,000
 ▲ New WTG
 ■ Noise sensitive area

WTGs

Geo [deg]-WGS84 Longitude	Latitude	Z	Row data/Description	WTG type Valid Manufact. Type-generator	Power, rated	Rotor diameter	Hub height	Noise data						
								Creator	Name	First wind speed [m/s]	LwaRef [dB(A)]	Last wind speed [m/s]	LwaRef [dB(A)]	Pure tones
1 71.546570° East	26.517700° North	290.0	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
2 71.543925° East	26.519642° North	290.0	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
3 71.501479° East	26.508319° North	300.0	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
4 71.512562° East	26.509659° North	293.6	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
5 71.548484° East	26.515347° North	290.0	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
6 71.530213° East	26.504095° North	287.4	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
7 71.530362° East	26.501268° North	286.0	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
8 71.532480° East	26.498640° North	283.4	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
9 71.514827° East	26.507742° North	291.4	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
10 71.537719° East	26.496508° North	280.0	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
11 71.559342° East	26.505172° North	281.0	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
12 71.561811° East	26.503413° North	284.8	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
13 71.535308° East	26.527394° North	294.7	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
14 71.517904° East	26.506262° North	290.0	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
15 71.535886° East	26.490702° North	280.0	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
16 71.542376° East	26.489855° North	280.0	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
17 71.555455° East	26.509420° North	287.1	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
18 71.555423° East	26.513436° North	287.5	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
19 71.558078° East	26.604077° North	298.5	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
20 71.525477° East	26.487484° North	282.1	Hyundai HQ2000-WT93 60Hz ... Yes	Hyundai HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a

a) Generic data based on turbine power (very uncertain)

Calculation Results

Sound Level

Noise sensitive area No.	Name	Geo [deg]-WGS84 Longitude	Latitude	Z	Demands			Sound Level			Demands fulfilled ? Noise	
					Imission height	Max Additional exposure [dB(A)]	Max Noise demand [dB(A)]	Max From WTGs [dB(A)]	Max Ambient+WTGs [dB(A)]	Max Additional exposure [dB(A)]		Distance to noise demand [m]
A	Khelana Receptor	71.580441° East	26.598378° North	290.0	4.0	0.0	45.0	26.7	40.7	0.2	1,871	Yes

Distances (m)

WTG	A
1	9144
2	9065
3	12514
4	11691
5	9305
6	11229

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Project: **Jaisalmer_JUNE** Description: 40 MW Wind Farm in district of Jaisalmer

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DECIBEL - Main Result

Calculation: Ambient Night (Khelana)

...continued from previous page

WTG	A
7	11497
8	11657
9	11723
10	11648
11	10023
12	10153
13	8763
14	11676
15	12311
16	12156
17	9679
18	9257
19	2316
20	13076

Project: **Jaisalmer_JUNE** Description: **40 MW Wind Farm in district of Jaisalmer**

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 0091-11-30003206
 EQMS / eqms@eqmsindia.org
 Calculated:
6/25/2015 5:25 PM/2.9.285

DECIBEL - Main Result

Calculation: Ambient Night (Barmer Road)

Noise calculation model:

ISO 9613-2 General

Wind speed:

4.0 m/s - 10.0 m/s, step 2.0 m/s

Ground attenuation:

General, Ground factor: 0.0

Meteorological coefficient, C0:

2.0 dB

Type of demand in calculation:

2: WTG plus ambient noise is compared to ambient noise plus margin (FR etc.)

Noise values in calculation:

All noise values are mean values (Lwa) (Normal)

Pure tones:

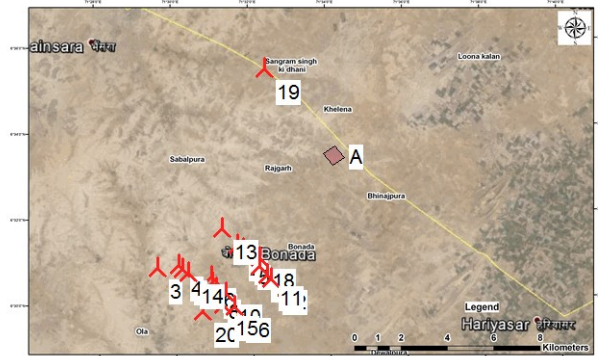
Pure and Impulse tone penalty are added to WTG source noise

Height above ground level, when no value in NSA object:

4.0 m Don't allow override of model height with height from NSA object

Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:

0.0 dB(A)



Scale 1:400,000
 ▲ New WTG ■ Noise sensitive area

WTGs

Geo [deg]-WGS84 Longitude	Latitude	Z [m]	Row data/Description	WTG type			Noise data										
				Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Creator	Name	First wind speed [m/s]	LwaRef [dB(A)]	Last wind speed [m/s]	LwaRef [dB(A)]	Pure tones	
1	71.546570° East	26.517700° North	290.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
2	71.543925° East	26.519642° North	290.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
3	71.501479° East	26.508319° North	300.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
4	71.512562° East	26.509659° North	293.6	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
5	71.548484° East	26.515347° North	290.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
6	71.530213° East	26.504095° North	287.4	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
7	71.530362° East	26.501268° North	286.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
8	71.532480° East	26.498640° North	283.4	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
9	71.514827° East	26.507742° North	291.4	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
10	71.537719° East	26.496508° North	280.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
11	71.559342° East	26.505172° North	281.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
12	71.561811° East	26.503413° North	284.8	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
13	71.535308° East	26.527394° North	294.7	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
14	71.517904° East	26.506262° North	290.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
15	71.535886° East	26.490702° North	280.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
16	71.542376° East	26.489855° North	280.0	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
17	71.555455° East	26.509420° North	287.1	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
18	71.555423° East	26.513436° North	287.5	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
19	71.558078° East	26.604077° North	298.5	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a
20	71.525477° East	26.487484° North	282.1	Hyundai HQ2000-WT93 60Hz ... Yes	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	USER	Runtime input	4.0	101.6	10.0	107.6	0 dB a

a) Generic data based on turbine power (very uncertain)

Calculation Results

Sound Level

Noise sensitive area No.	Name	Geo [deg]-WGS84		Z [m]	Imission height [m]	Demands		Sound Level			Demands fulfilled ? Noise
		Longitude	Latitude			Max Additional exposure [dB(A)]	Max Noise demand [dB(A)]	Max From WTGs [dB(A)]	Max Ambient+WTGs [dB(A)]	Max Additional exposure [dB(A)]	
A	Barmer Road Receptor	71.594177° East	26.557817° North	280.0	4.0	0.0	70.0	24.5	44.9	0.0	Yes

Distances (m)

WTG	A
1	6504
2	6558
3	10660
4	9681
5	6551
6	8725

To be continued on next page...

Project: **Jaisalmer_JUNE** Description: 40 MW Wind Farm in district of Jaisalmer

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DECIBEL - Main Result

Calculation: Ambient Night (Barmer Road)

...continued from previous page

WTG	A
7	8932
8	8993
9	9638
10	8824
11	6791
12	6839
13	6686
14	9504
15	9440
16	9134
17	6609
18	6255
19	5498
20	10378

Annexure II – Output Files of the Shadow Flicker Assessment

Project: Jaisalmer_JUNE	Description: 40 MW Wind Farm in district of Jaisalmer	Printed/Page: 6/25/2015 6:03 PM / 1
		Licensed user: EQMS India Private Limited 304 & 305, 3RD Floor, Plot No. 16 Rishabh Towers, Community Center IN-KARKARDUMA Delhi 110 092 0091-11-30003206 EQMS / eqms@eqmsindia.org
		Calculated: 6/25/2015 5:57 PM/2.9.285

SHADOW - Main Result

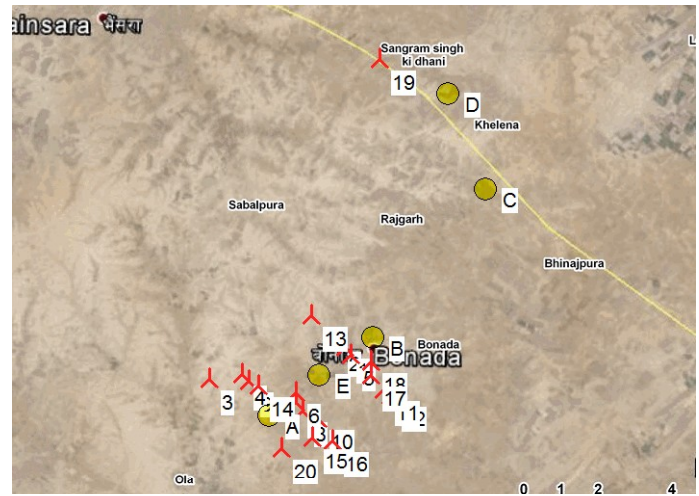
Calculation: Shadow Flicker

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes
The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Isolines showing shadow in Hours per year, worst case
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10.0 m



🚧 New WTG

🟡 Shadow receptor

WTGs

UTM (north)-WGS84 Zone: 42				WTG type			Shadow data					
East	North	Z	Row data/Description	Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Calculation distance [m]	RPM [RPM]	
1	753,778	2,935,537	290.0	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7
2	753,510	2,935,747	290.0	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7
3	749,303	2,934,409	300.0	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7
4	750,405	2,934,579	292.6	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7
5	753,974	2,935,280	290.0	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7
6	752,177	2,933,997	287.4	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7
7	752,198	2,933,684	285.6	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7
8	752,415	2,933,397	283.1	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7
9	750,635	2,934,371	290.6	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7
10	752,942	2,933,171	280.0	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7
11	755,079	2,934,174	288.3	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7
12	755,329	2,933,984	287.9	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7
13	752,634	2,936,589	294.2	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7
14	750,945	2,934,213	290.0	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7
15	752,772	2,932,524	280.0	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7
16	753,421	2,932,443	280.0	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7
17	754,682	2,934,637	289.0	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7
18	754,670	2,935,082	287.7	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7
19	754,734	2,945,132	300.0	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7
20	751,741	2,932,147	282.0	Hyundai HQ2000-WT93 60Hz 20...	Yes	Hyundai	HQ2000-WT93-2,000	2,000	93.3	80.0	1,087	15.7

Shadow receptor-Input

UTM (north)-WGS84 Zone: 42										
No.	Name	East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
		[m]	[m]	[m]	[m]	[m]	[m]	[°]	[°]	
A	Bonada Shadow Rec 1	751,321	2,933,219	289.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"
B	Bonada Shadow Rec 3	754,697	2,935,875	287.3	1.0	1.0	1.0	0.0	90.0	"Green house mode"
C	Barmer Road Shadow Rec	758,326	2,940,884	280.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
D	Khelana Shadow Rec	757,016	2,944,028	289.8	1.0	1.0	1.0	0.0	90.0	"Green house mode"
E	Bonada Shadow Rec 2	752,947	2,934,607	289.2	1.0	1.0	1.0	0.0	90.0	"Green house mode"

Project: **Jaisalmer_JUNE** Description: 40 MW Wind Farm in district of Jaisalmer

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Calculated:
6/25/2015 5:57 PM/2.9.285

SHADOW - Main Result

Calculation: Shadow Flicker

Calculation Results

Shadow receptor

No.	Name	Shadow, worst case		
		Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
A	Bonada Shadow Rec 1	1:41	19	0:07
B	Bonada Shadow Rec 3	8:42	34	0:21
C	Barmer Road Shadow Rec	0:00	0	0:00
D	Khelana Shadow Rec	0:00	0	0:00
E	Bonada Shadow Rec 2	0:00	0	0:00

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
1	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (1)	8:42	
2	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (2)	0:00	
3	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (3)	0:00	
4	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (4)	0:00	
5	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (5)	0:00	
6	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (6)	0:00	
7	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (7)	1:41	
8	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (8)	0:00	
9	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (9)	0:00	
10	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (10)	0:00	
11	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (11)	0:00	
12	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (12)	0:00	
13	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (13)	0:00	
14	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (14)	0:00	
15	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (15)	0:00	
16	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (16)	0:00	
17	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (17)	0:00	
18	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (18)	0:00	
19	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (19)	0:00	
20	Hyundai HQ2000-WT93 60Hz 2000 93.3 !O! hub: 80.0 m (TOT: 126.7 m) (20)	0:00	