Environmental & Social Impact Assessment (ESIA)

for

Barmer Wind Farm Project (40 MW) at Rajasthan

Submitted by:

HERO FUTURE ENERGIES ™

planet positive power

June 2015

Environmental Consultant:

Eqms

EQMS INDIA PVT. LTD. INDIA

304-305, 3rd Floor, Plot No. 16, Rishabh Corporate Tower,

Community Centre, Karkardooma, Delhi – 110092

Phone: 011-30003200, 30003219; Fax: 011-22374775

Website: www.eqmsindia.com ; E-mail – eqms@eqmsindia.org

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 4
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 21
2.6. Power Evacuation 21
2.7. Land Requirement 22
2.8. Project Implementation and Schedule 23
2.9. Project Development – Construction Phase 24
2.9.1. Site Development 24
2.9.2. Internal Pathways/Access Roads 25
2.9.3. Civil Works 25
2.9.4. Labor 25
2.9.5. Water and Wastewater 25
2.9.6. Waste Generation 25
2.10. Operation and Maintenance 26
2.10.1. Operation and Maintenance Staff 26
2.10.2. Water requirement 26
2.10.3. Waste water generation 26
2.10.4. Routine Maintenance Services 26
2.10.5. Routine Operational Services 26
2.10.6. Monitoring and Reporting 27
3. ESIA Process and Methodology 28
3.1. ESIA Process 28
3.2. Methodology followed 28
3.2.1. Review of regulatory and legislative framework 29
3.2.2. Environmental and Social Assessment 29
3.2.3. Assessment of Environmental and Social Impacts and Mitigation Measures proposed 33
3.2.4. Formulation of Environmental and Social Management Plan (ESMP) 33
4. Policy, Legal and Administrative Framework 34
4.1 IFC Performance Standards 34

4.2 IFC Categorization of Projects 40
4.3 Environment, Health and Safety (EHS) General Guidelines of IFC 41
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 79
5.2.4 Noise Environment 85
5.2.5 Ecological Environment 87
5.2.6 Socio-Economic Environment 97
5.3 Corporate Social Responsibility 109
6. Environmental and Social Impact Assessment 110
6.1 Approach 110
6.2 Community Consultation 110
6.3 Impact Assessment 111
6.3.1 Construction Phase 111
6.3.2 Operation Phase 119
7. Environmental and Social Management Plan 133
7.1 Introduction 133
7.2 Environmental and Social Management System (ESMS) 133
7.3 Organizational Structure 133
7.4 Roles and Responsibilities 134
7.5 Monitoring and Audit 135
7.6 Documentation and Record Keeping 136
7.7 Proposed Environment and Social Management Plan 136
7.8 Management Plans and Procedures 146
7.8.1 Occupational Health and Safety Management Plan 146
7.8.2 Road Safety and Traffic Management Plan 148
7.8.3 Emergency Management Plan 149
7.8.4 Crane Safety Plan 151
7.8.5 Community Liaison Plan 154
7.8.6 Grievance Redressal Mechanism 155
7.8.7 Community Property Replacement Plan 156
8. Summary and Conclusions 158

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 31st May, 2014) 7
Table 1.3 : Framework of Regulations referenced for ESIA Study 11
Table 2.1 : WTG Location Details of Barmer Wind Farm 14
Table 2.2 : WTG Location Details of Barmer Wind Farm 16
Table 2.3 : Land Use Category of the Surrounding Area 17
Table 2.4 : WTG Location Details of Barmer Wind Farm 21
Table 2.5 : Land details of the Parcels for proposed Barmer Wind Farm 23
Table 2.6 : Project Schedule Details 24
Table 3.1 : Details of Sampling Locations 30
Table 4.1 : IFC Performance Standards for Environmental and Social Sustainability 38
Table 4.2 : Summary of General EHS Guidelines 44
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 62
Table 5.1 : Rainfall Pattern in last 10 years recorded in Barmer District (2004-2013) 68
Table 5.2 : Ambient Air Quality Analysis Results 72
Table 5.3 : Water Quality Monitoring Analysis Results 77
Table 5.4 : Major Type of Soil in Barmer District 80
Table 5.5 : Physico-Chemical Characteristics of Soil 81
Table 5.6 : Ambient Noise Quality in the Study Area 86
Table 5.7 : Phytosociological Characters of Vegetation around Shiv area 89
Table 5.8 : Phytosociological Characters of Vegetation around Gunga area 91
Table 5.9 : Phytosociological Characters of Vegetation around Ambawadi Area 93
Table 5.10 : Mammals recorded during primary Survey 96
Table 5.11 : Bird species recorded from the study area 96
Table 5.12 : Area of Tehsils and their Population of District Barmer 98
Table 5.13 : Village-wise Details of Population of Project Affected Villages 99
Table 5.14 : Village-wise Details of SC/ST Population of Project Affected Villages 101
Table 5.15 : Literacy Profile of the Study Area Villages 102
Table 5.16 : Workforce Participation for Study Area Villages 103
Table 5.17 : Basic Amenities in the Study Area 105
Table 5.18 : Identifying CSR initiatives in line with local requirements 109
Table 6.1 : Resultant Noise Levels at Receptor Locations 121
Table 6.2 : ICNIRP Exposure Limits for General Public Exposure 128
Table 6.3 : ICNIRP Exposure Limits for Occupational Exposure 128
Table 6.4 : Impacts of Shadow Flicker effects 129
Table 7.1 : Proposed Environmental and Social Management Plan (ESMP) 138
Table 7.2 : Crane Safety Plan 152

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 Barmer Wind Farm 9
Figure 1.4 : Micro-siting Details of Barmer Wind Farm 10
Figure 2.1 : Site Photographs 15
Figure 2.2 : Land use Breakup of Proposed Barmer Wind Farm 17
Figure 2.3 : Land Use Map of Barmer Wind Farm 18
Figure 2.4 : Anatomy of WTG 20
Figure 2.5 : Power Evacuation Scheme for Barmer Wind Farm 22
Figure 3.1 : Sampling Locations for the ESIA Study 31
Figure 5.1 : Average Rainfall Pattern in Barmer 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 SOx Concentrations 74
Figure 5.8 : Graphical Representation of NOx 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 85
Figure 5.13 : Graphical Representation of Noise Environment 87
Figure 5.14 : Diversity, Evenness & Species Richness of Shiv Area 90
Figure 5.15 : Diversity, Evenness & Species Richness of Gunga Area 92
Figure 5.16 : Diversity, Evenness & Species Richness of Ambabadi Area 94
Figure 5.17 :Graph Representation of Tehsil Population of Barmer District 99
Figure 5.18 :Graphical Representation Male/Female Population 100
Figure 5.19 : Comparative Graph of SC/ST Population in Study Area 101
Figure 5.20 : Gender-wise Distribution of Literacy and of Illiteracy in Study Area 102
Figure 5.21 : Workforce Participation in Study Area 103
Figure 5.22 : Main Workforce Participation in Study Area 104
Figure 5.23 : Marginal Workforce Participation in Study Area 104
Figure 5.24 : Pictures taken during Stakeholder Consultation 108
Figure 6.1 : Noise Level generated due to operation of WTGs with ambient noise during day time 122
Figure 6.2 : Noise Level generated due to operation of WTGs with ambient noise during night time 123
Figure 6.3 : Shadow Flicker Assessment Map 131
Figure 7.1 : Organizational Chart 134

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 Private Limited (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 the 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.

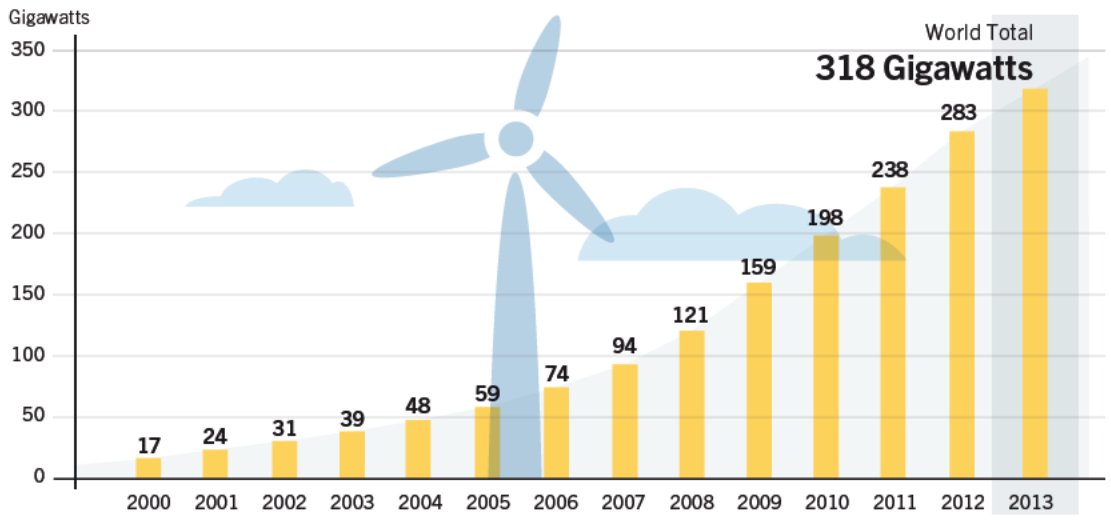
Though sunlight is considered a “compelling solution” to the “need for clean, abundant sources of energy,” solar energy currently provides only 0.01 percent of the total electricity supply needs. However, recent market trends, Government policies, regulatory support, consumer incentives, and technological 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

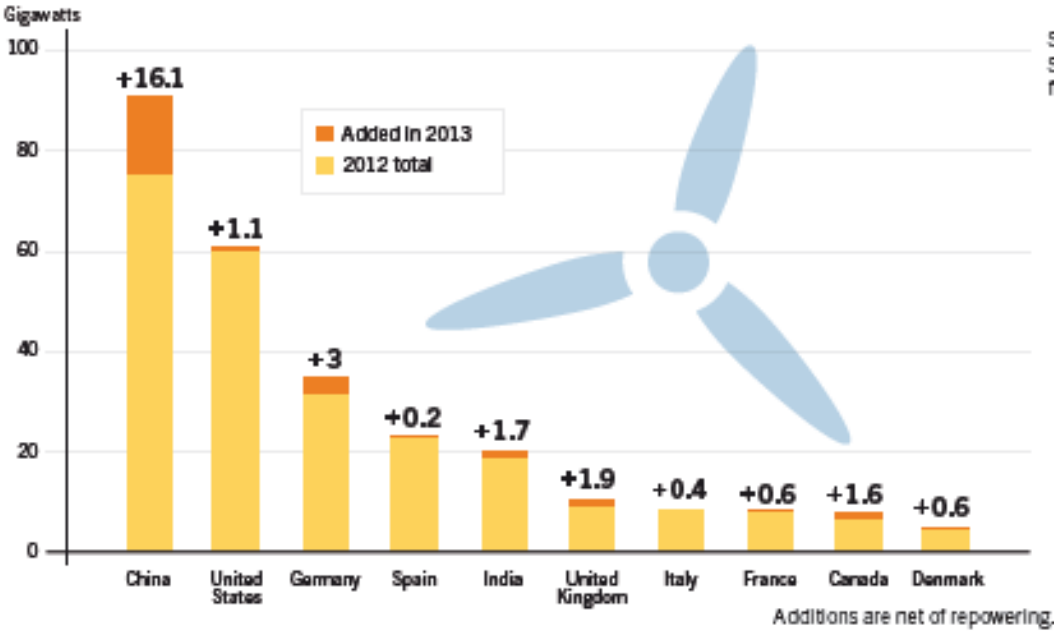
The energy demand worldwide is increasing rapidly, especially in developing countries, which seek to catch up with the economic development achieved by industrialized nations during the last century. Until now, fossil fuel resources have been utilized extensively resulting in an adverse impact on its 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 eightfold 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 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 support for wind energy has led India to rank fifth with largest installed wind power capacity. 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 onshore wind potential has been utilized so far by India. In spite of the fact that India has long coast line over 7500 km, we have not yet tapped our offshore 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 develops projects under its various project companies/SPV's. Clean Wind Power (Devgarh) Private Limited (CWP-Devgarh) is the subsidy company of HFEPL under which 40 MW Barmer Wind Farm shall be developed.

HFEPL proposes to set up a 40 MW wind power project (Barmer Wind Farm) in Barmer District of Rajasthan. Barmer Wind Farm is spread across 4 villages of Gunga, Ambawadi, Jaseka Gaon and Shiv in Barmer District of Rajasthan. The capacity of Barmer Wind Farm is rated at 40 MW and will comprise of 20 Wind Turbine Generators (WTGs) of Gamesa G-97 model with a rated capacity of 2 MW each. The extent of the Wind Farm is spread over 50 acres.

The associated facilities for the project include:

- Construction of external and internal 33 kV transmission lines of about 16 km and 16.32 km in length respectively
- Construction of internal pathways of varying lengths and 7 m in width

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

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

Gamesa has further sub-contracted the following for the various tasks:

- Sahej – Development of road and land & liaisoning and evacuation
- MS Ramawat – Foundation work and RCC reinforcement and concreting
- Velcity – Soil testing

The proposed location of the 20 WTGs of Barmer Wind Farm is shown in Figure 1.3 and 1.4.

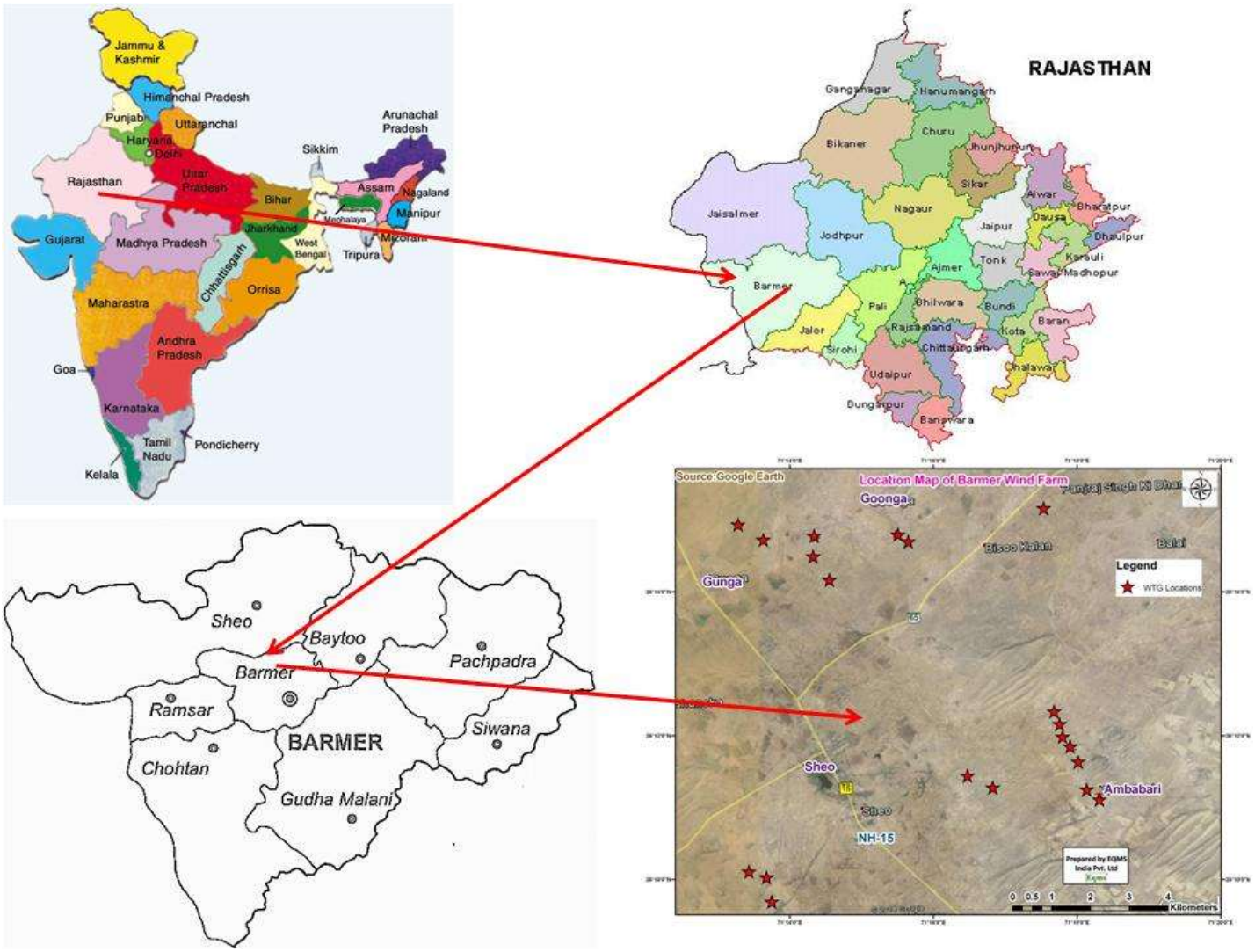


Figure 1.3 : Proposed Location of Barmer Wind Farm

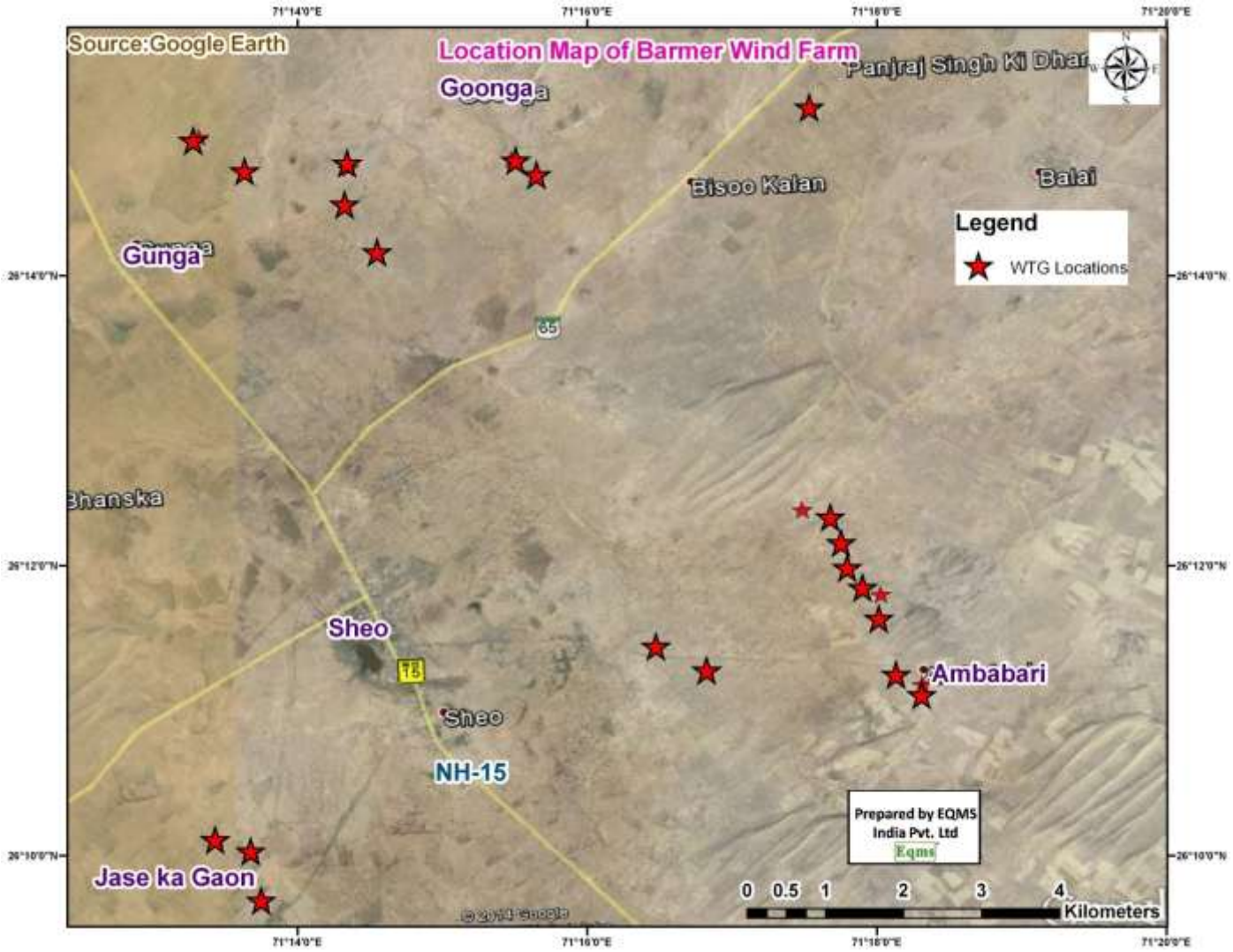


Figure 1.4 : Micro-siting Details of Barmer Wind Farm

1.4. Purpose and Scope of Work

The study has been undertaken to assess the Environmental and Social impacts associated with Barmer Wind Farm as per the requirements of the 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 • **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 Gamesa 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
- Gamesa
- 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 (Gamesa). 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 Client. 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 Barmer 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 Barmer Wind Farm.

Chapter 5: Description of Environment

This chapter describes the baseline environmental conditions around the surrounding area of the proposed Barmer 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 (Barmer Wind Farm) in Barmer District of Rajasthan. Barmer Wind Farm is spread across 4 villages of Gunga, Ambawadi, Jaseka Gaon and Shiv in Barmer District of Rajasthan.

The capacity of Barmer Wind Farm is rated at 40 MW and will comprise of 20 WTGs of Gamesa G-97 model with a rated capacity of 2 MW each. The extent of the Wind Farm is spread over 50 acres. Power generated from 40 MW Barmer Wind Farm will be evacuated at 33 kV level using Rajasthan Rajya Vidyut Prasaran Nigam Limited (RRVPN) Sheo 132/33 kV Sub-Station (SS).

The proposed Barmer Wind Farm is spread across 4 villages in four clusters. There are 8 WTGs in the village of Gunga, two sets of 7 WTGs and 2 WTGs which run in a linear pattern along the village of Ambawadi and the last cluster comprises of 3 WTGs in the village of Ambawadi. The site elevation of the four clusters varies from 225 to 260 m. The location of WTGs with respect to geographic proximity to the villages is presented in Table able 2.1.

Table 2.1 : WTG Location Details of Barmer Wind Farm

S. No.	Village	Tehsil	District	Number of WTGs	Type of Land
1	Gunga	Shiv	Barmer	8	Private Land
2	Ambawadi	Shiv	Barmer	9	Private Land
3	Jaseka Gaon	Shiv	Barmer	3	Private Land
			Total	**20**	

2.2. Site Settings

The first cluster of the proposed Barmer Wind Farm is located at a distance of 1.52 km north-east of Gunga village. The second cluster is located in the village of Ambawadi village. The third cluster is located at a distance of 2.15 km north-east of village Jaseka Gaon. The fourth cluster consisting of a single WTG is located at a distance of 700 m north-east of village Panjraj Singh ki Dhani. The nearest highway, NH-15, is located at a distance of 1.60 km and the State Highway, SH-65, is located at a distance of 600 meters. The site elevation of the four clusters varies from 225 to 260 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 Barmer Wind Farm.

	
Site Location of WTG (Gunga)	**RCC work done for one of the WTGs (Gunga)**
	
Foundation work done for one of the WTGs (Ambawadi)	**Foundation work done for one of the WTGs (Jaseka Gaon)**
	
Office Location of Gamesa (Shiv Village)	**Store Yard of Gamesa (Shiv Village)**

Figure 2.1 : Site Photographs

Table 2.2 : WTG Location Details of Barmer Wind Farm

S. No.	WTG Label Number	WTG Number	Geographical Coordinates (m)		Village	Tehsil	District
			Easting	Northing			
1	GG/97-144	GG 1	723643	2904889	Gunga	Shiv	Barmer
2	GG/97-120	GA3	729486	2899837	Ambavadi	Shiv	Barmer
3	GG/97-122	GG 2	724011	2903764	Gunga	Shiv	Barmer
4	GG/97-102	GA4	729864	2899196	Ambavadi	Shiv	Barmer
5	GG/97-126	GS 3	722819	2895481	Jaseka Gaon	Shiv	Barmer
6	GG/97-119	GS 1	722276	2896244	Jaseka Gaon	Shiv	Barmer
7	GG/97-151	GG 6	723624	2904364	Gunga	Shiv	Barmer
8	GG/97-111	GG 4	725826	2904781	Gunga	Shiv	Barmer
9	GG/97-164	GG 3	725583	2904958	Gunga	Shiv	Barmer
10	GG/97-115	GA1	729280	2900478	Ambavadi	Shiv	Barmer
11	GG/97-121	GA 2	729412	2900156	Ambavadi	Shiv	Barmer
12	GG/97-127	GS 2	722686	2896104	Jaseka Gaon	Shiv	Barmer
13	GG/97-125	GA 5	728945	29005694	Ambavadi	Shiv	Barmer
14	GG/97-162	GA 6	729670	2899588	Ambavadi	Shiv	Barmer
15	GG/97-157	GS 6	730371	2898233	Jaseka Gaon	Shiv	Barmer
16	GG/97-145	GA 8	727303	2898796	Ambavadi	Shiv	Barmer
17	GG/97-160	GS 5	730075	2898486	Jaseka Gaon	Shiv	Barmer
18	GG/97-163	GS 7	721869	2905149	Gunga	Shiv	Barmer
19	GG/97-147	GG 8	722466	2904770	Gunga	Shiv	Barmer
20	GG/97-153	GS 7	727893	2898502	Jaseka Gaon	Shiv	Barmer

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 (3-5 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
- Water body
- Vegetation

- Barren land
- Open grass and shrub land
- Settlement

Open grass and shrub land dominates the surrounding area of the proposed Barmer Wind Farm covering approximately 80% of the surrounding area. 8% of the surrounding area is classified as barren followed by 6% of agricultural land. There are a few settlements in the surrounding area. 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. Figure 2.3 depicts the land use of the proposed Barmer Wind Farm.

Table 2.3 : Land Use Category of the Surrounding Area

Class	Area (Sq. km)	Percentage (%)
Agricultural land	7.25	2
Agri fallow land	22.27	6
Water body	0.01	0
Vegetation	10.72	3
Barren land	30.48	8
Open grass and shrub land	295	80
Settlement	2.02	1
Total	**367.75**	**100**

Source: Primary data analysis

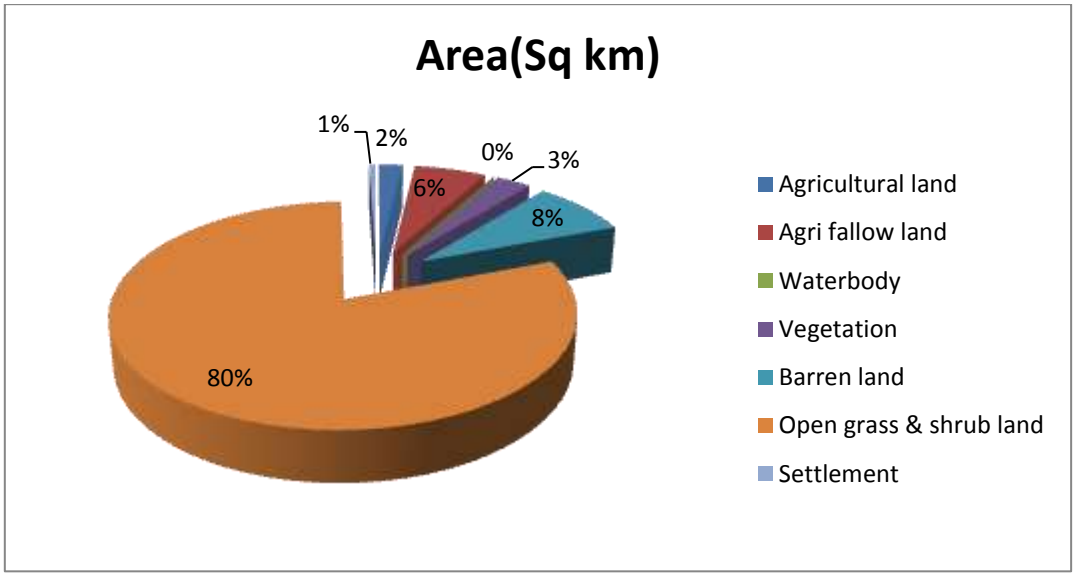


Figure 2.2 : Land use Breakup of Proposed Barmer Wind Farm

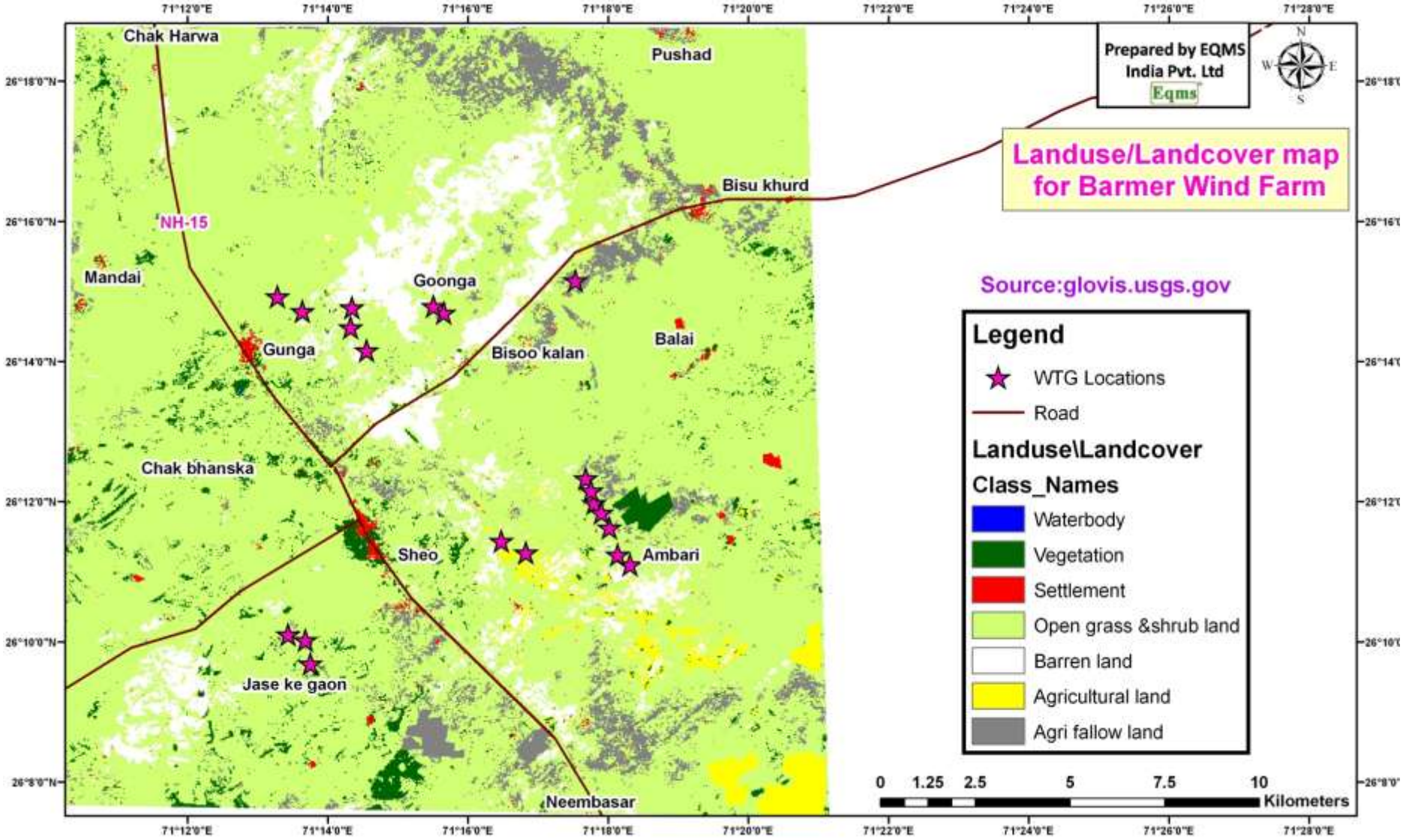


Figure 2.3 : Land Use Map of Barmer Wind Farm

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.

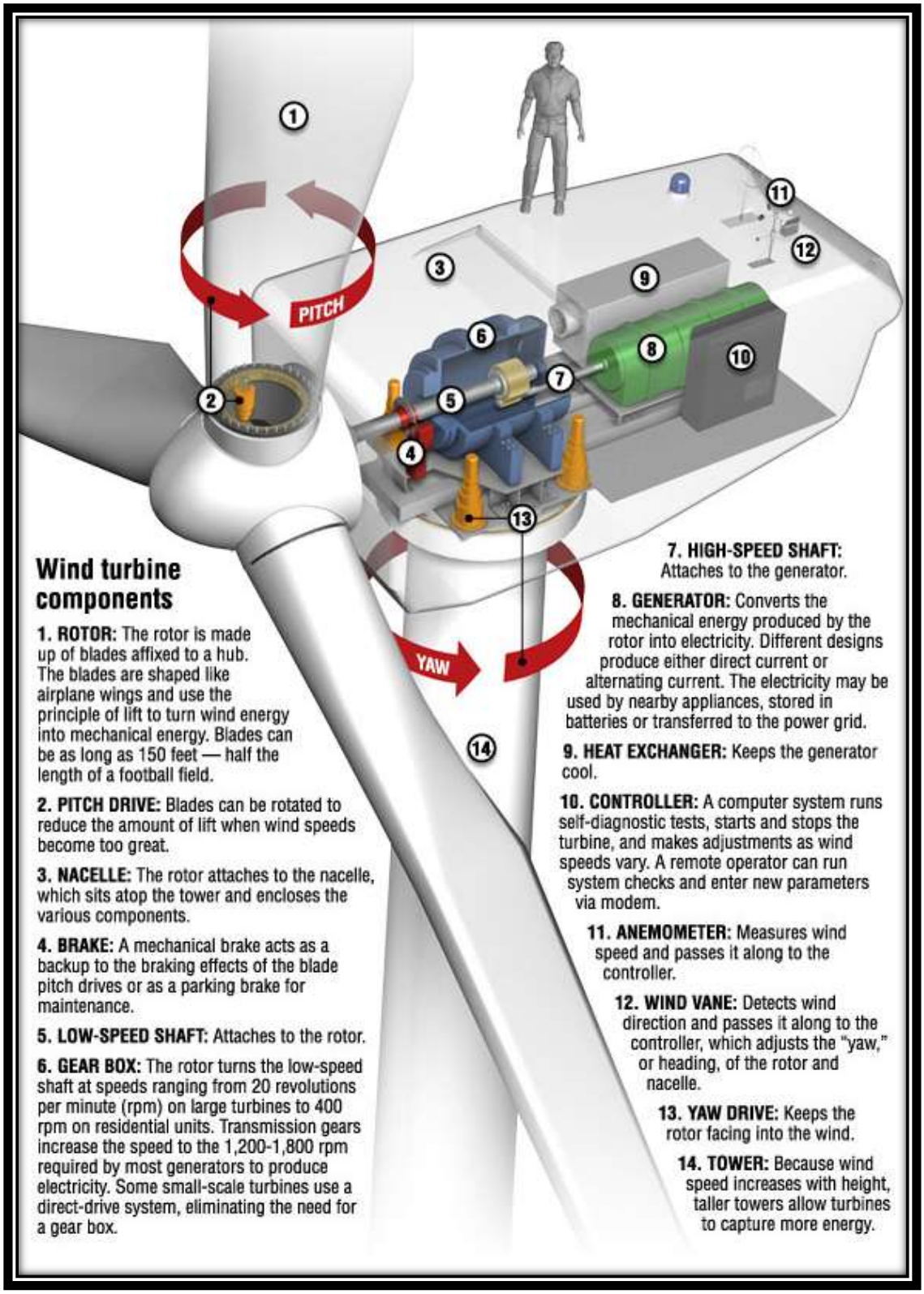
Nacelle

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

Barmer Wind Farm will comprise of 20 WTGs of Gamesa G-97 model with a rated capacity of 2 MW each. The rotor diameter and hub height is 97 m and 90 m respectively. The key technical details of Gamesa G-97 model are presented in Table 2.4.

Table 2.4 : WTG Location Details of Barmer Wind Farm

S. No.	Parameter	Value
A	**Rotor**	
1	Diameter	97 m
2	Swept area	7,390 m2
3	Rotational Speed	9.6-17.8 rpm
B	**Blades**	
1	Number of Blades	3
2	Length	47.5 m
3	Airfoils	Gamesa
4	Material	Pre-impregnated epoxy glass fiber + carbon fiber
C	**Tower**	
1	Type	Modular
2	Height	90 m
D	**Gear Box**	
1	Type	1 planetary stage 2 parallel stages
2	Ratio	1:106.8 (50 Hz) 1:127.1 (60 Hz)
E	**Generator 2 MW**	
1	Type	Doubly-fed machine
2	Rated Power	2.0 MW
3	Voltage	690 V AC
4	Frequency	50 Hz / 60 Hz
5	Protection Class	IP 54
6	Power Factor	0.95 CAP – 0.95 IND throughout the power range*
* Power factor at generator output terminals, on low voltage side before transformer input terminals.		

(Source: http://www.gamesacorp.com/en/)

2.5. Status of the Wind Farm

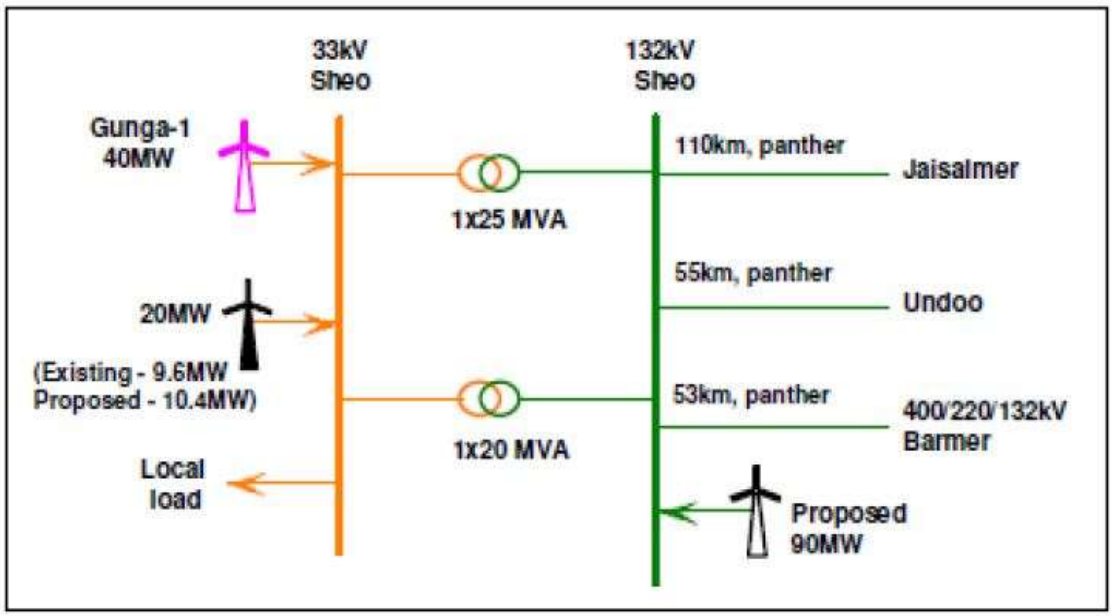
Barmer Wind Farm will comprise of 20 WTGs spread across 4 villages of Gunga, Ambawadi, Jaseka Gaon and Shiv in Barmer District of Rajasthan. Power generated from the Wind Farm will be evacuated at 33 kV level using RRVPN Sheo 132/33 kV SS. The construction of the access roads has been initiated.

2.6. Power Evacuation

Power generated from the proposed Barmer Wind Farm will be evacuated at 33 kV level using RRVPN Sheo 132/33 kV SS. The construction of the access roads has been

initiated. The length of the external and internal 33 kv transmission lines is approximately 16km and 16.32 km respectively.

Figure 2.5 presents the power evacuation scheme from the proposed Barmer Wind Farm.



(***Source: HFEPL***)

Figure 2.5 : Power Evacuation Scheme for Barmer Wind Farm

2.7. Land Requirement

Gamesa had sub-contracted Sahej for the process of land procurement of the private land for the proposed Barmer 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 50 acres. The first cluster of the proposed Barmer Wind Farm is located at a distance of 1.52 km north-east of Gunga village. The second cluster is located in the village of Ambawadi village. The third cluster is located at a distance of 2.15 km north-east of village Jaseka Gaon. The fourth cluster consisting of a single WTG is located at a distance of 700 m north-east of village Panjraj Singh ki Dhani. The site elevation of the four clusters varies from 225 to 260 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 Barmer Wind Farm.

Table 2.5 : Land details of the Parcels for proposed Barmer Wind Farm

WTG Identifier	Village	Khasra Number	Area (acres)
GG/97-083	Gunga	428	4
GG/97-098	Ambavadi	534	2.412
GG/97-101	Gunga	1084/425	3.332
GG/97-102	Ambavadi	542	2.84
GG/97-104	Shiv	170/139	3.64
GG/97-105	Shiv	25	2.86
GG/97-106	Gunga	431	4
GG/97-108	Gunga	225	3.2
GG/97-090	Gunga	1010/224	3.2
GG/97-096	Ambavadi	718/537	2.8
GG/97-097	Ambavadi	720/537	2.828
	Shiv	142	3.2
GG/97-126	Ambavadi	508	3.28
GG/97-127	Ambavadi	542	
GG/97-043	Shiv	586	3.88
GG/97-137	Ambavadi	644/472	3.32
GG/97-139	Shiv	585	
GG/97-149	Gunga	129	4
GG/97-147	Gunga	132	3.32
GG/97-153	Shiv	393	3.32

2.8. Project Implementation and Schedule

Gamesa has been contracted by CWP-Devgarh for the construction of the proposed Barmer Wind Farm including works related to land acquisition, obtaining statutory approvals, development of logistics route, construction of internal pathways, crane beds, 33 kV transmission lines and pooling substation, etc. including but not limited to 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 Gamesa.

Furthermore, Gamesa 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 Gamesa will be partly in charge for the Project Management including financial and administrative control, overall project co-ordination, 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 part of the construction phase of the wind farm. Table 2.6 presents the schedule for the completion of activities for the proposed Barmer Wind Farm.

Table 2.6 : Project Schedule Details

S. No.	Activity	Status/Schedule
1	Land Procurement	15 land parcels have already been procured. The remaining 5 land parcels have been identified and negotiations for the same are being done.
2	Micro Siting Activities	Wind resource assessment for the region was undertaken by Gamesa in 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 7 m is planned for the wind farm. Same is expected to be completed by 31st March, 2014.
4	Pooling Substation and Power Evacuation System	Power generated from the proposed Barmer Wind Farm will be evacuated at 33 kV level using RRVPN Sheo 132/33 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 and internal 33 kv transmission lines is approximately 16km and 16.32 km respectively and is expected to be completed by mid-March, 2015
5	Foundation of WTGs	The task is expected to be completed by end of February, 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 Barmer 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 90 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 Gamesa 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 Gamesa 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 Barmer 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 related to conventional thermal or hydro power plants, the methodology followed was 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
- Biodiversity 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 discussed briefly.

3.2.1. Review of regulatory and legislative framework

A review of applicable environmental and social legislations was carried out to assess the framework for the proposed Barmer 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 for Wind Energy.

3.2.2. Environmental and Social Assessment

An environmental and social assessment of the proposed Barmer 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 Barmer 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 (Gurgoan, 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	
Shiv	AQ1
Ambawadi	AQ2
Gunga	AQ3
Ground Water	
Shiv	GW1
Ambawadi	GW2
Gunga	GW3
Soil	
Ambawadi	S1
Gunga	S2
Noise	
NH-15 (near Shiv)	N1
Ambawadi	N2
Gunga	N3

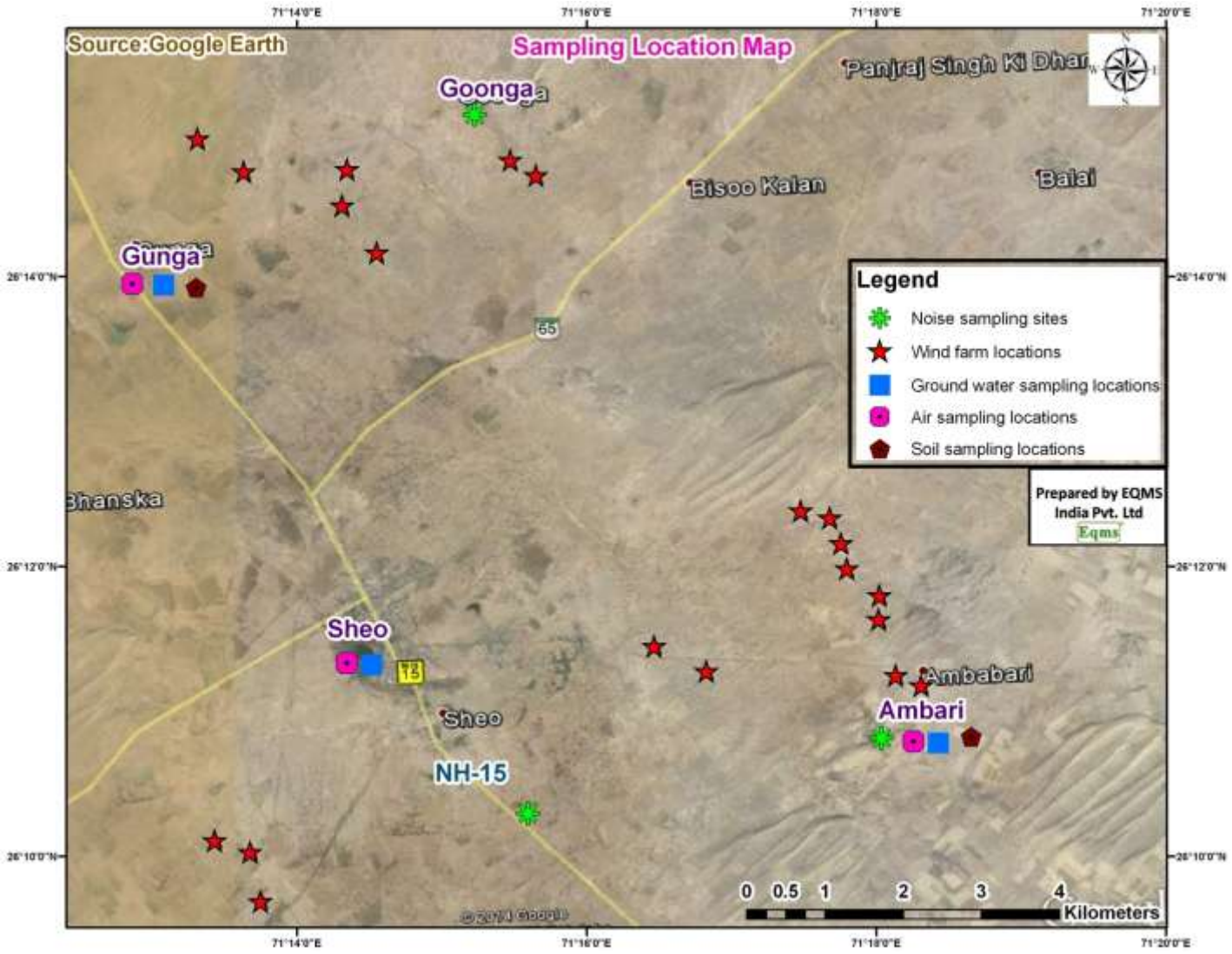


Figure 3.1 : Sampling Locations for the ESIA Study

Ambient Air Quality

Three 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 (PM_{10} and $PM_{2.5}$), Sulphur Dioxide (SOx), Oxides of Nitrogen (NOx) and Carbon Monoxide (CO). Monitoring was done twice a week at each location. The monitoring was conducted according to the National Ambient Air Quality Standards notified by Central Pollution Control Board on 18th November, 2009. The details of the AAQM analysis are presented in Chapter 5.

Ground Water Quality

Three 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 physicochemical parameters, to determine the existing soil characteristics of the study area. Physicochemical characteristics of soil are presented in Chapter 5.

Noise

Three locations – one near the National Highway (NH-15) 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 and Forests, Government of India. The results of the monitoring 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 No. 5. 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 10x10m^2 were placed in three study sites. Quadrats were regularly placed at an interval of 0.5 km in each of the three 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. The second step was then to propose mitigation measures for the impacts identified.

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

An Environmental and Social Management Plan (ESMP) has been formulated for the proposed Barmer 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 ongoing 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 Barmer Wind Farm.

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

- IFC Performance Standards
- Applicable Environmental and Social regulations and policies
- Enforcement Agencies
- Equator Principles
- 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 PS 1 through 8 and discusses the applicability to the proposed Barmer Wind Farm.

Table 4.1 : IFC Performance Standards for Environmental and Social Sustainability

S. No.	IFC Performance Standards (PS)	Applicability
1	**Performance Standard 1 (PS1)**: Assessment and Management of Environmental and Social Risks and Impacts	PS1 is applicable to the proposed Barmer 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. 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.
2	**Performance Standard 2 (PS2)**: Labor and Working Conditions	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 Gamesa 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 /Gamesa shall provide adequate provisions such as access to clean water, sanitary facilities and other necessary facilities at the construction sites. CWP-Devgarh /Gamesa shall also ensure measures to prevent child labor, forced labor, and discrimination. Freedom of association and collective bargaining shall

S. No.	IFC Performance Standards (PS)	Applicability
		be provided. Wages, work hours and other benefits shall be as per the national labor and employment laws. CWP-Devgarh/Gamesa 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.
3	**Performance Standard 3 (PS3)**: Resource Efficiency and Pollution Prevention	In conformance with PS3, CWP-Devgarh/Gamesa 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. CWP-Devgarh/Gamesa 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.
4	**Performance Standard 4 (PS4)**: Community Health, Safety, and Security	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. 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 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. The shadow flicker and noise levels at adjoining

S. No.	IFC Performance Standards (PS)	Applicability
		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 Sl. No. 17). An Emergency Preparedness & Response Plan/Procedure also need to formulated and implemented by the contractor to this regard.
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	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. 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.
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,	This guideline promotes continuous reduction in water consumption and to achieve savings in the water

S. No.	EHS Guideline	Applicability	Requirements	Description
			reuse, and other techniques; and sanitary water conservation techniques.	pumping, treatment and disposal costs.
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	Clean Eating Area

S. No.	EHS Guideline	Applicability	Requirements	Description
			employees	
		Y	Natural lighting supplemented with artificial illumination should be used to light up the workspace. Emergency lighting should be installed upon failure of principal artificial lighting.	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	Visitor Orientation

S. No.	EHS Guideline	Applicability	Requirements	Description
			not enter hazard areas unescorted.	
		Y	Adequate training and information enabling the workers to understand work hazards prior to commencement of new assignments	New Task Employee and Contractor Training
		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	Rotating and Moving Equipment

S. No.	EHS Guideline	Applicability	Requirements	Description
			equivalent ISO or ANSI standard	
		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 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	Noise
		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	Working at Heights

S. No.	EHS Guideline	Applicability	Requirements	Description
			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.	
		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 Barmer Wind Farm
2.5	**Biological Hazards**	N/A	-	There will be no biological hazards associated with the operation of Barmer Wind Farm
2.6	**Radiological Hazards**	N/A	-	There will be no radiological hazards associated with the operation of Barmer 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	Confined Space

S. No.	EHS Guideline	Applicability	Requirements	Description
			or around the 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
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**	**Y**	International codes, such as those compiled by the International Code Council (ICC) should be followed to regulate the design,	Hazard Analysis

S. No.	EHS Guideline	Applicability	Requirements	Description
	Infrastructure		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.	
3.3	**Life and Fire Safety (L&FS)**	**Y**	Compliance with local building code, local fire department regulations, local legal/insurance requirements and international L&FG standards	Detection and Alarm Systems Fire Suppression and Control Emergency Response Plan
		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	Providing surveillance and active screening and treatment of workers

S. No.	EHS Guideline	Applicability	Requirements	Description
			communities and health services	
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

<table>
<tr><th>Environmental Parameters</th><th>Applicability to Barmer Wind Farm</th><th>Limits/Methodology</th><th>Monitoring Frequency</th></tr>
<tr><td colspan="4">Environment</td></tr>
<tr><td>Emissions and Effluent Guidelines</td><td>1.No Air Emissions
2.Sanitary sewage will be discharged to a septic tank</td><td>1. NA
2. NA</td><td>1. NA
2. NA</td></tr>
<tr><td>Noise Guidelines</td><td>Noise generated from the propulsion of the WTGs</td><td>Noise generated should not exceed the following limits:
<table><tr><td>Receptor</td><td colspan="2">One hour L_{Aeq} (dBA)</td></tr><tr><td></td><td>Day time</td><td>Night time</td></tr><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><tr><td colspan="3">Day time – 0700-2200
Night time – 2200-0700</td></tr></table>NOR
Result in a maximum increase in background levels of 3 dB at the nearest receptor location</td><td>Frequency should be sufficient to provide representative data</td></tr>
<tr><td>Environmental Monitoring of Bird and bat injury and</td><td></td><td>Dead bird searches, involving entire carcasses, partial remains, and feathers, is the</td><td>Periodic searches</td></tr>
</table>

mortality		most common way to monitor for collisions with wind blades	
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**	**Y**	There should be no, to the extent possible,	Shadow Flicker and Blade Glint

S. No.	EHS Guideline	Applicability	Requirements	Description
	issues		or minimum shadow flicker and blade glint.	
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	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

S. No.	EHS Guideline	Applicability	Requirements	Description
			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 down the turbine, if necessary. Warning signs should be used to alert the public of risk.	safety, although the risk of ice throw is only relevant to cold climates and the overall risk of blade throw is extremely low.
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 Barmer 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 Barmer 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 Barmer 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 Barmer 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 Barmer 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 Barmer 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 Barmer 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 Barmer 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 Barmer 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 2002.	RSPCB MoEFCC CPCB	CWP-Devgarh/Gamesa shall ensure compliance under these Rules in order to maintain stipulated standards and environmental management through various supporting rules promulgated under the EP 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/Gamesa shall ensure that 'Consent to Establish' and 'Consent to Operate' under Water Act are obtained for Barmer 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/Gamesa shall ensure

S. No.	Applicable Legislation	Enforcing Agency	Applicable Permits and Requirement
			compliance under the rules to maintain stipulated standards.
5.	**Hazardous Wastes (Management Handling and Trans boundary Movement) Rules, 2008 as amended up to 2009** under the Environment (Protection) Act, 1986	RSPCB	The operation phase of the proposed project will result in generation of some quantities of hazardous waste, mostly in the form of waste/used oil. The project shall make an application in **Form 1** of The *Hazardous Waste (Management, Handling and Trans-boundary Movement) Rules, 2008* 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. 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. All the hazardous waste generated due to the project shall be stored and disposed as per the requirements of the *Hazardous Waste Rules* 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.**
6.	**Ozone Depleting Substances (Regulation) Rules, 2000** as amended in 2005	Ministry of Environment, Forests & Climate Change (MoEFCC)	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. CWP-Devgarh/Gamesa shall ensure that all the insulation material used for wiring and electrical units used for the proposed project are free of ozone depleting substances.
7.	**The Electricity Act, 2003** including rules 1956 and 2005 The Rules specify the general safety requirements for construction, installation,	Rajasthan State Electricity Board (RSEB) Rajasthan Electricity	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

S. No.	Applicable Legislation	Enforcing Agency	Applicable Permits and Requirement
	protection, operation and maintenance of electricity supply lines and apparatus.	Regulatory Commission (RERC)	license requires power generating companies to comply with the standards of performance specified in the Act. CWP-Devgarh/Gamesa shall obtain license as mandated under provisions of the Electricity Act and ensure that the health and safety requirements specified under the rules are complied to.
8.	**The Motor Vehicles Act 1988**, as amended by Motor Vehicles (Amendment) Act 2000, dated 14th August 2000 The **Central Motor Vehicles Rules 1989**, as amended through 29th June, 2012	Rajasthan Motor Vehicles Department	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. CWP-Devgarh/Gamesa shall ensure Compliance of stipulated emission standards under Rule 115.
9.	**Explosives Act 1884 and Rules 2008**	PESO Department of Geology and Mining, Rajasthan	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). Gamesa 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.
10.	The **Contract Labor (Regulation and Abolition) Act,** 1970 **Rajasthan Contract Labor (Regulation and Abolition) Rules**, **1971**	Chief Labor Commissioner, Rajasthan	CWP-Devgarh shall ensure that Gamesa 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. CWP-Devgarh/Gamesa 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.

S. No.	Applicable Legislation	Enforcing Agency	Applicable Permits and Requirement
11.	**The Trade Union Act, 1926**	Directorate of Industrial Safety and Health, Rajasthan	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. CWP-Devgarh/Gamesa shall ensure that there is no policy restricting association of workers union.
12.	**The Child Labor (Prohibition and Regulation) Act, 1986**	Directorate of Industrial Safety and Health, Rajasthan	The Act prohibits employment of children in certain occupation and processes. The Act also specifies conditions of work for children, if permitted to work. CWP-Devgarh/Gamesa 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.
13.	**Bonded Labor (Abolition) Act 1976**	Directorate of Industrial Safety and Health, Rajasthan	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. CWP-Devgarh/Gamesa shall ensure no bonded labor is engaged at site for construction or operation works.
14.	**Minimum Wages Act, 1948**	Directorate of Industrial Safety and Health, Rajasthan	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. CWP-Devgarh/Gamesa shall ensure payment of minimum wages as fixed by the government without any gender bias.
15.	**Equal Remuneration Act, 1976**	Directorate of Industrial Safety and Health, Rajasthan	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. CWP-Devgarh/Gamesa shall ensure compliance to the requirements of the Act.
16.	**Workmen's Compensation Act, 1923**	Directorate of Industrial	The Act requires if personal injury is caused to a workman by accident arising

S. No.	Applicable Legislation	Enforcing Agency	Applicable Permits and Requirement
		Safety and Health, Rajasthan	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. CWP-Devgarh/Gamesa shall ensure compliance to the requirements of the Act.
17.	**Maternity Benefit Act, 1961** 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.	Directorate of Industrial Safety and Health, Rajasthan	CWP-Devgarh/Gamesa shall ensure that engagement of female workers, if any, during their pregnancy adheres the requirement of the act.
18.	**National Environmental Policy 2006**	RSPCB	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. CWP-Devgarh/Gamesa shall ensure compliance to the requirements of this policy.

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 Barmer 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 Barmer district and study area.

5.1.1 Climate and Meteorology

The climate of Barmer is typically of the desert type i.e. hot and dry, with extreme conditions. The variation in day and night temperature is high. The mean monthly temperature varies from 44.5°C to 25.6°C in summer and 31.0°C to 9.0°C in winter. Throughout summer, the heat is intense and scorching winds prevail. Even during monsoon, the air is dry in between the fitful spells of rain. Hot winds blows throughout the day but nights are cool and pleasant in summers. The winter season sets in by November, when both day and night temperatures begin to drop, reaching the lowest point in January.

Atmosphere of the region is generally dry except during the monsoon period. Humidity is highest in August with mean daily relative humidity is 43%. The predominant wind direction is from South-west and wind speed varies from 8 to 12 km/hour during fine weather and 20 to 24 km/hour during storms. The dust storms are common phenomenon especially during summer. Due to extremely low rainfall and high temperatures, rate of evaporation is observed to be high. Moisture accumulates to some extent during rainy season and a few scattered trees are found.

5.1.2 Rainfall

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-Sept. Table 5.1 presents the annual and monthly rainfall in Barmer district in last ten years. The rainfall has been observed with a decrease towards the west. The rainfall over Barmer is scanty and is concentrated over four months, i.e. from June to September. 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 Barmer District (2004-2013)

Rainfall (mm)													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
2004	0	0	0	0	28.4	12.4	112	207.8	2	14.8	0	0	377.4
2005	0	0	8.2	20	0	51.4	158.8	71.8	193.2	0	0	0	503.4
2006	0	0	3.4	0	36.2	49.8	104.2	182.6	41.2	0	0	0	417.4
2007	0	22	13	0	5	42	58	35	68	0	0	12	255
2008	0	0	1	29	0	9	68	66	13	0	0	21	207
2009	0	0	3	0	0	36	97	31	0	0	0	0	167
2010	5	0	0	0	0	17.5	123	91	108	0	89	0	433.5
2011	0	13	0	0	3	0	38	187	102	0	0	0	343
2012	0	0	0	0	0	0	15	78	165	0	0	0	258
2013	3	23	1.5	15	0	31	112	122	98	49	0	0	454.5

Source: Dept. of water resources, Rajasthan

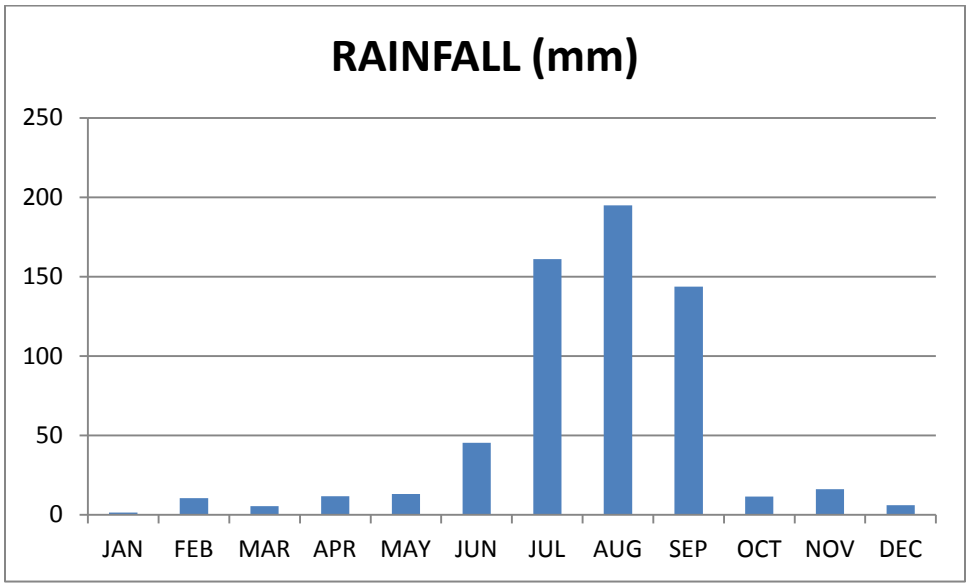


Figure 5.1 : Average Rainfall Pattern in Barmer District (2004-2013)

5.1.3 Seismicity

According to the seismic-zoning map of India, Barmer district lies in medium to high risk zone (III and IV). The western parts of the district are reported to fall under zone IV. The seismic data has been verified from “Vulnerability Atlas of India, Rajasthan Urban Sector Development, 2012”.

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 3 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 these three stations.

$PM_{2.5}$ Dust sampler of Envirotech Instruments, New Delhi, was used for monitoring of PM_{10}, $PM_{2.5}$, SOx, NOx and CO. Monitoring was done twice a week at each location for PM_{10} and $PM_{2.5}$, SOx and NOx and 8 hours a day twice a week for CO. The monitoring was conducted according to the National Ambient Air Quality Standards notified by Central Pollution Control Board 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 Barmer, the predominant wind direction in the area is from south west and north-west in the morning hours and south-west and south in the 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 three locations in the project area:

- Shiv
- Gunga
- Ambawadi

Figure 5.2 depicts that the predominant wind direction for the 30 year data period (1951-1980) considered for the analysis is south-west (23.6%) followed by north-west (17.3%) in the morning hours (8:30 am). The calm days (wind speed less than 1 kmph) account for 23.7% 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 (28.9%) followed by south (11.2%) in the

evening hours (17:30). The calm days (wind speed less than 1 kmph) account for 16.4% of the data period.

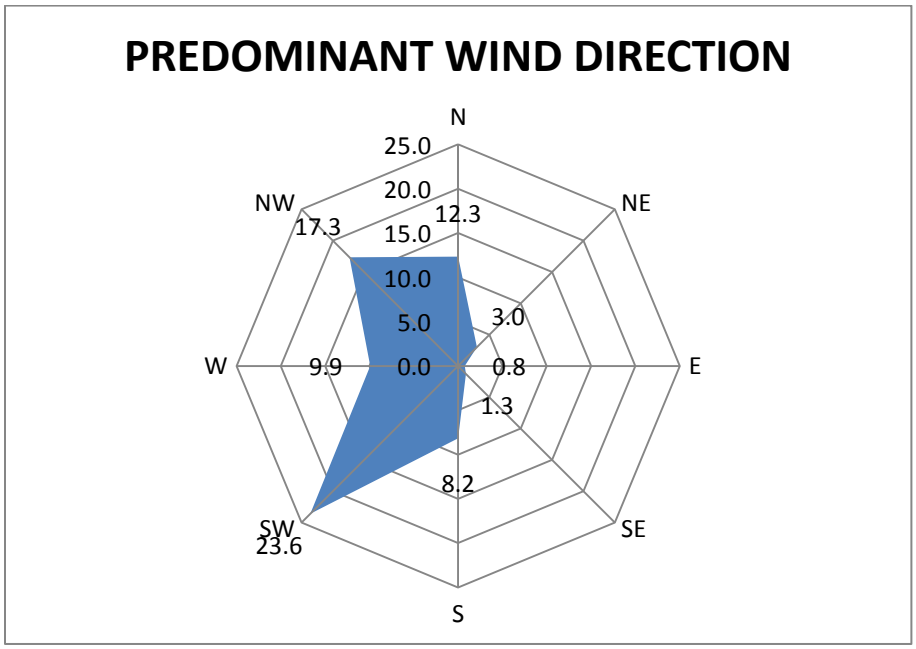


Figure 5.2 : Predominant Wind Direction in the Study Area – Morning Hours (08:30)

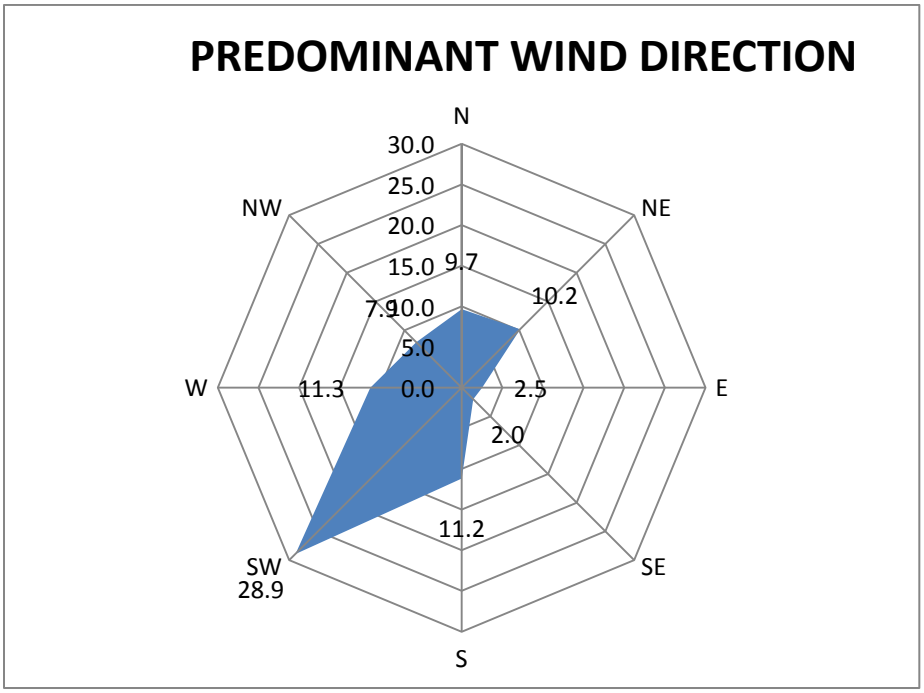


Figure 5.3 : Predominant Wind Direction in the Study Area – Evening Hours (17:30)

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

AAQ Monitoring Site at Shiv Village

AAQ Monitoring Site at Gunga Village

AAQ Monitoring Site at Ambawadi Village

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/m³)	$PM_{2.5}$ (µg/m³)	SOx (µg/m³)	NOx (µg/m³)	CO (µg/m³)
NAAQS (Industrial/Residential/Rural and other areas)		**100**	**60**	**80**	**80**	**2000**
Shiv	Max	73.1	31.7	7.3	14.7	680
	Min	55.2	24.5	5.7	11.0	525
	Mean	62.6	27.5	6.4	13.0	604
	98 Percentile	72.5	31.4	7.3	14.6	676
Gunga	Max	79.2	34.6	6.9	12.6	685
	Min	62.5	27.2	4.5	9.3	596
	Mean	71.8	30.9	5.8	10.9	634
	98 Percentile	78.9	34.4	6.8	12.5	682
Ambawadi	Max	76.2	35.0	6.2	12.2	617
	Min	60.6	28.3	4.7	9.4	426
	Mean	66.4	31.3	5.5	11.0	545
	98 Percentile	75.6	34.8	6.2	12.2	616

Interpretation of Air quality

PM_{10}

The average highest PM_{10} level was observed at Gunga (79.2 µg/m^3), while the lowest level was observed at Shiv (55.2 µg/m^3). The PM_{10} levels are observed to be lower than the NAAQS level of 100 µg/m^3. The graphical representation of PM_{10} concentrations is provided in Figure 5.5.

$PM_{2.5}$

The highest mean $PM_{2.5}$ levels were found at the Ambawadi (35.0 µg/m^3) while the lowest levels was found at Shiv (24.5 µg/m^3). The $PM_{2.5}$ values are within the NAAQS level of 60 µg/m^3. The graphical representation of the $PM_{2.5}$ concentrations is provided in Figure 5.6.

SOx

The highest levels of SOx were found to be within the prescribed NAAQS standards. The maximum limit was observed at Shiv (7.3 µg/m^3) and the lowest level was observed at Gunga (4.5 µg/m^3). The graphical representation of SOx concentrations is provided in Figure 5.7.

NOx

The highest level of NOx was found at Shiv (14.7 µg/m^3) whereas lowest level was found at Gunga (9.3 µg/m^3). NOx values are within the NAAQS level of 80 µg/m^3. The graphical representation of NOx concentrations is provided in Figure 5.8.

CO

The highest level of CO was found at Gunga (685 µg/m^3) whereas lowest level was found at Ambawadi (426 µg/m^3). CO values are within the NAAQS level of 2000 µg/m^3. The graphical representation of CO concentrations is provided in Figure 5.9.

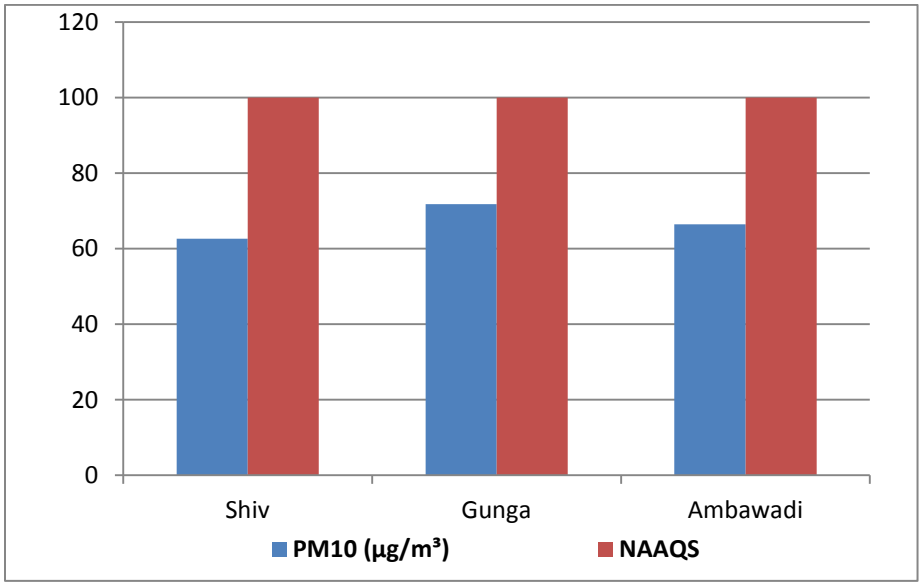


Figure 5.5 : Graphical Representation of PM_{10} Concentrations

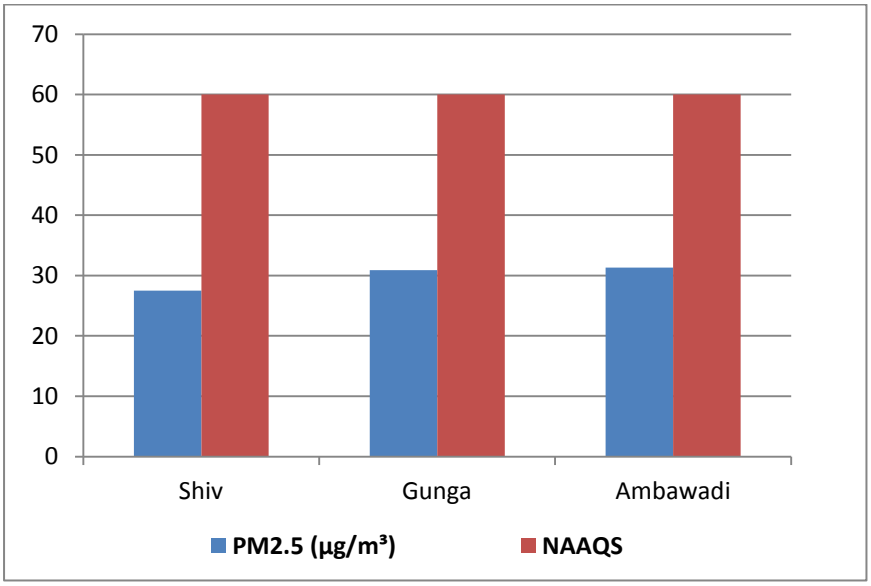


Figure 5.6 : Graphical Representation of $PM_{2.5}$ Concentrations

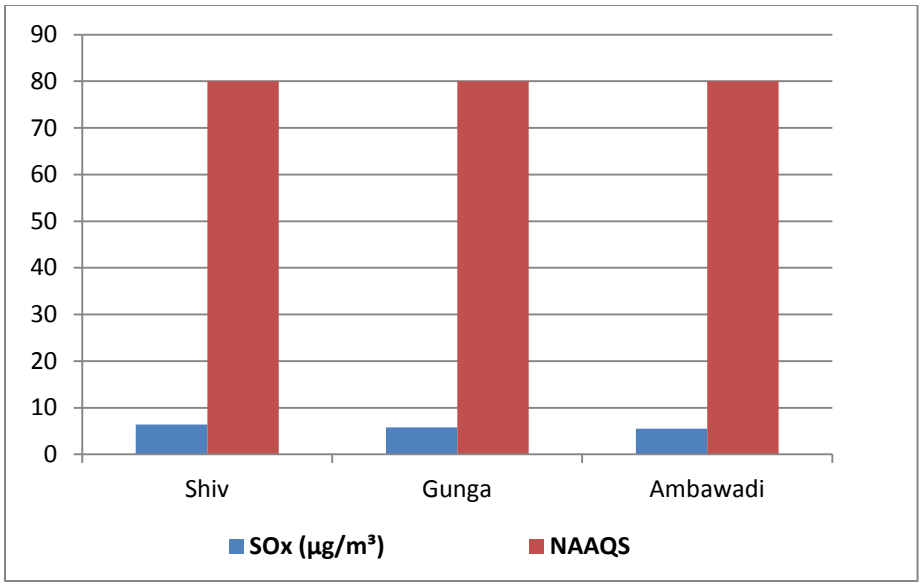


Figure 5.7 : Graphical Representation of SOx Concentrations

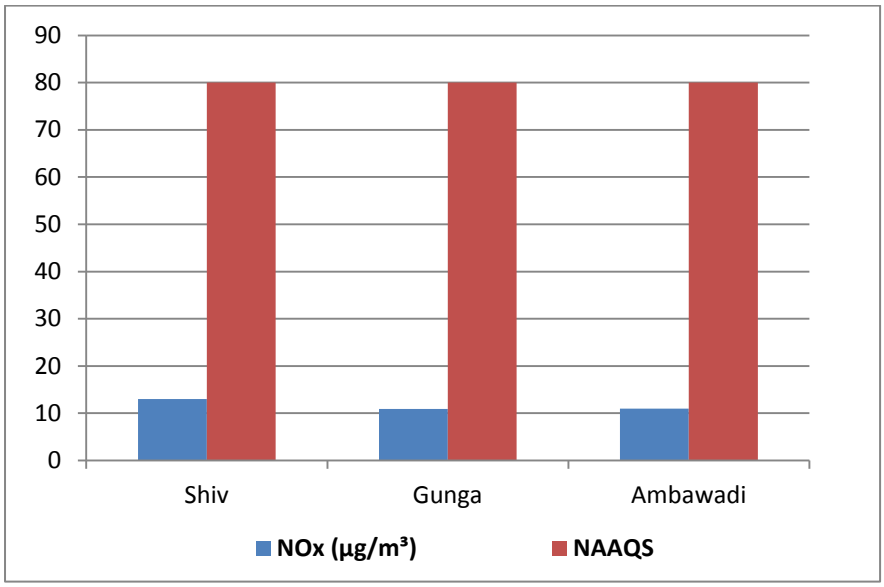


Figure 5.8 : Graphical Representation of NOx Concentrations

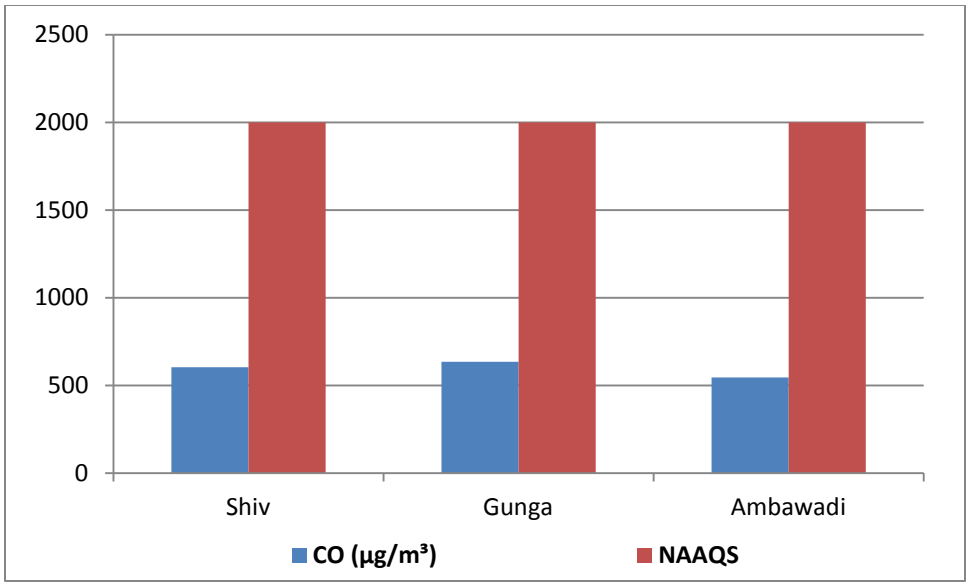


Figure 5.9 : Graphical Representation of CO Concentrations

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

Groundwater is the main source of water in the project area for drinking and other purposes. As per the assessment by Central Ground Water Board (CGWB), specific conductance ranges between 385 and 46,580 micro mhos/cm at 25^0C. It has been observed that by and large, concentration of specific conductivity confirms broadly with that of chlorides. The chloride contents ranges from 10 to 19,099 ppm in phreatic aquifer and from 98 to 76,470 ppm in deeper aquifer. Fluoride in the ground water ranges between traces and 11.30 mg/l. In major part of the area, it is within the limit of 2.0 mg/l. The nitrates in the ground water vary widely. Its concentration ranges between traces to as high as 745 ppm. In north eastern part of the district, the concentration of nitrate is under permissible limit. 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.

	
Water Sampling at Shiv Village	**Water Sampling at Ambawadi Village**

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 (Shiv)	GW-2 (Gunga)	GW-3 (Ambawadi)
1	Color	Hazen	5	15	Less than 5	Less than 5	Less than 5
2	pH	-	6.5-8.5	No relaxation	7.89	7.83	7.68
3	Turbidity	NTU	1	5	0.1	0.1	0.1
4	Total Dissolved Solids	Hazen units	500	2000	624	598	603
5	Conductivity	umhos/cm	--	--	931	893	900
6	Total Alkalinity	mg/L	200	600	230	212	224
7	Total Arsenic (as As)	mg/L	0.01	0.05	0.01	0.01	0.01
8	Fluoride (as F)	mg/L	1.0	1.5	0.82	0.4	1.3
9	Total Hardness (as CaCO3)	mg/L	200	600	357	302	312
10	Calcium (as Ca)	mg/L	75	200	69	70	61
11	Chlorides (as Cl)	mg/L	250	1000	54	48	51
12	Copper (as Cu)	mg/L	0.05	1.5	0.01	0.01	0.01
13	Cyanide (as Cn)	mg/L	0.05	No relaxation	0.01	0.01	0.01
14	Sulphate (as SO4)	mg/L	200	400	26	28	32
15	Magnesium (as Mg)	mg/L	30	100	45	31	39
16	Nitrate (as NO3)	mg/L	45	No relaxation	120	119	125
17	Iron (as Fe)	mg/L	0.3	No relaxation	0.34	1.37	1.34
18	Lead (as Pb)	mg/L	0.01	No relaxation	0.01	0.01	0.01
19	Manganese (as Mn)	mg/L	0.1	0.3	0.01	0.01	0.01
20	Mercury (as Hg)	mg/L	0.001	0.001	0.001	0.001	0.001
21	Aluminum (as Al)	mg/L	0.03	0.2	0.001	0.001	0.001
22	Phenolic Compounds (as C_6H_5OH)	mg/L	0.001	0.002	0.001	0.001	0.001
23	Selenium (as Se)	mg/L	0.01	No relaxation	0.01	0.01	0.01
24	Total Chromium	mg/L	0.05	No relaxation	0.01	0.01	0.01

S. No.	Parameters	Measurement Unit	Requirement (Acceptable Limit)	Permissible Limits	GW-1 (Shiv)	GW-2 (Gunga)	GW-3 (Ambawadi)
	(as Cr)						
25	Cadmium (as Cd)	mg/L	0.003	No relaxation	0.001	0.001	0.001
26	Free Residual Chlorine	mg/L	0.2	1.0	0.01	0.01	0.01
27	Zinc (as Zn)	mg/L	5	15	31	0.1	0.1
28	Sodium (as Na)	mg/L	-	-	9	12	15
29	Potassium (as K)	mg/L	-	-	30	9	8
30	Anionic Detergent (as MBAS)	mg/L	0.2	1.0	0.1	0.1	0.1
31	Mineral Oil	mg/L	0.5	No relaxation	0.01	0.01	0.01
32	Boron (as B)	mg/L	0.5	1.0	0.1	0.1	0.1
33	Pesticides	-	-	0.001	Absent	Absent	Absent
34	Chemical Oxygen demand	mg/L	-	-	5	5	5

** IS 10500:2012 Drinking Water Specifications (Second Revision) by Bureau of Indian Standards (BIS)*

**The figures in the brackets indicated permissible limit in absence of alternate source*

Interpretation of water quality

Ground water of Barmer district has high fluoride and other metal heavy metal contents. Serious problem of hunchback and related disease are on the rise in district. The number of physically challenged is increasing. People are getting weak, their teeth have turned yellow and they have other related problems. As per water supply project of Barmer- RUIDP-Government of India (November 2008), maximum fluoride content is 0.36- 5.34 mg/l in district while at three sampling fluoride content was measured as 0.4 - 1.3mg/l. As per Central Ground Water Authority, Barmer District, conductivity of district lies between 835-17520 umhos/cm while at sampling location EC measured between 893-931 umhos/cm. TDS of area is 543-11388 while at sampling locations TDS measured between 598-624 mg/l. Calcium content is 4-412 mg/l while at sampling location calcium content was measured as 61- 70 mg/l. Magnesium content is 5- 554 mg/l while at sampling location magnesium content was measured as 31- 45 mg/l. Total hardness is 70- 3060 mg/l while at sampling location hardness was measured as 302-357 mg/l. Chloride content is 50- 8130 mg/l while at sampling location chloride content was measured as 48- 54 mg/l. Sulfate content is 20- 1825 mg/l while at sampling location sulfate content was measured as 26- 32 mg/l. Nitrate content is 0- 745 mg/l while at sampling location nitrate content was measured as 119- 125 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 the Soil in Barmer District

The district as a whole forms part of the Great Indian Thar Desert. The district is known for its bentonite, lignite and petroleum mineral wealth. The district is situated between 24^0 40' 00" and 26^0 32' 00" North latitude and 70^0 05' 00" and 72^0 52' 00" East longitude covering geographical area of 28,387 km^2. Geographically, the area as a whole forms a part of the Great Indian Desert. A part from a small off shoot of the Aravalli hills in the east, the area is a vast sandy tract. The country west of Luni River represents sandy plain dotted with bold hills.

Soils of the district are classified as follows:

- **Desert Soil**: Desert soil area is occupied by alluvium and wind blown sand, yellowish brown, sandy to sandy loam, loose, structure less, well drained with high permeability and lies in northern, western and central part of the district.
- **Sand Dunes**: These are non-calcareous soil, sandy to loamy sand, loose, structure less and well drained. It lies in northern, western and central part of the district.
- **Red Desert Soil**: These are pale brown to reddish brown soils, structure less, loose, and well drained. Texture varies from sandy loam to sandy clay loam and lies in eastern and south eastern part of the district.

- **Saline soil of depressions**: This type of soil found in salt lakes. They are dark grey to pale brown, heavy soils with water table very near to the surface and are distinctly saline.
- **Lithosols & Regosols of Hills:** This type of soil found in isolated hills as litho-slopes. These soils are shallow with gravels very near to the surface, high textured, fairly drained, reddish brown in color and lies in south eastern part of the district.

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

Table 5.4 : Major Type of Soil in Barmer District

Major Soil Type	1. Desert soil 2. Sand dunes 3. Red desert soil 4. Saline soil of depressions 5. Lithosols & Regosols of hills
Geomorphology:	
Major Physiographic Units	Sand Dunes, Aeolians & Alluvial Plain, Ridges and Hillocks
Major Drainage	Luni River

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 gms) 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 physicochemical 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.

Soil Sampling at Gunga Village

Soil Sampling at Ambawadi Village

Figure 5.11 : Pictures taken during soil sampling

Physicochemical characteristics of soil are presented in Table 5.5.

Table 5.5 : Physico-Chemical Characteristics of Soil

S No.	Parameters	Unit	S-1 Gunga	S-2 Ambawadi
Physical Parameters				
1.	Color	--	Yellowish Brown	Yellowish Brown
2	Texture	--	Clay Loam	Sandy Loam
3	Porosity	%	49.8	46.8
4.	Bulk Density	gm/cc	1.33	1.41
5	Water Holding Capacity	%	30.4	27.5
6	Moisture Content	%	2.6	1.8
Chemical Parameters				
7	pH	--	7.54	7.36
8	Electrical Conductivity	µmhos/cm	503.3	284.8
9	Organic Matter	%	0.95	0.83
10	Organic Carbon	%	0.55	0.48
11	Calcium (as Ca+)	mg/kg	1176	1335
12	Magnesium (as Mg+)	mg/kg	1190	865
13	Sulphate as SO4	mg/kg	2830	2934
14	Chloride as Cl	mg/kg	673.6	436.4
15	Sodium as Na	mg/kg	2246	3245
16	Cation Exchange Capacity (CEC)	meq/100 gm	16	31
17.	**Available Nutrients**			
I)	Available Nitrogen (as N)	kg/ha	286.2	256.3
II)	Available Phosphorous (as P)	kg/ha	14.8	17.5
III)	Available Potassium (as K)	kg/ha	132.0	146.0
18	Manganese as Mn	mg/kg	0.1	0.1
19	Zinc as Zn	mg/kg	1.4	1.6

S No.	Parameters	Unit	S-1 Gunga	S-2 Ambawadi
20	Copper as Cu	mg/kg	0.38	0.45
21	Boron as B	mg/kg	0.1	0.1
22	SAR	%	1.5	1.8

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 Clay Loam and 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 1.33 to 1.41 gm/cm^3.

- **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 27.5 to 30.4%.

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 7.36 to 7.54 thereby indicating the soils are neutral to slightly 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 0.48 to 0.55 % (0.83 to 0.95% 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 256.3 & 286.2-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 14.8 & 17.5-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 132.0 & 146.0-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) as 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 1.4 to 1.6 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 medium fertility status or agricultural potential of soil. Thus the soil of the study area are low fertile.

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 the National Highway (NH-15) and two residential locations 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 5.6 and graphically represented in Figure 5.13.

Noise Monitoring at Shiv Village

Noise Monitoring at Gunga Village

Noise Monitoring at Ambawadi Village

Figure 5.12 : Pictures taken during Noise Monitoring

Table 5.6 : Ambient Noise Quality in the Study Area

Location	NH-15 (Near Shiv)	Gunga	Ambawadi
Category	**Industrial Area**	**Residential Area**	**Residential Area**
Standard (Day)	**75**	**55**	**55**
Standard (Night)	**70**	**45**	**45**
Time	**Noise Level (dBA)**		
	Hourly Leq		
Day - 06:00-07:00	54.2	51.3	47.8
07:00-08:00	57.6	55.5	51.4
08:00-09:00	58.7	54.8	52.6
09:00-10:00	60.2	50.5	55.7
10:00-11:00	60.5	51.7	51.6
11:00-12:00	57.6	48.2	50.2
12:00-13:00	61.0	51.9	48.3
13:00-14:00	58.9	49.7	49.7
14:00-15:00	59.6	47.8	48.5
15:00-16:00	57.2	51.2	42.6
16:00-17:00	58.3	48.6	46.3
17:00-18:00	60.0	48.1	50.8
18:00-19:00	55.6	52.3	51.2
19:00-20:00	57.5	54.2	50.9
20:00-21:00	56.4	50.3	49.6
21:00-22:00	55.6	51.0	47.7
Night - 22:00-23:00	50.9	44.9	44.0
23:00-00:00	48.2	39.2	41.8
00:00-01:00	47.0	42.1	41.2
01:00-02:00	45.6	43.0	40.5
02:00-03:00	45.4	42.1	38.6
03:00-04:00	46.6	41.2	40.2
04:00-05:00	44.5	39.9	39.3
05:00-06:00	45.1	41.6	43.0
Leq Day	**58.4**	**51.7**	**50.6**
Leq Night	**47.2**	**42.1**	**41.4**

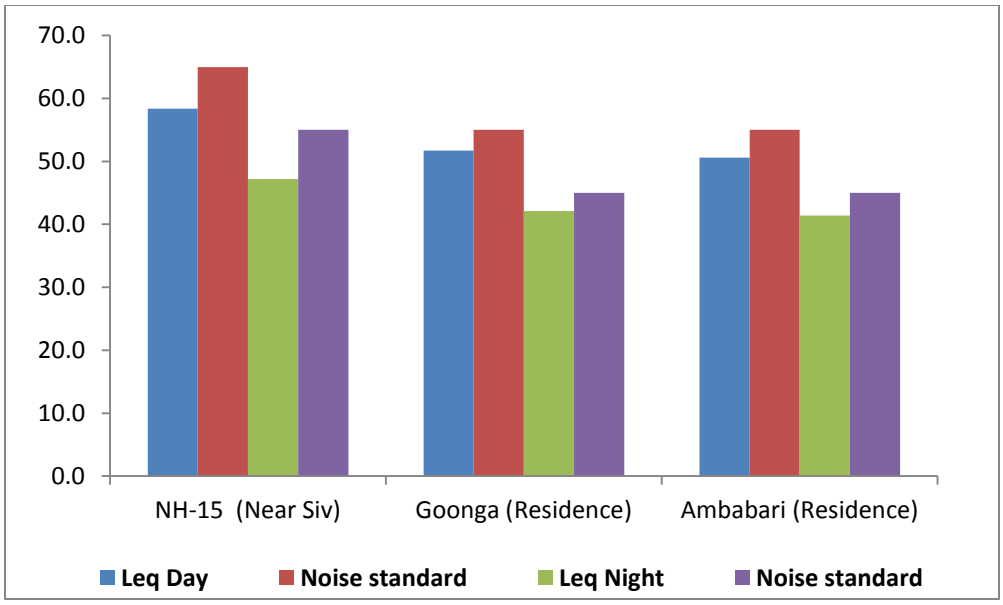


Figure 5.13 : Graphical Representation of Noise Environment

Interpretation of Noise Environment

It was observed that the noise levels at the receptor locations ranged from 50.6 to 58.4 dB (A) during day time and 41.4 to 47.2 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

Western India, an area of half a million km^2 is largely arid and semiarid region. The oldest mountain range Aravali cuts across the northwestern part of India defining the eastern boundary of the Thar Desert in Rajasthan. Thar Desert occupies about 2 million km^2 of unique and diverse habitats. Each of the various habitats and landforms in the desert supports distinctive plants (Khan et al., 2003). The whole Thar 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 were found in the area. Such type of specialism makes these life forms more sensitive to climatic and habitat changes.

Forest and Forest Types

The natural vegetation present in the Indian desert is classed as Northern Desert Thorn Forest (Champion 1936). A total of 32639 km^2 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.

Present project falls in the Barmer District which accounts for a geographical area of 28,387 km^2 having 172 km^2 forest cover which is about 0.61% of the district's geographical area.[1] A 106 km^2 scrub land is also reported from Barmer district. In terms of Forest Density Classes, the district has 3 km^2 areas under moderately dense forest and 169 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 Shiv Forest Range is hot and sandy. Generally the vegetation in this arid region is sparse and mainly xerophytic adapted plants are able to establish themselves in this region. Most of the study area under Forest Range Shiv consists of dry undulating plains of hardened sand and the remaining region is largely a rolling plain of loose sand, forming shifting sand dunes varying in size and length. 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. 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. It has sparse vegetation without any true forest. The climate of the studied site is characterized by the high wind velocity, low relative humidity, with less rainfall.

Flora

In the Thar Desert, **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.

The vegetation of the project area has been assessed by using phyto-sociological survey in the month of October, 2014. A total of 30 quadrats (N=30) measuring 10x10m^2 were placed in three study sites. Quadrats were regularly placed at an interval of 0.5 km in each of the three 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

[1] ***India State of Forest Report, 2011***

was computed by using Shannon Wiener Diversity Index (Shannon Wiener, 1963) as: H = - Σ (ni/n) x ln (ni/n) Where, ni 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.

Although forest working plan of Barmer Forest Division reported 57 trees, 55 herbs and 41 grasses from the division but a total of 9 trees, 7 shrubs and 8 herbs/grasses species were recorded during present primary survey. Prosopis juliflora, Capparis deciduas, and Acacia nilotica were found dominant tree species, Calotropis procera and Aerva javanica were the leading shrub's species whereas Cenchrus biflorus and Cynodon dactylon has been recorded dominant herb/grass species. The density of tree species was recorded between 16.67 and 26.67/ha, shrub's density was recorded from 55.00 to 151.67/ha while density of herb and grasses has been recorded between 390.00 and 811.67/ha. Tables 5.7 through 5.9 present the phytosociological characteristics of vegetation around Shiv, Gunga and Ambabadi villages respectively. Figures 5.14 through 5.16 present the diversity, evenness and species richness of Shiv, Gunga and Ambawadi villages respectively.

Table 5.7 : Phytosociological Characters of Vegetation around Shiv area

Species	Family	Density (/ha)	Frequency (%)	Abundance	A/F Ratio	IVI
Trees						
Acacia nilotica	Fabaceae	3.33	3.33	1.00	0.30	45.27
Azadirachta indica	Meliaceae	3.33	3.33	1.00	0.30	45.80
Prosopis juliflora	Fabaceae	6.67	6.67	1.00	0.15	108.78
Capparis decidua	Capparaceae	3.33	6.67	1.00	0.15	100.15
Total		**16.67**				**300.00**
Shrub						
Calotropis procera	Apocynaceae	23.33	8.33	2.80	0.34	115.6
Capparis sp	Capparaceae	8.33	5.00	1.67	0.33	51.99
Indigofera sp	Fabaceae	10.00	3.33	3.00	0.90	57.67

Species	Family	Density (/ha)	Frequency (%)	Abundance	A/F Ratio	IVI
Acacia jacquemontii	Fabaceae	13.33	5.00	2.67	0.53	74.74
Total		**55.00**				**300**
Herb						
Leptadenia pyrotechnica	Asclepiadaceae	71.67	11.67	6.14	0.53	47.17
Erogrostis sp	Poaceae	60.00	8.33	7.20	0.86	47.33
Cenchrus biflorus	Poaceae	85.00	10.00	8.50	0.85	63.93
Cynodon dactylon	Poaceae	105.00	11.67	9.00	0.77	71.49
Fagonia cretica	Zygophyllaceae	68.33	13.33	5.13	0.38	70.09
Total		**390.00**				**300**

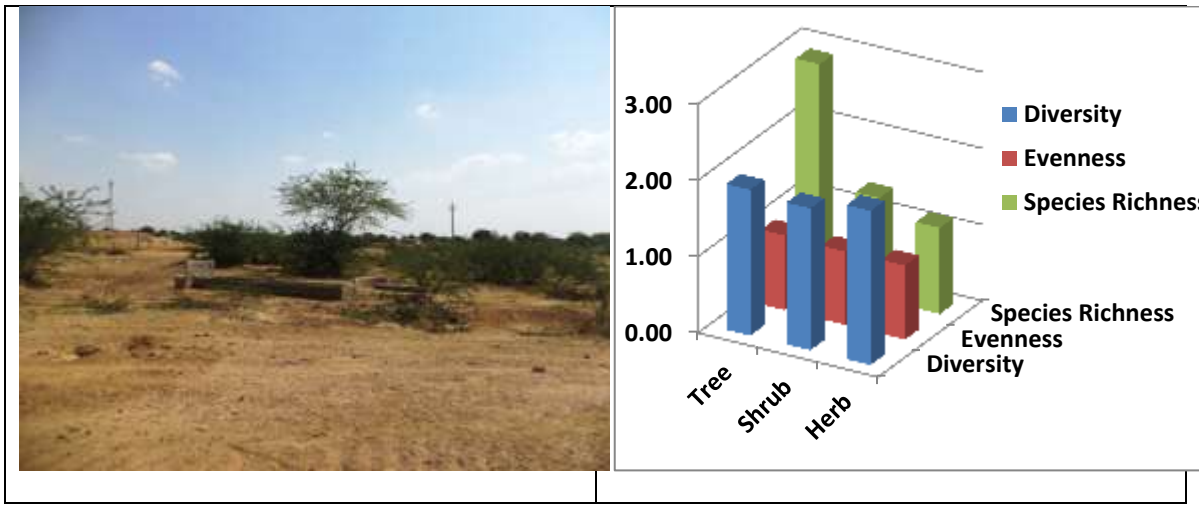


Figure 5.14 : Diversity, Evenness & Species Richness of Shiv Area

Table 5.8 : Phytosociological Characters of Vegetation around Gunga area

Species	Family	Density (/ha)	Frequency (%)	Abundance	A/F Ratio	IVI
Trees						
Acacia nilotica	Fabaceae	3.33	3.33	1.00	0.30	50.48
Azadirachta indica	Meliaceae	3.33	3.33	1.00	0.30	51.12
Prosopis juliflora	Fabaceae	3.33	3.33	1.00	0.30	75.81
Capparis decidua	Capparaceae	3.33	3.33	1.00	0.30	63.10
Ziziphus xylopyrus	Rhamnaceae	3.33	3.33	1.00	0.30	59.49
Total		**16.67**				**300.00**
Shrub						
Calotropis procera	Apocynaceae	16.67	8.33	2.00	0.24	108.03
Capparis sp	Capparaceae	8.33	5.00	1.67	0.33	35.28
Indigofera sp	Fabaceae	10.00	6.67	1.50	0.23	52.91
Acacia jacquemontii	Fabaceae	11.67	5.00	2.33	0.47	52.21
Mimosa rubicaulis	Fabaceae	11.67	3.33	3.10	0.93	51.58
Total		**58.33**	**28.33**			**300.00**
Herb						
Dactyloctenium scindicum	Poaceae	101.67	13.33	7.63	0.57	40.66
Cenchrus biflorus	Poaceae	108.33	11.67	9.29	0.80	43.01
Cynodon dactylon	Poaceae	110.00	13.33	8.25	0.62	46.94
Saccharum spontaneum	Poaceae	110.00	15.00	7.33	0.49	48.34
Ergamopagan sp	Poaceae	71.67	13.33	5.38	0.40	43.87
Erogrostis sp	Poaceae	70.00	15.00	4.67	0.31	38.2

Species	Family	Density (/ha)	Frequency (%)	Abundance	A/F Ratio	IVI
Fagonia cretica	Zygophyllaceae	75.00	11.67	6.43	0.55	38.97
Total		**646.67**	**93.33**			**300.00**

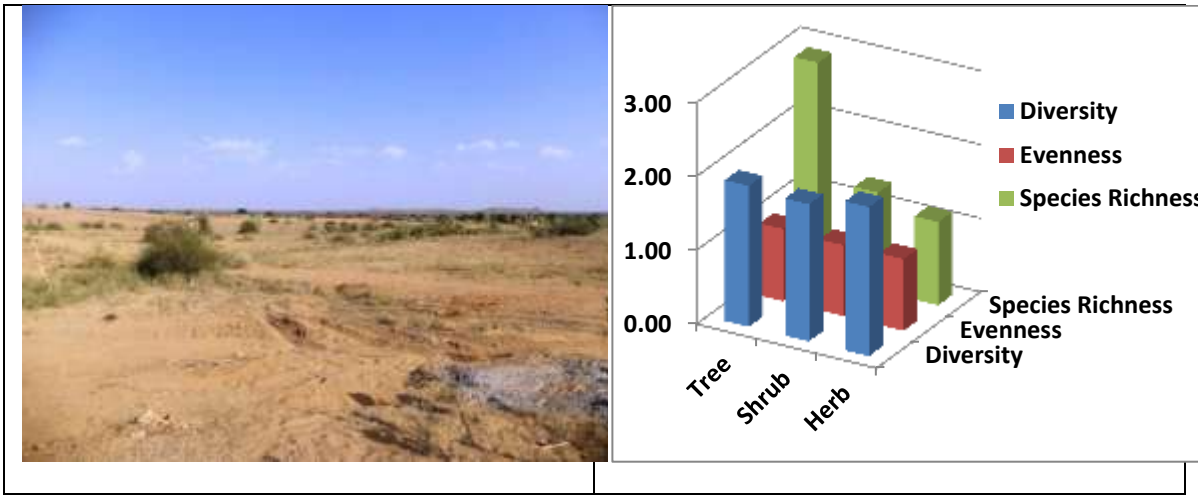


Figure 5.15 : Diversity, Evenness & Species Richness of Gunga Area

Table 5.9 : Phytosociological Characters of Vegetation around Ambawadi Area

Species	Family	Density (/ha)	Frequency (%)	Abundance	A/F Ratio	IVI
Trees						
Acacia nilotica	Fabaceae	3.33	3.33	1.00	0.30	34.56
Azadirachta indica	Meliaceae	3.33	3.33	1.00	0.30	35.14
Prosopis juliflora	Fabaceae	3.33	3.33	1.00	0.30	41.22
Prosopis cineraria	Fabaceae	6.67	6.67	1.00	0.15	72.82
Ziziphus xylopyrus	Rhamnaceae	3.33	3.33	1.00	0.30	42.77
Salvadora oleoides	Salvadoraceae	3.33	3.33	1.00	0.30	38.35
Capparis decidua	Capparaceae	3.33	3.33	1.00	0.30	35.14
Total		**26.67**				**300.00**
Shrub						
Calotropis procera	Apocynaceae	21.67	5.00	4.33	0.87	48.57
Aerva javanica	Amaranthaceae	38.33	11.67	3.29	0.28	86.59
Capparis sp	Capparaceae	18.33	6.67	2.75	0.41	30.68
Indigofera sp	Fabaceae	21.67	5.00	4.33	0.87	30.91
Acacia jacquemontii	Fabaceae	6.67	3.33	2.00	0.60	20.51
Calligonum polygonoides	Polygonaceae	20.00	10.00	2.00	0.20	38.3
Mimosa rubicaulis	Fabaceae	25.00	11.67	2.14	0.18	44.45
Total		**151.67**	**53.33**			**300.00**
Herb						
Leptadenia pyrotechnica	Asclepiadaceae	110.00	13.33	8.25	0.62	35.94
Dactyloctenium scindicum	Poaceae	111.67	11.67	9.57	0.82	36.92

Species	Family	Density (/ha)	Frequency (%)	Abundance	A/F Ratio	IVI
Cenchrus biflorus	Poaceae	130.00	13.33	9.75	0.73	42.43
Cynodon dactylon	Poaceae	170.00	11.67	14.57	1.25	45.32
Saccharum spontaneum	Poaceae	93.33	13.33	7.00	0.53	40.22
Ergamopagan sp	Poaceae	68.33	13.33	5.13	0.38	31.33
Erogrostis sp	Poaceae	63.33	10.00	6.33	0.63	30.15
Fagonia cretica	Zygophyllaceae	65.00	10.00	6.50	0.65	37.68
Total		**811.67**	**96.67**			**300.00**

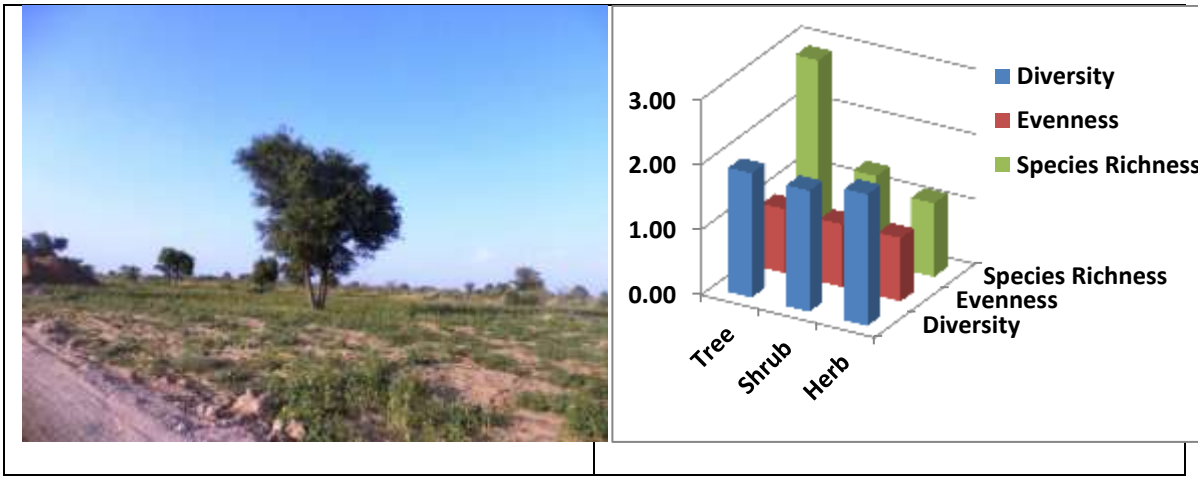


Figure 5.16 : Diversity, Evenness & Species Richness of Ambabadi Area

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), Indian Jird (Meriones hurrianae), and antelope like Desert 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 (Pterocles 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 information 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. Forest Working Plan of Forest Division reported 16 species of mammals in the study area and out of these 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	Vulpes bengalensis	Carnivora	Canidae	LC	II
2	Blue Bull	Boselaphus tragocamelus	Artiodactyla	Bovidae	LC	IV
3	Indian Palm Squirrel	Funambulus pennantii	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 23 bird species in the study area which is both residents and migrants but a total of 12 bird species were sighted during present primary study. 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	Indian Silverbill	Euodice malabarica	R	LC
2	White-eared Bulbul	Pycnonotus leucotis	R	LC
3	House Sparrow	Passer domesticus	R	LC
4	Common Sandpiper	Actitis hypoleucos	M	LC
5	Common Quail	Coturnix coturnix	M	LC
6	Common Pigeon	Columba livia	R	LC
7	Red-wattled Lapwing	Vanellus indicus	R	LC
8	Baya Weaver	Ploceus philippinus	R	LC

S. No.	Name	Scientific Name	Habit	CS
9	Tawny Pipit	Anthus campestris	M	LC
10	House Crow	Corvus splendens	R	LC
11	Asian Desert Warbler	Sylvia nana	R	LC
12	Eurasian Collared Dove	Streptopelia decaocto	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, 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

Barmer is located in the western part of the state forming a part of the Thar Desert. The district borders Jaisalmer district in the north, Jalore district in the south, Pali district and Jodhpur district in the east, and Pakistan in the West. The total area of the district is 28,387 square kilometres (10,960 sq mi). The district is located between 24° 58' to 26° 32' N Latitude and 70° 05' to 72° 52' E Longitude.

The longest river in the district is the Luni. It is 480 km in length and drain into the Gulf of Kutch passing through Jalore. Poorly planned and rapid urbanisation has increased Barmer's vulnerability to flash flooding. The local ecology and soil type is not equipped to deal with sudden or excessive water accumulation, which causes short- and long-term damage. Other areas suffer the gradual effects of 'invisible disasters', which also threaten the lives and livelihoods of the locals

Area and Administrative Units

The district is divided into 4 sub-divisions - Barmer, Gudhamalani, Balotra and Sheo and 8 tehsils. Out of the five tehsils existed during 1981, four namely Barmer, Sheo, Siwana and Pachpadra, were transferred from former Jodhpur State and Chohtan was constituted with 77 villages, transferred from Sanchore tehsil of Jalore district, and 69 villages taken from Barmer tehsil of the district during the inter-censal period 1951-61. During this period, 54 villages were also transferred from Barmer to Pachpadra tehsil. During the inter-censal period 1981-91, two new tehsils Baytoo and Gudhamalani have been formed. Baytoo tehsil has been formed from 244 villages transferred from Barmer tehsil likewise, Gudhamalani from 353 villages also transferred from Barmer tehsil. In all there are 1933 inhabited villages and 8 un-inhabited villages. There are 2 towns classified.

Total Area of Barmer District is 28,387 Sq.km. which is 8.29% of total area of Rajasthan. For the Administrative convenience, Barmer is divided in 8 Tehsils as listed in Table 5.12 and as shown graphically in Figure 5.17.

Table 5.12 : Area of Tehsils and their Population of District Barmer

Tehsils	Total Population	Urban Population	Rural Population
Sheo	237080	0	237080
Baytoo	253350	0	253350
Pachpadra	422784	74496	348288
Siwana	106988	0	272560
Gudha Malani	453911	6513	447398
Barmer	370721	100828	269893
Ramsar	108001	0	108001
Chohtan	485344	0	485344

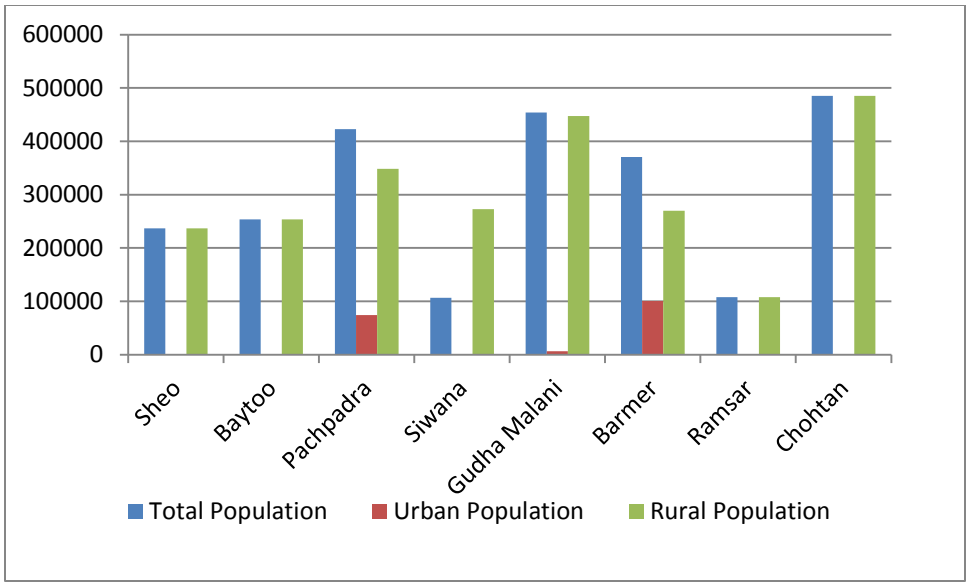


Figure 5.17 :Graph Representation of Tehsil Population of Barmer District

Study Area Details

Socio-Economic Environment

The study area Villages mainly falls in the tehsil: Shiv of Barmer district. Project site is well connected with road (NH-15). Geographical Coordinates of the Project site is as follows:

Latitude: 23°45'1.68"N

Longitude: 75°38'30.66"E

Project Affected Villages

There are 4 Villages which are going to be affected by the project activities namely Gunga, Ambavadi, Jaseka Gaon and Shiv.

Demographic Profile Project Affected Villages

Population

Total Population of the Study area villages as per Census of India, 2011 is 10,798. The total number of Household being 1958. Total Male Population of the Study area is 5790 and total Female Population of the Study Area is 5008. 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
Sheo	Gunga	849	4484	2413	2071

Tehsil	Village	No. of Household	Total Population	Male Population	Female Population
	Ambavadi	183	1138	580	558
	Jase KaGaon	119	636	331	305
	Shiv	807	4540	2466	2074
Total		**1958**	**10798**	**5790**	**5008**

Sex Ratio

The Sex Ratio of the Study area is 914. Figure 5.18 presents the graphical representation of the male/female population of the project affected villages in comparison to the total population.

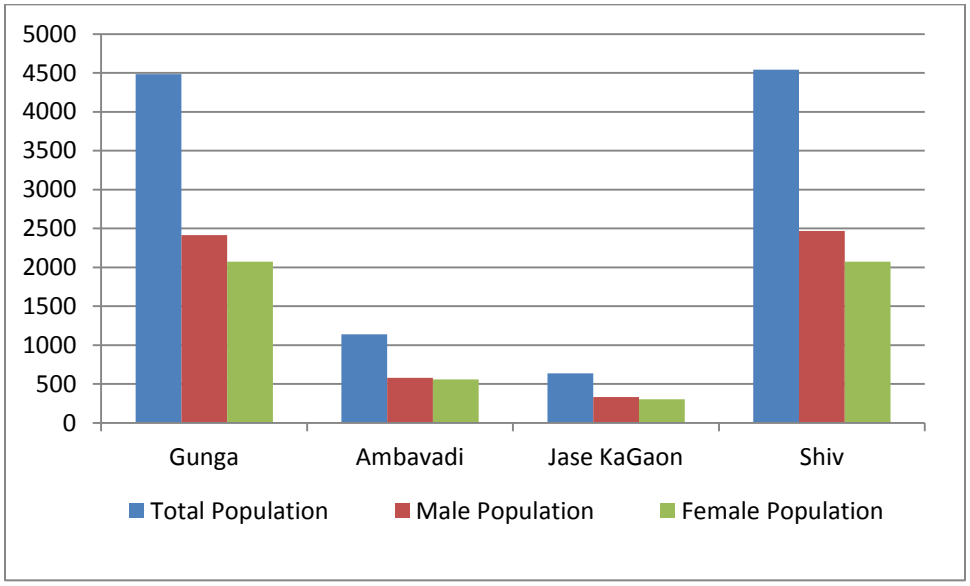


Figure 5.18 :Graphical Representation Male/Female Population

SC / ST Population

A considerable 9.7% of the population in the Study Area is constituted by SC and there is 0.07% 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 5.19.

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

Village Name	SC Population	% SC	ST Population	% ST
Ambawadi	47	4	0	0.00
Shiv	651	14	9	0.20
Jase Ka Gaon	133	21	0	0.00
Gunga	428	10	3	0.07
	608	9.7	3	0.07

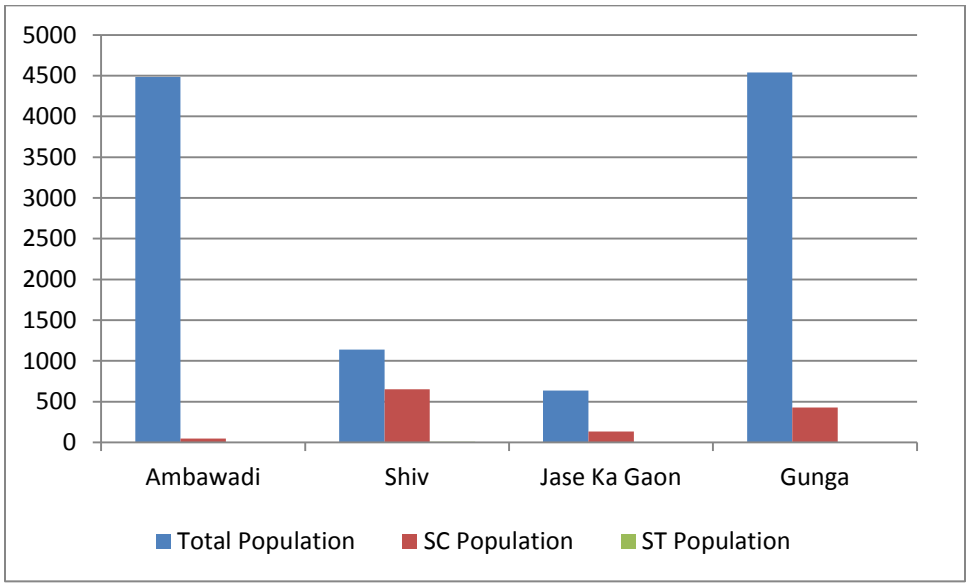


Figure 5.19 : Comparative Graph of SC/ST Population in Study Area

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.

According to the 2011 census data, literacy levels in Barmer district is 56.53% respectively. Three villages in the study area is having literacy rate below 50%, whereas Gunga village is having literacy rate of 52%. The highest female literacy rate was observed in Ambawadi (17%) and in village Gunga (17%) and the lowest in Jase Ka Gaon (14%).

Table 5.15 : Literacy Profile of the Study Area Villages

Village Name	Total Literate	%	Male Literate	%	Female Literate	%	Illiterates	%
Ambawadi	520	46	329	29	191	17	618	54
Jase Ka Gaon	303	48	216	34	87	14	333	52
Shiv	2121	47	1453	32	668	15	2419	53
Gunga	2318	52	1541	34	777	17	2166	48

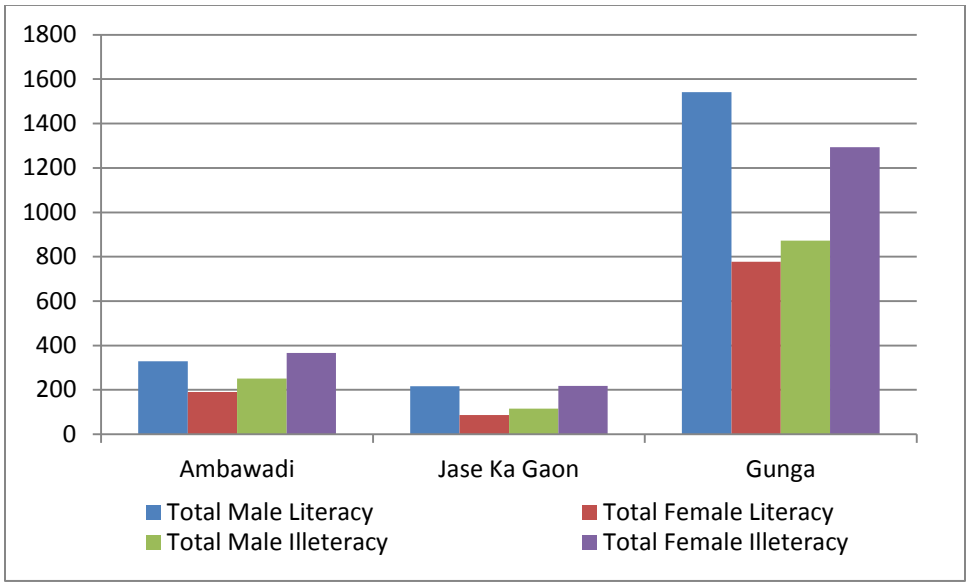


Figure 5.20 : Gender-wise Distribution of Literacy and of Illiteracy in Study Area

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 below.

The workforce participation rate in the study area villages of Barmer district varies from 35% to 54.0%. Majority of inhabitants (about 54%) in the study area villages are employed in the category of Cultivators. Workers in agricultural Category comprise the second most important work category in the study area constituting about 18% of the total workforce. Employment in activities such as household (1 %) as well as workers in other workers category (4%) are low in number.

Workers Participation Ratio of the main workers is 18.31%, non-workers 56.44% and 25.25% is the marginal Workers. Figure 5.21 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
Ambawadi	527	2	0.35	0.00	7.29	611	53.69
Jase Ka Gaon	345	47	0.00	0.00	1.26	291	45.75
Shiv	1596	8	0.51	1.81	12.82	2944	64.85
Gunga	1854	9	0.20	0.96	5.87	2630	58.65

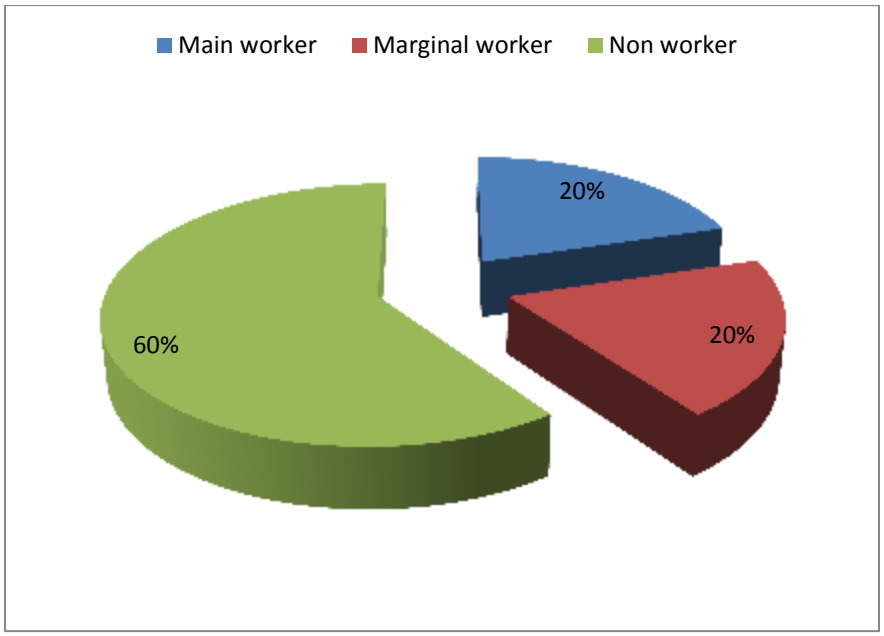


Figure 5.21 : Workforce Participation in Study Area

Main Workers:

Study area consist 11.76 % of Casual labour, 0.21% of Agricultural, 0.69% of Household population and 5.66% of other population. Figure 5.22 presents the graphical representation of the main workers participation in the study area.

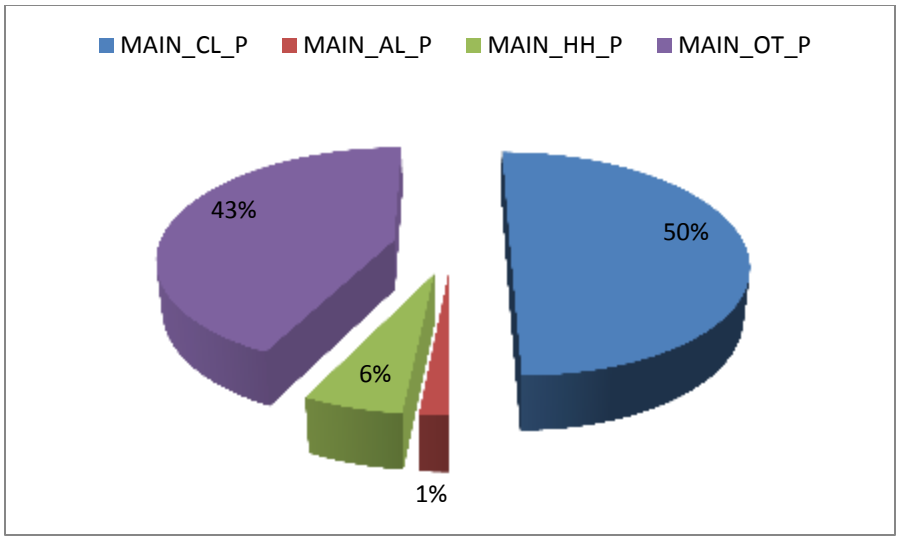


Figure 5.22 : Main Workforce Participation in Study Area

Marginal Workers

Unlike Main Workers, Casual Labour constitutes a 10.32% of total Marginal Worker Population. Agricultural Labours constitutes 89.68 % of Total Marginal Worker Population. Figure 5.23 presents the graphical representation of the marginal workers participation in the study area.

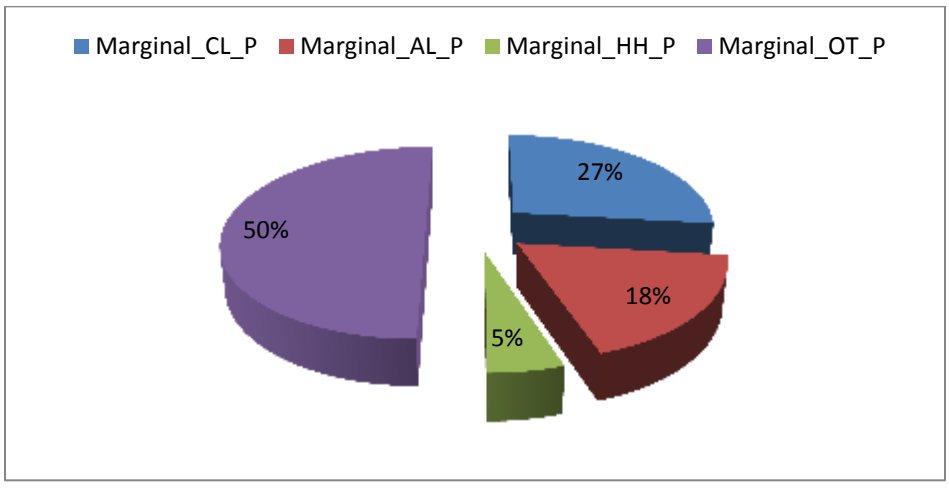


Figure 5.23 : Marginal Workforce Participation in Study Area

Socio-economic Infrastructure

There are 2714 primary schools, 130 secondary and higher secondary schools, plus 2 general degree colleges and 2 industrial training institutes (ITI) in Barmer District. As per 2011 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
Ambawadi	P_SCH (1), M_SCH (1)	Not available	W, HP	MR	Not available
Jaseka Gaon	P_SCH (1),	Not available	W, HP	FP	ED
Shiv	P_SCH (1),	Not available	W, HP	FP	ED
Gunga	P_SCH (1),	Not available	W,HP	MR, FP	Ed, EAG

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 2011)

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 Gamesa, 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 9th 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 Ambawadi and Gunga 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, labours 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 Gunga village while higher education facility is available at Ambawadi.

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 not aware of the projects but when we have updated them and they are favouring 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.

Interactions with Gamesa Team

Consultation with the land sellers

Consultation at Gunga Village

Consultation at Ambawadi Village

Consultation at Shiv Village

Figure 5.24 : 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 Barmer 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
- 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. There are a total of 20 land parcel required to be occupied by the developer out of which 15 were already occupied and negotiations were on for balance 5 land parcels.

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 Barmer 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 pilled 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 (SOx, NOx, 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. Rock cutting activities and blasting for foundation of towers may also be involved. 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 turbine site. Since the nearest settlement is approximately 500-700 m from GG/97-79, 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 land arable land tends to have minimal ecological value though there are several 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. All three recorded species of mammals 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, one species is found under Schedule II and two under Schedule IV. All the avifaunal species recorded from the study area come under the Least Concerned category of IUCN and Common Sandpiper, Common Quail and Tawny Pipit are some important bird species of the study area.

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

Gamesa sub-contracted Sahej for the process of land procurement of the private land for the proposed Barmer 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.

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 90 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 Gamesa. 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 Gamesa 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 Barmer 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 Barmer 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 Gamesa G97 wind turbines 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 through 6.3.

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 (Gunga Receptor 1)	51.7	42.1	38.2	51.9	43.6	0.2	1.5	793	492
B (Gunga Receptor 2)	51.7	42.1	38.8	51.9	43.8	0.2	1.7	760	454
C (Receptor near Shiv)	51.7	42.1	39.3	51.9	43.9	0.2	1.8	690	364
D (Receptor near Panjraj Singh ki Dhani)	51.7	42.1	31.6	51.7	42.5	0.0	0.4	1,188	919
E (Ambawadi Receptor 1)	50.6	41.4	36.4	50.8	42.6	0.2	1.2	1,323	949
F (Ambawadi Receptor 2)	50.6	41.4	41.2	51.1	44.3	0.5	2.9	575	247
G (NH-15)*	58.4	47.2	27.5	58.4	47.2	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. *Industrial Area									

The incremental noise level due to the operation of the proposed WTGs is in the range of 27.5 – 41.2 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 0.0-0.5 during day time and 0.0-2.9 during night time. The output files of the modeling analyses are enclosed in Annexure I.

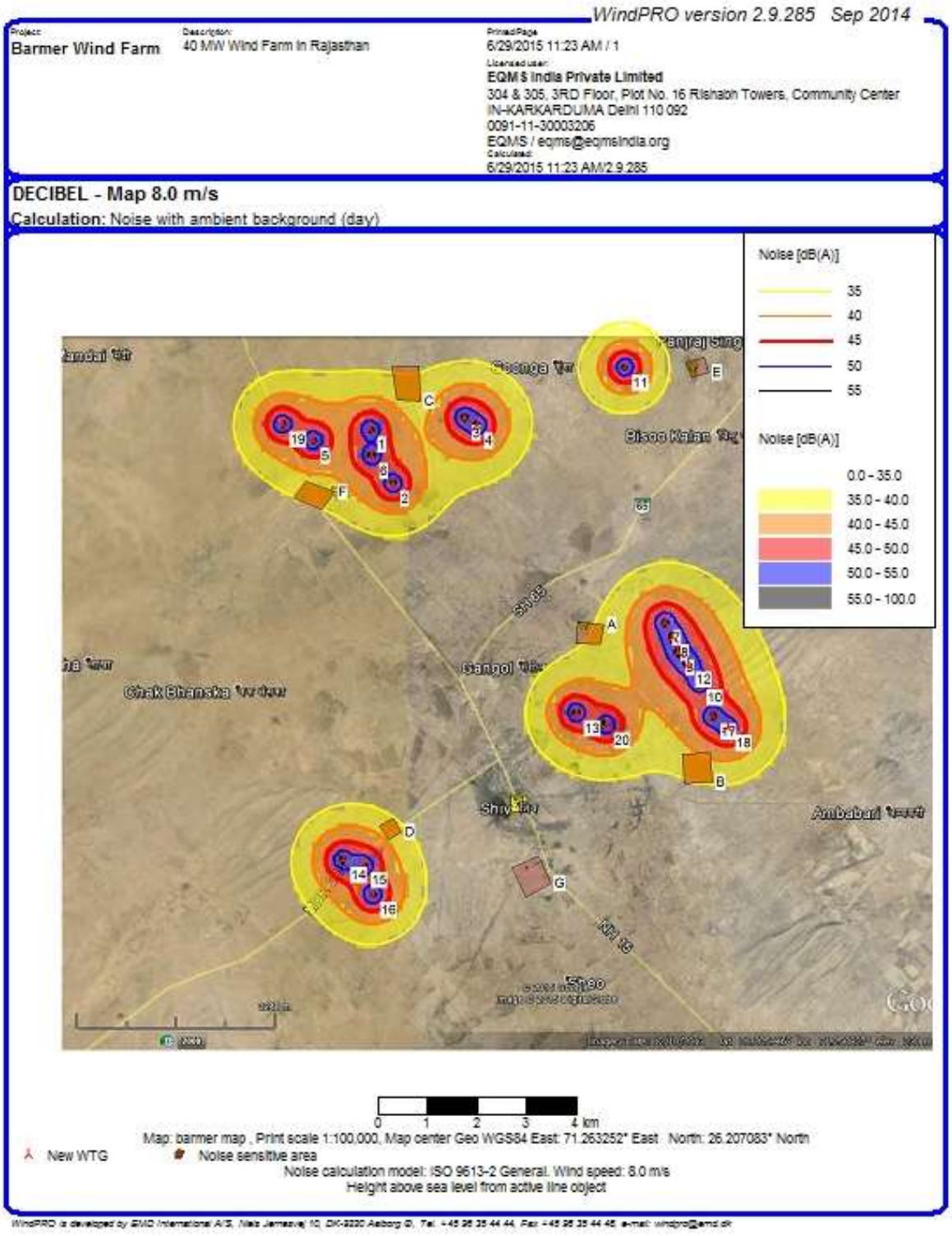


Figure 6.1 : Noise Level generated due to operation of WTGs with ambient noise during day time

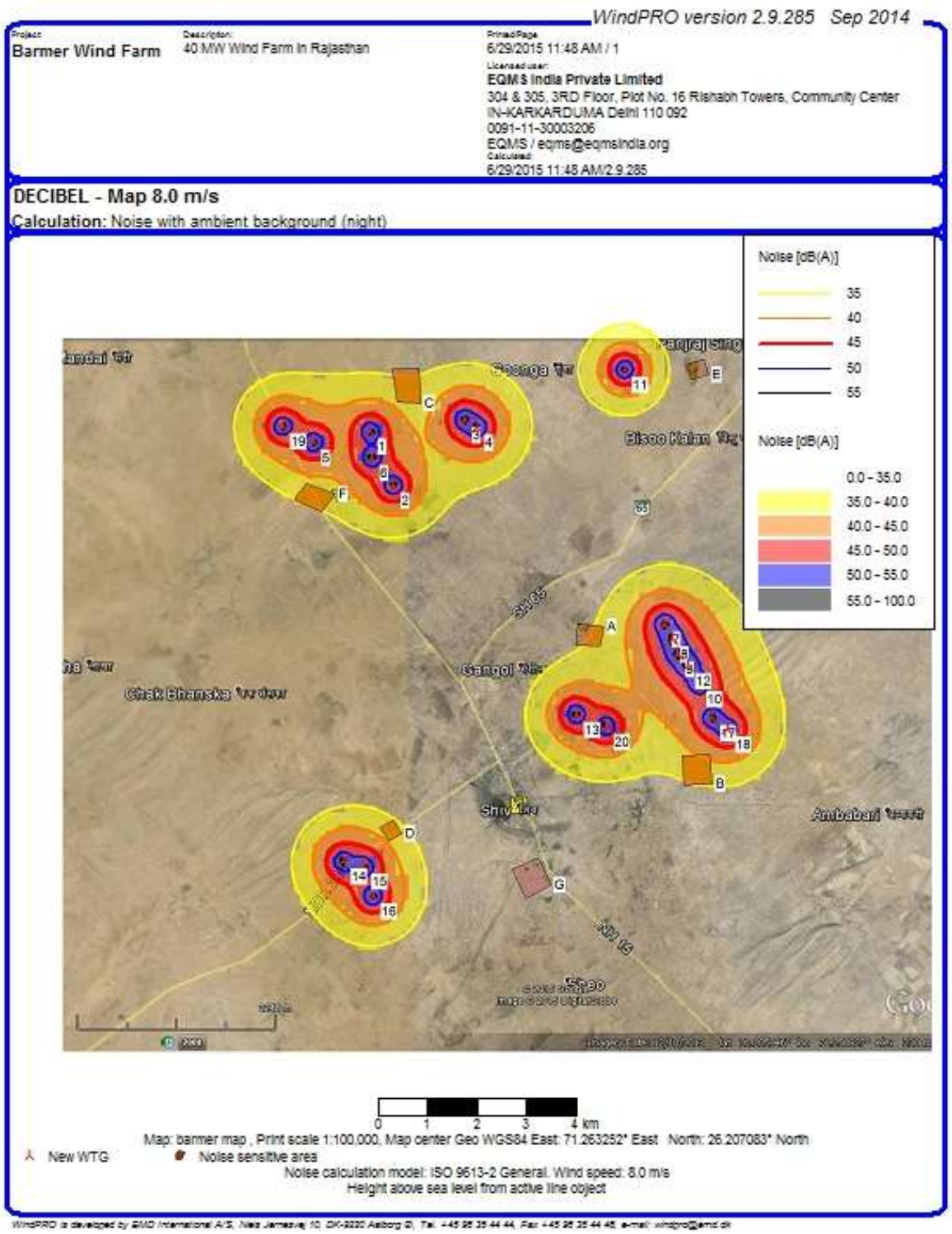


Figure 6.2 : Noise Level generated due to operation of WTGs with ambient noise during night time

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
- The second cluster is located at a distance of 300 m south of Ambawadi village.
- 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 the second cluster of WTGs 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 windfarms (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. There is no bat species 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 three 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
- 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.

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 ~85 meters above the ground the EMF[2] 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 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]

[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

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

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 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	Gunga (Receptor 1)	2:03	17	0:09
B	Gunga (Receptor 2)	0:04	4	0:01
C	Near Shiv	10:06	60	0:16
D	Near Panjraj ki Dhani	2:04	18	0:09
E	Ambawadi (Receptor 1)	6:32	72	0:10
F	Ambawadi	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
	(Receptor 2)			
G	Near NH-15	0:00	0	0:00

The shadow flicker assessment indicates that the shadows will not exceed for more than 10.06 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.

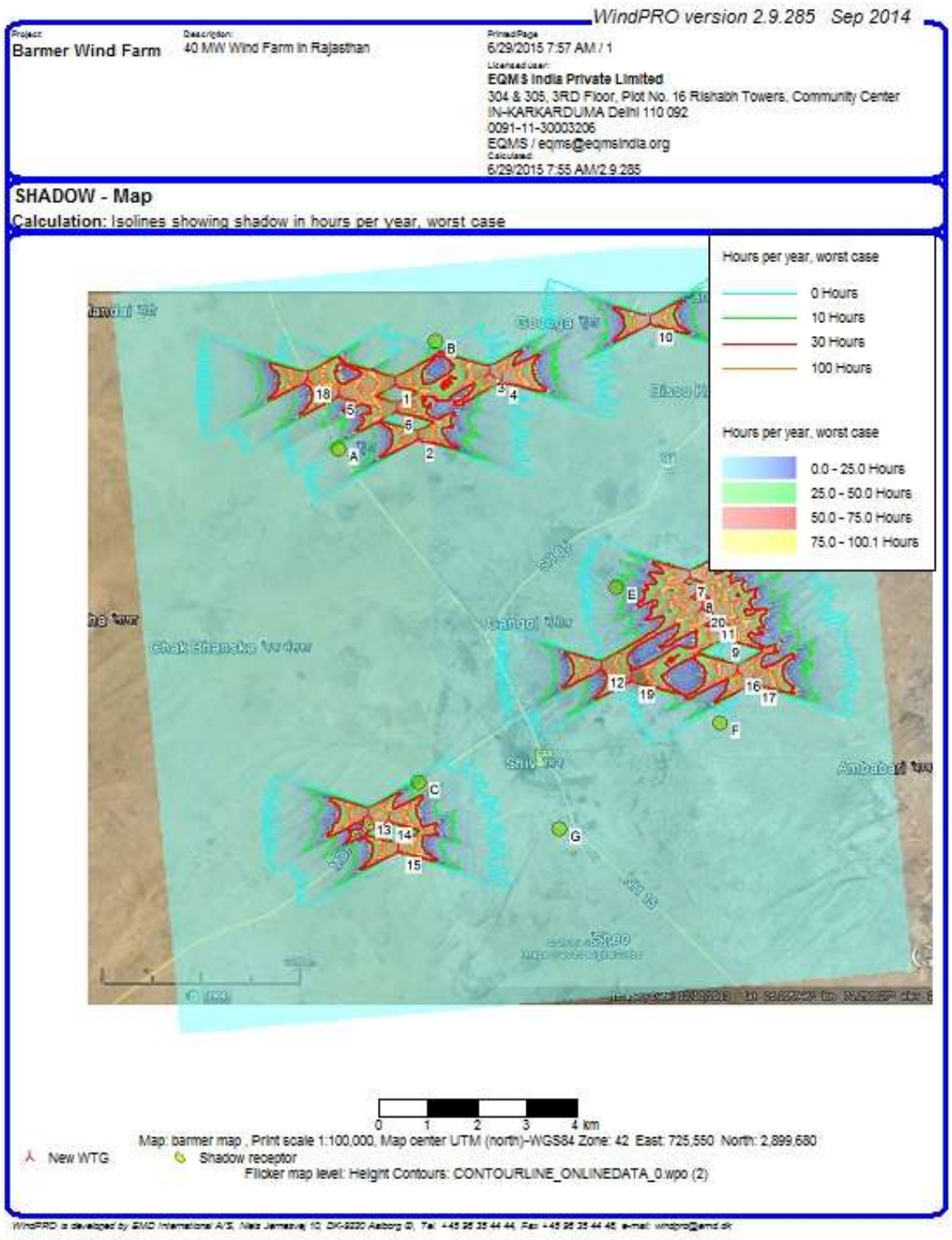


Figure 6.3 : Shadow Flicker Assessment Map

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 perfoamce 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 (Gamesa) 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.

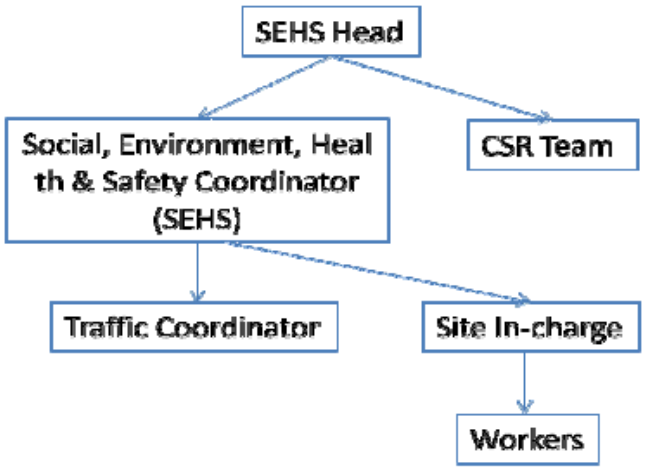


Figure 7.1 : Organizational Chart

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 incude 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**	• Change in land use due to construction of turbines	***Minor***	• 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.	***Insignificant***	Site Manager – Gamesa/ CWP-Devgarh
2.	**Soil Quality**	• 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;	***Minor***	• 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 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.	***Insignificant***	Site Manager – Gamesa/ CWP-Devgarh

S. No.	Environmental Issues	Potential Impacts	Significance without mitigation measures	Mitigation Measures	Significance with mitigation measures	Responsibility
		• Accidental oil leaks/spillages from vehicles and machinery operations at site can cause soil and groundwater contamination.		• Excavated material will be stock piled and used for backfilling of foundations, trenches etc.		
3.	**Air Quality**	• Dust generation and subsequent dispersal by wind during site preparation activities; • Pollutant (SOx, NOx, PM) discharge into surrounding air from exhaust emission of construction vehicles.	***Minor***	• 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 – Gamesa/ CWP-Devgarh
4.	**Water Quality**	• 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***	• 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 – Gamesa/ CWP-Devgarh
5.	**Noise Quality**	• 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***	• 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	***Minor***	Site Manager – Gamesa/ CWP-Devgarh

S. No.	Environmental Issues	Potential Impacts	Significance without mitigation measures	Mitigation Measures	Significance with mitigation measures	Responsibility
				• 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**	• The construction activities may lead to loss of such natural resources. • Disturbance to local livestock population	***Minor***	• 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 – Gamesa/ CWP-Devgarh
7.	**Socio-Economic Environment**	• 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	***Moderate***	• 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	***Minor***	Site Manager – Gamesa/ CWP-Devgarh

S. No.	Environmental Issues	Potential Impacts	Significance without mitigation measures	Mitigation Measures	Significance with mitigation measures	Responsibility
		• 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		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 Gamesa. 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 Gamesa commit and adhere to social obligations including community		

S. No.	Environmental Issues	Potential Impacts	Significance without mitigation measures	Mitigation Measures	Significance with mitigation measures	Responsibility
				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**	• 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**	• 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. • Excess waste debris and liquid spills shall be cleaned up regularly to avoid slips and falls.	**Minor**	Site Manager – Gamesa/ CWP-Devgarh

S. No.	Environmental Issues	Potential Impacts	Significance without mitigation measures	Mitigation Measures	Significance with mitigation measures	Responsibility
Operation Phase						
9.	**Land/Soil Quality**	• 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***	• 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 – Gamesa/ CWP-Devgarh
10.	**Water Quality**	• Burden on local ground/surface water resources due to water demand of onsite personnel. • Wastewater generated from site office.	***Minor***	• 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 – Gamesa/ CWP-Devgarh
11.	**Noise Environment**	• Noise generation due to operation of wind turbines.	***Moderate***	• Siting of WTGs to ensure that there is a minimum setback distance of 140 m from built structures and settlements as per IREDA guidelines. • Wind turbines shall be designed in accordance with the international acoustic design standards. • Minimize the ground vegetation being cleared during	***Minor***	Site Manager – Gamesa/ CWP-Devgarh

S. No.	Environmental Issues	Potential Impacts	Significance without mitigation measures	Mitigation Measures	Significance with mitigation measures	Responsibility
				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.		
12.	**Ecology**	• Bird Collision • Barrage effect • Modification of habitat	***Moderate***	• 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 – Gamesa/ CWP-Devgarh
13.	**Socio-Economic Environment**	• Visual Aesthetics • Electromagnetic Field (EMF) interference • Shadow flicker	***Minor***	• 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 having same direction of rotation, type of turbine and height. • Maintaining a minimum distance based on the formula prescribed by MEDA.	***Insignificant***	Site Manager – Gamesa/ CWP-Devgarh

S. No.	Environmental Issues	Potential Impacts	Significance without mitigation measures	Mitigation Measures	Significance with mitigation measures	Responsibility
				• 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**	• Possible injuries associated with working at height (≥ 2m) • Electrical work injuries (eye injuries, shocks, burns, fires/explosion) • Other occupational hazards	***Moderate***	• 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 – Gamesa/ 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 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 Gamesa 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 Gamesa'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	• 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	• 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	• 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	• 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	• 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.
6.	Crane Travel Limits	• All cranes shall have a published chart indicating the operating guidelines for moving the crane.

S. No.	Safety Aspect	Precautions/Safety Measures to be taken
		• 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	• 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	• 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 equipments/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 Gamesa 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/resources[5] 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 Barmer 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:
Barmer Wind Farm

Description:
40 MW Wind Farm in Rajasthan

Printed/Page
6/28/2015 11:36 PM / 1

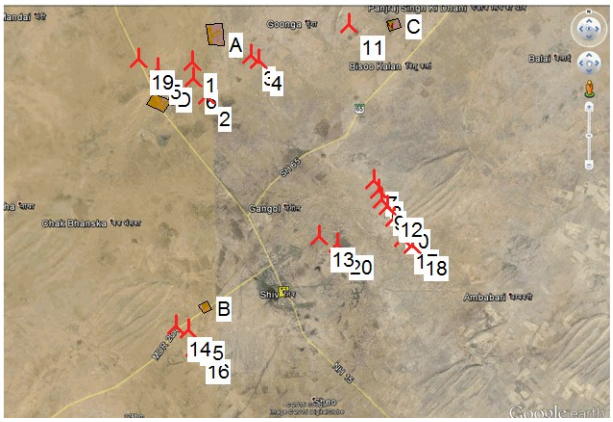
Licensed user:
EQMS India Private Limited
304 & 305, 3RD Floor, Plot No. 16 Rishabh Towers, Community Center
IN-KARKARDUMA Delhi 110 092
0091-11-30003206
EQMS / eqms@eqmsindia.org

Calculated:
6/28/2015 11:36 PM/2.9.285

DECIBEL - Main Result

Calculation: Noise with ambient background (day) - Gunga

Noise calculation model:
ISO 9613-2 General
Wind speed:
4.0 m/s - 12.0 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 1:250,000

New WTG Noise sensitive area

WTGs

	Geo [deg]-WGS84				WTG type							Noise data					
	Longitude	Latitude	Z	Row data/Description	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Creator	Name	First wind speed	LwaRef	Last wind speed	LwaRef	Pure tones
			[m]					[kW]	[m]	[m]			[m/s]	[dB(A)]	[m/s]	[dB(A)]	
1	71.239034° East	26.246259° North	260.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g
2	71.242522° East	26.236051° North	250.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g
3	71.258457° East	26.246577° North	244.3	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g
4	71.260858° East	26.244942° North	241.1	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g
5	71.227237° East	26.245368° North	245.2	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g
6	71.238754° East	26.241525° North	250.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g
7	71.294653° East	26.205571° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g
8	71.295916° East	26.202644° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g
9	71.296600° East	26.199755° North	229.9	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g
10	71.300266° East	26.193911° North	233.2	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g
11	71.292225° East	26.252685° North	234.7	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g
12	71.298396° East	26.197479° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g
13	71.274584° East	26.190709° North	223.2	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g
14	71.223873° East	26.168469° North	227.3	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g
15	71.227949° East	26.167143° North	225.6	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g
16	71.229172° East	26.161501° North	220.3	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g
17	71.302251° East	26.187471° North	228.5	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g
18	71.305166° East	26.185141° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g
19	71.221329° East	26.248880° North	248.6	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g
20	71.280433° East	26.187963° North	223.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB g

h) Generic octave distribution used
g) Data calculated from data for other wind speed (uncertain)

Calculation Results

Sound Level

Noise sensitive area		Geo [deg]-WGS84			Demands		Sound Level				Demands fulfilled ?
No.	Name	Longitude	Latitude	Z	Imission height	Max Additional exposure	Max Noise demand	Max From WTGs	Max Ambient+WTGs	Max Additional exposure	Distance to noise demand	Noise
				[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[m]	
A	Gunga Rec 2	71.245084° East	26.251070° North	254.0	4.0	0.0	55.0	38.8	51.9	0.2	760	Yes
B	Rec near Shiv	71.233657° East	26.171281° North	229.7	4.0	0.0	55.0	39.3	51.9	0.2	690	Yes
C	Rec 5	71.304602° East	26.252408° North	237.0	4.0	0.0	55.0	31.6	51.7	0.0	1,188	Yes
D	Gunga Rec 1	71.224839° East	26.238063° North	240.0	4.0	0.0	55.0	38.2	51.9	0.2	793	Yes

Project:
Barmer Wind Farm

Description:
40 MW Wind Farm in Rajasthan

Printed/Page
6/28/2015 11:36 PM / 2

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:
6/28/2015 11:36 PM/2.9.285

DECIBEL - Main Result

Calculation: Noise with ambient background (day) - Gunga

Distances (m)

WTG	A	B	C	D
1	806	7895	6587	1467
2	1684	6796	6463	1211
3	947	8261	4656	3057
4	1243	8160	4449	3216
5	1892	7824	7770	844
6	1233	7370	6690	1065
7	6676	6857	4993	7228
8	7003	6816	5285	7493
9	7291	6737	5589	7713
10	8025	6815	6188	8368
11	4205	10328	1237	6462
12	7600	6792	5814	7997
13	7052	4319	7216	6612
14	9396	1008	12138	7110
15	9457	732	11979	7249
16	10052	1173	12387	7876
17	8710	6792	6887	8940
18	9092	7018	7138	9328
19	2386	8288	8330	1249
20	7554	4727	7270	7245

Project:
Barmer Wind Farm

Description:
40 MW Wind Farm in Rajasthan

Printed/Page
6/29/2015 2:30 AM / 1

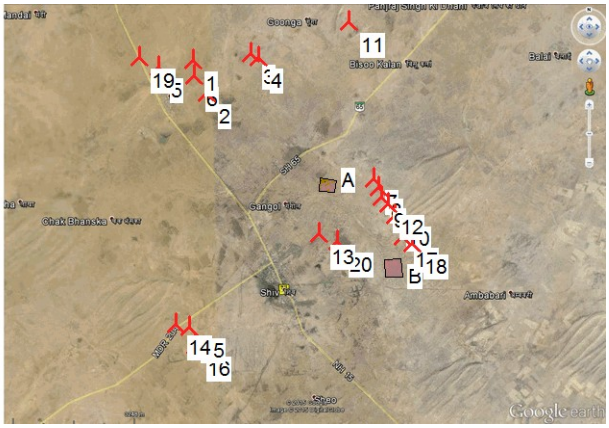
Licensed user:
EQMS India Private Limited
304 & 305, 3RD Floor, Plot No. 16 Rishabh Towers, Community Center
IN-KARKARDUMA Delhi 110 092
0091-11-30003206
EQMS / eqms@eqmsindia.org

Calculated:
6/29/2015 2:30 AM/2.9.285

DECIBEL - Main Result

Calculation: Noise with ambient background (day) - Ambawadi

Noise calculation model:
ISO 9613-2 General
Wind speed:
4.0 m/s - 12.0 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 1:250,000

New WTG Noise sensitive area

WTGs

	Geo [deg]-WGS84				WTG type						Noise data							
	Longitude	Latitude	Z	Row data/Description	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Creator	Name	First wind speed	LwaRef	Last wind speed	LwaRef	Pure tones	
			[m]					[kW]	[m]	[m]			[m/s]	[dB(A)]	[m/s]	[dB(A)]		
1	71.239034° East	26.246259° North	260.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
2	71.242522° East	26.236051° North	250.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
3	71.258457° East	26.246577° North	244.3	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
4	71.260858° East	26.244942° North	241.1	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
5	71.227237° East	26.245368° North	245.2	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
6	71.238754° East	26.241525° North	250.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
7	71.294653° East	26.205571° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
8	71.295916° East	26.202644° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
9	71.296600° East	26.199755° North	229.9	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
10	71.300266° East	26.193911° North	233.2	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
11	71.292225° East	26.252685° North	234.7	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
12	71.298396° East	26.197479° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
13	71.274584° East	26.190709° North	223.2	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
14	71.223873° East	26.168469° North	227.3	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
15	71.227949° East	26.167143° North	225.6	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
16	71.229172° East	26.161501° North	220.3	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
17	71.302251° East	26.187471° North	228.5	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
18	71.305166° East	26.185141° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
19	71.221329° East	26.248880° North	248.6	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
20	71.280433° East	26.187963° North	223.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g

h) Generic octave distribution used
g) Data calculated from data for other wind speed (uncertain)

Calculation Results

Sound Level

Noise sensitive area		Geo [deg]-WGS84			Demands		Sound Level				Demands fulfilled ?
No.	Name	Longitude	Latitude	Z	Imission height	Max Additional exposure	Max Noise demand	Max From WTGs	Max Ambient+WTGs	Max Additional exposure	Distance to noise demand	Noise
				[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[m]	
A	Ambawadi Rec 1	71.281050° East	26.202762° North	228.8	4.0	0.0	55.0	36.4	50.8	0.2	1,323	Yes
B	Ambawadi Rec 2	71.300810° East	26.180826° North	230.0	4.0	0.0	55.0	41.2	51.1	0.5	575	Yes

Project:
Barmer Wind Farm

Description:
40 MW Wind Farm in Rajasthan

Printed/Page
6/29/2015 2:30 AM / 2

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:
6/29/2015 2:30 AM/2.9.285

DECIBEL - Main Result

Calculation: Noise with ambient background (day) - Ambawadi

Distances (m)

WTG	A	B
1	5744	9142
2	4689	8046
3	4727	8127
4	4469	7858
5	6518	9838
6	5381	8752
7	1239	2706
8	1419	2382
9	1582	2066
10	2157	1443
11	5244	7932
12	1830	1826
13	1409	2317
14	6492	7157
15	6263	6772
16	6594	6770
17	2714	750
18	3103	647
19	7220	10529
20	1641	1658

Project:
Barmer Wind Farm

Description:
40 MW Wind Farm in Rajasthan

Printed/Page
6/28/2015 11:42 PM / 1

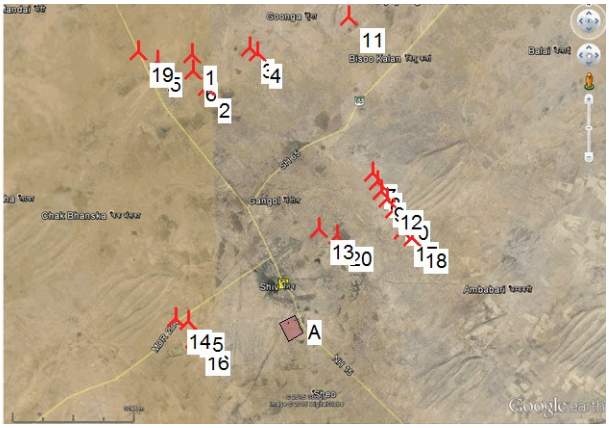
Licensed user:
EQMS India Private Limited
304 & 305, 3RD Floor, Plot No. 16 Rishabh Towers, Community Center
IN-KARKARDUMA Delhi 110 092
0091-11-30003206
EQMS / eqms@eqmsindia.org

Calculated:
6/28/2015 11:42 PM/2.9.285

DECIBEL - Main Result

Calculation: Noise with ambient background (day) - NH15

Noise calculation model:
ISO 9613-2 General
Wind speed:
4.0 m/s - 12.0 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 1:250,000

New WTG Noise sensitive area

WTGs

	Geo [deg]-WGS84				WTG type						Noise data							
	Longitude	Latitude	Z	Row data/Description	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Creator	Name	First wind speed	LwaRef	Last wind speed	LwaRef	Pure tones	
			[m]					[kW]	[m]	[m]			[m/s]	[dB(A)]	[m/s]	[dB(A)]		
1	71.239034° East	26.246259° North	260.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
2	71.242522° East	26.236051° North	250.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
3	71.258457° East	26.246577° North	244.3	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
4	71.260858° East	26.244942° North	241.1	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
5	71.227237° East	26.245368° North	245.2	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
6	71.238754° East	26.241525° North	250.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
7	71.294653° East	26.205571° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
8	71.295916° East	26.202644° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
9	71.296600° East	26.199755° North	229.9	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
10	71.300266° East	26.193911° North	233.2	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
11	71.292225° East	26.252685° North	234.7	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
12	71.298396° East	26.197479° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
13	71.274584° East	26.190709° North	223.2	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
14	71.223873° East	26.168469° North	227.3	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
15	71.227949° East	26.167143° North	225.6	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
16	71.229172° East	26.161501° North	220.3	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
17	71.302251° East	26.187471° North	228.5	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
18	71.305166° East	26.185141° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
19	71.221329° East	26.248880° North	248.6	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
20	71.280433° East	26.187963° North	223.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g

h) Generic octave distribution used
g) Data calculated from data for other wind speed (uncertain)

Calculation Results

Sound Level

Noise sensitive area		Geo [deg]-WGS84			Demands		Sound Level			Demands fulfilled ?
No.	Name	Longitude	Latitude	Z	Imission height	Max Additional exposure	Max Noise demand	Max From WTGs	Max Ambient+WTGs	Max Additional exposure	Noise
				[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	
	A Rec near NH15	71.263680° East	26.165493° North	220.0	4.0	0.0	75.0	27.5	58.4	0.0	Yes

Distances (m)

WTG	A
1	9283
2	8100
3	9001
4	8809
5	9556

To be continued on next page...

Project:
Barmer Wind Farm

Description:
40 MW Wind Farm in Rajasthan

Printed/Page
6/28/2015 11:42 PM / 2

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:
6/28/2015 11:42 PM/2.9.285

DECIBEL - Main Result

Calculation: Noise with ambient background (day) - NH15

...continued from previous page

WTG	A
6	8786
7	5414
8	5229
9	5025
10	4827
11	10075
12	4961
13	3000
14	3459
15	3035
16	2900
17	4561
18	4685
19	10124
20	3001

Project:
Barmer Wind Farm

Description:
40 MW Wind Farm in Rajasthan

Printed/Page
6/28/2015 11:25 PM / 1

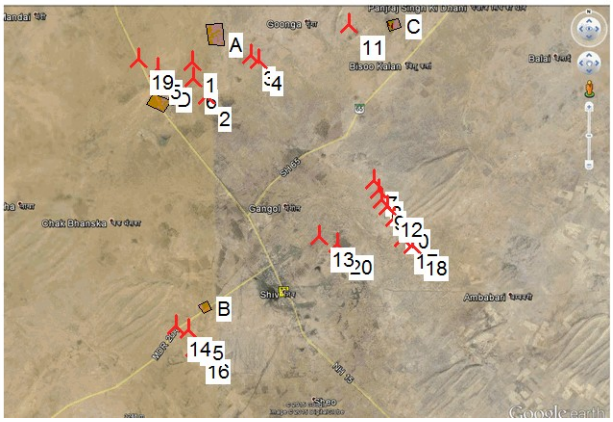
Licensed user:
EQMS India Private Limited
304 & 305, 3RD Floor, Plot No. 16 Rishabh Towers, Community Center
IN-KARKARDUMA Delhi 110 092
0091-11-30003206
EQMS / eqms@eqmsindia.org

Calculated:
6/28/2015 11:19 PM/2.9.285

DECIBEL - Main Result

Calculation: Noise with ambient background (night) - Gunga

Noise calculation model:
ISO 9613-2 General
Wind speed:
4.0 m/s - 12.0 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 1:250,000

New WTG Noise sensitive area

WTGs

	Geo [deg]-WGS84				WTG type							Noise data						
	Longitude	Latitude	Z	Row data/Description	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Creator	Name	First wind speed	LwaRef	Last wind speed	LwaRef	Pure tones	
			[m]					[kW]	[m]	[m]			[m/s]	[dB(A)]	[m/s]	[dB(A)]		
1	71.239034° East	26.246259° North	260.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
2	71.242522° East	26.236051° North	250.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
3	71.258457° East	26.246577° North	244.3	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
4	71.260858° East	26.244942° North	241.1	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
5	71.227237° East	26.245368° North	245.2	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
6	71.238754° East	26.241525° North	250.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
7	71.294653° East	26.205571° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
8	71.295916° East	26.202644° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
9	71.296600° East	26.199755° North	229.9	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
10	71.300266° East	26.193911° North	233.2	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
11	71.292225° East	26.252685° North	234.7	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
12	71.298396° East	26.197479° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
13	71.274584° East	26.190709° North	223.2	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
14	71.223873° East	26.168469° North	227.3	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
15	71.227949° East	26.167143° North	225.6	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
16	71.229172° East	26.161501° North	220.3	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
17	71.302251° East	26.187471° North	228.5	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
18	71.305166° East	26.185141° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
19	71.221329° East	26.248880° North	248.6	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
20	71.280433° East	26.187963° North	223.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g

h) Generic octave distribution used
g) Data calculated from data for other wind speed (uncertain)

Calculation Results

Sound Level

Noise sensitive area		Geo [deg]-WGS84			Demands		Sound Level				Demands fulfilled ?
No.	Name	Longitude	Latitude	Z	Imission height	Max Additional exposure	Max Noise demand	Max From WTGs	Max Ambient+WTGs	Max Additional exposure	Distance to noise demand	Noise
				[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[m]	
A	Gunga Rec 2	71.245084° East	26.251070° North	254.0	4.0	0.0	45.0	38.8	43.8	1.7	454	Yes
B	Rec near Shiv	71.233657° East	26.171281° North	229.7	4.0	0.0	45.0	39.3	43.9	1.8	364	Yes
C	Rec 5	71.304602° East	26.252408° North	237.0	4.0	0.0	45.0	31.6	42.5	0.4	919	Yes
D	Gunga Rec 1	71.224839° East	26.238063° North	240.0	4.0	0.0	45.0	38.2	43.6	1.5	492	Yes

Project:
Barmer Wind Farm

Description:
40 MW Wind Farm in Rajasthan

Printed/Page
6/28/2015 11:25 PM / 2

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:
6/28/2015 11:19 PM/2.9.285

DECIBEL - Main Result

Calculation: Noise with ambient background (night) - Gunga

Distances (m)

WTG	A	B	C	D
1	806	7895	6587	1467
2	1684	6796	6463	1211
3	947	8261	4656	3057
4	1243	8160	4449	3216
5	1892	7824	7770	844
6	1233	7370	6690	1065
7	6676	6857	4993	7228
8	7003	6816	5285	7493
9	7291	6737	5589	7713
10	8025	6815	6188	8368
11	4205	10328	1237	6462
12	7600	6792	5814	7997
13	7052	4319	7216	6612
14	9396	1008	12138	7110
15	9457	732	11979	7249
16	10052	1173	12387	7876
17	8710	6792	6887	8940
18	9092	7018	7138	9328
19	2386	8288	8330	1249
20	7554	4727	7270	7245

Project:
Barmer Wind Farm

Description:
40 MW Wind Farm in Rajasthan

Printed/Page
6/29/2015 2:33 AM / 1

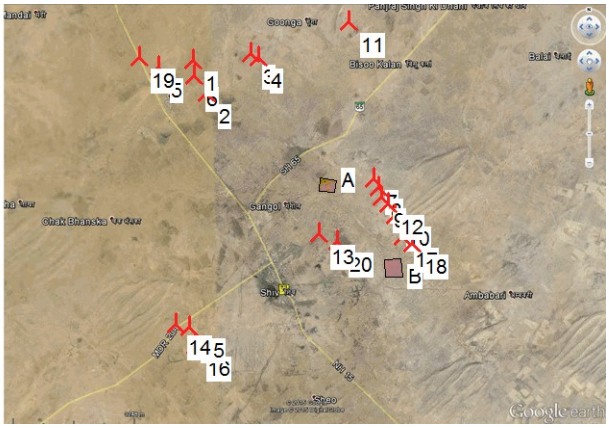
Licensed user:
EQMS India Private Limited
304 & 305, 3RD Floor, Plot No. 16 Rishabh Towers, Community Center
IN-KARKARDUMA Delhi 110 092
0091-11-30003206
EQMS / eqms@eqmsindia.org

Calculated:
6/29/2015 2:25 AM/2.9.285

DECIBEL - Main Result

Calculation: Noise with ambient background (night) - Ambawadi

Noise calculation model:
ISO 9613-2 General
Wind speed:
4.0 m/s - 12.0 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 1:250,000
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	LwaRef	Last wind speed	LwaRef	Pure tones	
			[m]					[kW]	[m]	[m]			[m/s]	[dB(A)]	[m/s]	[dB(A)]		
1	71.239034° East	26.246259° North	260.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
2	71.242522° East	26.236051° North	250.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
3	71.258457° East	26.246577° North	244.3	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
4	71.260858° East	26.244942° North	241.1	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
5	71.227237° East	26.245368° North	245.2	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
6	71.238754° East	26.241525° North	250.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
7	71.294653° East	26.205571° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
8	71.295916° East	26.202644° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
9	71.296600° East	26.199755° North	229.9	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
10	71.300266° East	26.193911° North	233.2	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
11	71.292225° East	26.252685° North	234.7	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
12	71.298396° East	26.197479° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
13	71.274584° East	26.190709° North	223.2	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
14	71.223873° East	26.168469° North	227.3	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
15	71.227949° East	26.167143° North	225.6	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
16	71.229172° East	26.161501° North	220.3	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
17	71.302251° East	26.187471° North	228.5	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
18	71.305166° East	26.185141° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
19	71.221329° East	26.248880° North	248.6	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
20	71.280433° East	26.187963° North	223.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g

h) Generic octave distribution used
g) Data calculated from data for other wind speed (uncertain)

Calculation Results

Sound Level

Noise sensitive area No.	Name	Geo [deg]-WGS84 Longitude	Latitude	Z	Demands Imission height	Max Additional exposure	Max Noise demand	Sound Level Max From WTGs	Max Ambient+WTGs	Max Additional exposure	Distance to noise demand	Demands fulfilled ? Noise
				[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[m]	
A	Ambawadi Rec 1	71.281050° East	26.202762° North	228.8	4.0	0.0	45.0	36.4	42.6	1.2	949	Yes
B	Ambawadi Rec 2	71.300810° East	26.180826° North	230.0	4.0	0.0	45.0	41.2	44.3	2.9	247	Yes

Project:
Barmer Wind Farm

Description:
40 MW Wind Farm in Rajasthan

Printed/Page
6/29/2015 2:33 AM / 2

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:
6/29/2015 2:25 AM/2.9.285

DECIBEL - Main Result

Calculation: Noise with ambient background (night) - Ambawadi

Distances (m)

WTG	A	B
1	5744	9142
2	4689	8046
3	4727	8127
4	4469	7858
5	6518	9838
6	5381	8752
7	1239	2706
8	1419	2382
9	1582	2066
10	2157	1443
11	5244	7932
12	1830	1826
13	1409	2317
14	6492	7157
15	6263	6772
16	6594	6770
17	2714	750
18	3103	647
19	7220	10529
20	1641	1658

Project:
Barmer Wind Farm

Description:
40 MW Wind Farm in Rajasthan

Printed/Page
6/28/2015 11:30 PM / 1

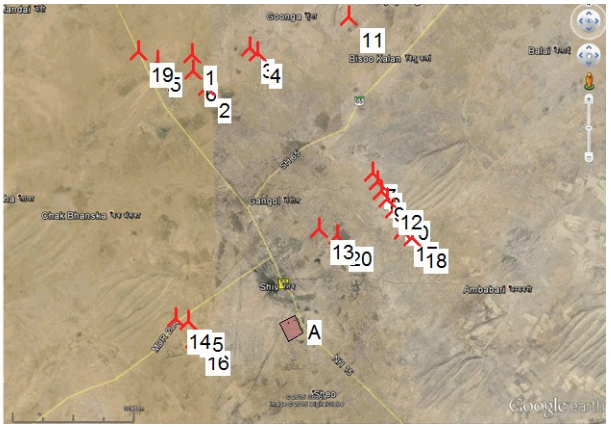
Licensed user:
EQMS India Private Limited
304 & 305, 3RD Floor, Plot No. 16 Rishabh Towers, Community Center
IN-KARKARDUMA Delhi 110 092
0091-11-30003206
EQMS / eqms@eqmsindia.org

Calculated:
6/28/2015 11:30 PM/2.9.285

DECIBEL - Main Result

Calculation: Noise with ambient background (night) - NH15

Noise calculation model:
ISO 9613-2 General
Wind speed:
4.0 m/s - 12.0 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 1:250,000

New WTG Noise sensitive area

WTGs

	Geo [deg]-WGS84				WTG type						Noise data							
	Longitude	Latitude	Z	Row data/Description	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Creator	Name	First wind speed	LwaRef	Last wind speed	LwaRef	Pure tones	
			[m]					[kW]	[m]	[m]			[m/s]	[dB(A)]	[m/s]	[dB(A)]		
1	71.239034° East	26.246259° North	260.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
2	71.242522° East	26.236051° North	250.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
3	71.258457° East	26.246577° North	244.3	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
4	71.260858° East	26.244942° North	241.1	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
5	71.227237° East	26.245368° North	245.2	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
6	71.238754° East	26.241525° North	250.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
7	71.294653° East	26.205571° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
8	71.295916° East	26.202644° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
9	71.296600° East	26.199755° North	229.9	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
10	71.300266° East	26.193911° North	233.2	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
11	71.292225° East	26.252685° North	234.7	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
12	71.298396° East	26.197479° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
13	71.274584° East	26.190709° North	223.2	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
14	71.223873° East	26.168469° North	227.3	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
15	71.227949° East	26.167143° North	225.6	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
16	71.229172° East	26.161501° North	220.3	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
17	71.302251° East	26.187471° North	228.5	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
18	71.305166° East	26.185141° North	230.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
19	71.221329° East	26.248880° North	248.6	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g
20	71.280433° East	26.187963° North	223.0	GAMESA G97 2000 97.0 !O! hu...	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	EMD	Level 0 - Estimated - - 07-2012	4.0	94.7	12.0	104.5	0 dB	g

h) Generic octave distribution used
g) Data calculated from data for other wind speed (uncertain)

Calculation Results

Sound Level

Noise sensitive area		Geo [deg]-WGS84			Demands		Sound Level			Demands fulfilled ?
No.	Name	Longitude	Latitude	Z	Imission height	Max Additional exposure	Max Noise demand	Max From WTGs	Max Ambient+WTGs	Max Additional exposure	Noise
				[m]	[m]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	
A	Rec near NH15	71.263680° East	26.165493° North	220.0	4.0	0.0	70.0	27.5	47.2	0.0	Yes

Distances (m)

WTG	A
1	9283
2	8100
3	9001
4	8809
5	9556

To be continued on next page...

Project:
Barmer Wind Farm

Description:
40 MW Wind Farm in Rajasthan

Printed/Page
6/28/2015 11:30 PM / 2

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:
6/28/2015 11:30 PM/2.9.285

DECIBEL - Main Result

Calculation: Noise with ambient background (night) - NH15

...continued from previous page

WTG	A
6	8786
7	5414
8	5229
9	5025
10	4827
11	10075
12	4961
13	3000
14	3459
15	3035
16	2900
17	4561
18	4685
19	10124
20	3001

Annexure II – Output Files of the Shadow Flicker Assessment

Project:
Barmer Wind Farm

Description:
40 MW Wind Farm in Rajasthan

Printed/Page
6/29/2015 7:57 AM / 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:
6/29/2015 7:55 AM/2.9.285

SHADOW - Main Result

Calculation: Isolines showing shadow in hours per year, worst case

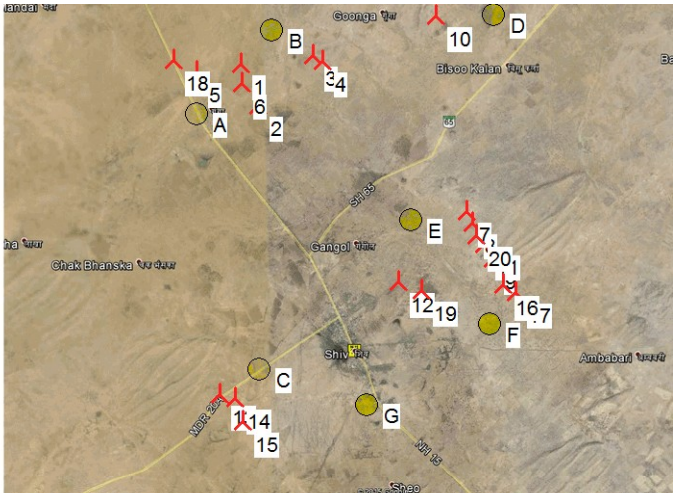
Assumptions for shadow calculations

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: Height Contours: CONTOURLINE_ONLINEDATA_0.wpo
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10.0 m



Scale 1:200,000

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	Rotor diameter	Hub height	Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
1	723,643	2,904,889	260.0	GAMESA G97 2000 97.0 !O! hub: 90....	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0
2	724,011	2,903,764	250.0	GAMESA G97 2000 97.0 !O! hub: 90....	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0
3	725,583	2,904,958	244.3	GAMESA G97 2000 97.0 !O! hub: 90....	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0
4	725,826	2,904,781	241.1	GAMESA G97 2000 97.0 !O! hub: 90....	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0
5	722,466	2,904,770	245.2	GAMESA G97 2000 97.0 !O! hub: 90....	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0
6	723,624	2,904,364	250.0	GAMESA G97 2000 97.0 !O! hub: 90....	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0
7	729,280	2,900,478	230.0	GAMESA G97 2000 97.0 !O! hub: 90....	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0
8	729,412	2,900,156	230.0	GAMESA G97 2000 97.0 !O! hub: 90....	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0
9	729,864	2,899,196	233.2	GAMESA G97 2000 97.0 !O! hub: 90....	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0
10	728,945	2,905,694	234.7	GAMESA G97 2000 97.0 !O! hub: 90....	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0
11	729,670	2,899,588	230.0	GAMESA G97 2000 97.0 !O! hub: 90....	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0
12	727,303	2,898,796	223.2	GAMESA G97 2000 97.0 !O! hub: 90....	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0
13	722,276	2,896,244	227.3	GAMESA G97 2000 97.0 !O! hub: 90....	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0
14	722,686	2,896,104	225.6	GAMESA G97 2000 97.0 !O! hub: 90....	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0
15	722,819	2,895,481	220.3	GAMESA G97 2000 97.0 !O! hub: 90....	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0
16	730,075	2,898,486	228.5	GAMESA G97 2000 97.0 !O! hub: 90....	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0
17	730,371	2,898,233	230.0	GAMESA G97 2000 97.0 !O! hub: 90....	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0
18	721,869	2,905,149	248.6	GAMESA G97 2000 97.0 !O! hub: 90....	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0
19	727,893	2,898,502	223.0	GAMESA G97 2000 97.0 !O! hub: 90....	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0
20	729,486	2,899,837	229.9	GA3	Yes	GAMESA	G97-2,000	2,000	97.0	90.0	2,500	0.0

Shadow receptor-Input

No.	Name	UTM (north)-WGS84 Zone: 42 East	North	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
				[m]	[m]	[m]	[m]	[°]	[°]	
A	Gunga Shadow Rec 1	722,366	2,903,668	240.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
B	Gunga Shadow Rec 2	724,552	2,905,688	253.4	1.0	1.0	1.0	0.0	90.0	"Green house mode"
C	Shadow Rec near Shiv	723,373	2,896,800	229.8	1.0	1.0	1.0	0.0	90.0	"Green house mode"

To be continued on next page...

Project:
Barmer Wind Farm

Description:
40 MW Wind Farm in Rajasthan

Printed/Page
6/29/2015 7:57 AM / 2

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:
6/29/2015 7:55 AM/2.9.285

SHADOW - Main Result

Calculation: Isolines showing shadow in hours per year, worst case

...continued from previous page

No.	Name	UTM (north)-WGS84 Zone: 42 East	North	Z [m]	Width [m]	Height [m]	Height a.g.l. [m]	Degrees from south cw [°]	Slope of window [°]	Direction mode
D	Shadow Rec near Panjraj singh ki dhani	730,469	2,905,589	237.2	1.0	1.0	1.0	0.0	90.0	"Green house mode"
E	Ambawadi Shadow Rec 1	727,767	2,900,396	228.6	1.0	1.0	1.0	0.0	90.0	"Green house mode"
F	Ambawadi Shadow Rec 2	729,618	2,897,461	230.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"
G	Shadow Receptor near NH15	726,148	2,895,614	220.0	1.0	1.0	1.0	0.0	90.0	"Green house mode"

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	Gunga Shadow Rec 1	2:03	17	0:09
B	Gunga Shadow Rec 2	0:04	4	0:01
C	Shadow Rec near Shiv	10:06	60	0:16
D	Shadow Rec near Panjraj singh ki dhani	2:04	18	0:09
E	Ambawadi Shadow Rec 1	6:32	72	0:10
F	Ambawadi Shadow Rec 2	0:00	0	0:00
G	Shadow Receptor near NH15	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	GAMESA G97 2000 97.0 !O! hub: 90.0 m (TOT: 138.5 m) (3)	0:00	
2	GAMESA G97 2000 97.0 !O! hub: 90.0 m (TOT: 138.5 m) (2)	2:03	
3	GAMESA G97 2000 97.0 !O! hub: 90.0 m (TOT: 138.5 m) (3)	0:00	
4	GAMESA G97 2000 97.0 !O! hub: 90.0 m (TOT: 138.5 m) (4)	0:00	
5	GAMESA G97 2000 97.0 !O! hub: 90.0 m (TOT: 138.5 m) (5)	0:04	
6	GAMESA G97 2000 97.0 !O! hub: 90.0 m (TOT: 138.5 m) (6)	0:00	
7	GAMESA G97 2000 97.0 !O! hub: 90.0 m (TOT: 138.5 m) (7)	2:24	
8	GAMESA G97 2000 97.0 !O! hub: 90.0 m (TOT: 138.5 m) (8)	1:40	
9	GAMESA G97 2000 97.0 !O! hub: 90.0 m (TOT: 138.5 m) (10)	0:00	
10	GAMESA G97 2000 97.0 !O! hub: 90.0 m (TOT: 138.5 m) (11)	2:04	
11	GAMESA G97 2000 97.0 !O! hub: 90.0 m (TOT: 138.5 m) (12)	0:59	
12	GAMESA G97 2000 97.0 !O! hub: 90.0 m (TOT: 138.5 m) (13)	0:00	
13	GAMESA G97 2000 97.0 !O! hub: 90.0 m (TOT: 138.5 m) (14)	10:06	
14	GAMESA G97 2000 97.0 !O! hub: 90.0 m (TOT: 138.5 m) (15)	0:00	
15	GAMESA G97 2000 97.0 !O! hub: 90.0 m (TOT: 138.5 m) (16)	0:00	
16	GAMESA G97 2000 97.0 !O! hub: 90.0 m (TOT: 138.5 m) (17)	0:00	
17	GAMESA G97 2000 97.0 !O! hub: 90.0 m (TOT: 138.5 m) (18)	0:00	
18	GAMESA G97 2000 97.0 !O! hub: 90.0 m (TOT: 138.5 m) (19)	0:00	
19	GAMESA G97 2000 97.0 !O! hub: 90.0 m (TOT: 138.5 m) (20)	0:00	
20	GA3	1:29	