

INITIAL ENVIRONMENTAL EXAMINATION (IEE)

50-MW GUL AHMED WIND POWER LIMITED JHIMPIR DISTRICT THATTA



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Executive Summary

Gul Ahmed Wind Power Limited (GAWPL) is planning to establish, own and operate a 50 MW Wind Power Generation Complex (WPGC) in Deh Kohistan 7/1, Jhimpir area in Taluka and District Thatta, about 60 km south-west of Hyderabad. GAWPL may seek finances for this project from one of the Equator Principles Financial Institutions (EPFIs), including International Finance Corporation (IFC). Since the EPFIs have modeled the Equator Principles on the environmental standards of the World Bank and the social policies of the IFC to ensure that the projects they finance are developed in a manner that is socially responsible and reflects sound environmental management practices, this IEE has been carried out in line with the prevailing legislation in the country and IFC performance standards.

Study Methodology

The present study was conducted using the standard methodology prescribed by Pakistan Environmental Protection Act of 1997 and international agencies. Various phases of this study include scoping, base line data collection, compilation and analysis, stakeholder consultation, screening potential environmental impacts, assessment of impacts, and report compilation.

Legislative Framework

The Pakistan Environmental Protection Act of 1997 (PEPA 1997) requires the proponents of every development project in the country to conduct an environmental assessment and submit its report to the relevant environmental protection agency before starting work on the project. The Equator Principles and IFC's Performance Standards also call for an environmental and social assessment for the GAWPL's WPGC. The present IEE has been carried out in response to the above-mentioned Act, Equator Principles and IFC Performance Standards.

Project Overview

AEDB has sub-leased 647 acre (about 258.8 hectares) land acquired from GoS to GAWPL to establish, own and operate its 50 MW WPGC IPP project in Deh Kohistan 7/1, Jhimpir in District Thatta, Sindh, Pakistan. The purchaser of the power will be the National Transmission and Distribution Company (NTDC). A detailed wind resource and micro-siting study is in progress. The site-specific wind data obtained from the meteorological mast that was set up by GAWPL in September 2008 will be used for micro-siting. Furthermore the Project would benefit from the data provided by AEDB and the experience of other IPPs in harnessing wind energy in the Jhimpir Wind Corridor.

The project will comprise an appropriate number of turbines in a range of 1.5 to 2.5 MW each, most suitable for wind data having a rotor diameter of 80 to 90 m located in a single row within the 11 km x 0.2 km strip of land. The 11 km internal road that shall service the towers and a new 9 km dirt approach road to the site from Super Highway M-9 will be improved/compacted for transporting heavy equipment and machinery along with construction of service facilities.

Description of the Environment

Administratively the proposed Wind Power Generation Complex site is located in Union Administration Jhimpir, of Taluka and District Thatta. Topographically it is on the arid and stony wasteland of Deh Kohistan. The climate in the project area can be characterized by dry, hot and sub-humid conditions, typical of tropical arid zones lying in the heat zone of the monsoon region. There is a minor seasonal intervention of a mild winter from mid-December to mid-February and then a long hot summer extending from mid-March to November. The site and its immediate surroundings have been degraded by rampant sand/gravel/stone excavation, exacerbated by wood cutting. The shrubs have dried out; trees are dwarfed while groundwater is simply not available.

The proposed site is outside the settled area of the Union Administration. The Project area has in its neighbourhood hamlets each distant at over 1.2 to 2.5 km from the site perimeter. The number of households in the villages varies from 6 to 15 and the population is estimated at about 430. The area

population is engaged in sand/gravel/stone excavation, and wood cutting, limited cultivation and grazing activity.

No anthropogenic sources of air pollution exist in the immediate vicinity of the site; therefore the ambient air of the area is free from the key pollutants such as carbon monoxide, oxides of nitrogen, sulfur dioxide but not particulate matter whose level often exceeds the National Environmental Quality Standards. The groundwater sources in the area, including the current source at the Nooriabad Industrial Area have dried up. The nearest irrigation canal is located over 15 km from the proposed site. It is hoped that the water supply scheme proposed for taking a share of 5 million gallon daily for Nooriabad from the water intake structure at Keenjhar Lake will be the source of freshwater for the Project area.

Scoping Sessions/Stakeholder Consultation

Stakeholder consultations were carried out as part of the IEE study. These consultations were conducted with the institutional as well as the grassroots stakeholders. The main objectives of the consultations were to: apprise the stakeholders about the proposed project activities; obtain their views, concerns and recommendations; and address/incorporate them in the project design and thus enhance the environmental and social performance of the project.

More important was the meeting with grassroots stakeholders, the residents of the five villages which are all located from 1.2 to 2.5 km outside the boundary of the proposed project. Some of them visited the wind farm that has been set up about 10 km from the GAWPL site. At the last consultation meeting the residents of the hamlets, while expressing their enthusiasm to have the wind farm in their area, described the noise level from another unit just installed as just perceptible; the shadow flicker effect a non-issue; the shadow effect not a nuisance but a landmark of development, and installation of wind turbines as curiosity of the same kind as construction of a minaret at a mosque.

Impact Assessment and Mitigation

During the present IEE, the potential social and environmental impacts of the project were identified. The identified impacts include: Land use, geology, seismic hazard, visual effects, noise impact, EMI impact, flicker shadow effect, cultural heritage and archaeology issues, fauna including birds and reptiles, and flora, and recreation values. Each identified impact was then characterized with respect to its nature, reversibility, geographical extent, severity and likelihood. Based upon this characterization, the impacts were assessed as of major, medium, small or no significance.

The key potential environmental and social issues identified during the present study included:

- ❖ Poor Rock Quality and low load bearing capacity for which mitigation measure proposed is providing bored reinforced concrete piles to the depth of hard rocks with RQD values less than 50%, and piles of the foundations of the towers to be so designed as to pose minimum risk to the liquefaction threat during major (> 7 on Richter Scale) earthquake.
- ❖ The wind turbines will be so located as to normalize wake effect over the area of five rotor diameter equivalent, which would be within the allotted area, and leave the air quality unaltered.
- ❖ The dispersion of the existing high level of PM₁₀ and other pollutants will maintain the status of the airshed of the corridor in the unpolluted category.

Other environmental issues assessed for their impact during the construction stage and GAWPL-WPGC operation, and found to have low or non-significant impact included:

- ❖ Erosion of soil and contamination of soil and water, safety hazards, damage to infrastructure, air quality deterioration, noise emissions, threat to wildlife and habitat modification. The impact of these issues has been found to have low or no significance.
- ❖ Noise emission from the WTGs, their visual effect, shadow flicker effect, EMI effect and shadow effect on the villages in proximity has, likewise been found to have no significance as the nearest WTG of the GAWPL wind farm would be sited at least 1.6 km distance, which is 20 equivalents of the hub height, from nearest villages viz. Haji Walloo, Haji Lakhano and

Murad Ali Chang goth. (Safe distance where such effects attenuate to acceptable levels is seven equivalents of hub height.)

- ❖ Land acquisition and resettlement of population are non-issue since the unsurveyed land on which the villages are located are outside the area sub-leased to GAWPL by AEDB.
- ❖ There are no cultural heritage, recognized archaeological sites, endangered species of flora, wildlife reserve, or potential tourism sites that may need protection and hence no mitigation measures need to be taken. Mitigation measures have been proposed for the protection of the spiny-tailed lizard (*Uromastix hardwickii*) Sandha and the straying high flying birds. The number of the few Houbara bustard and high flying eagles and falcons still around will be recorded during the pre-construction period. Mitigation measures such as hiring the services of sharp shooters will be in place to stupefy the high-flying stray birds and later on release them to safe environment.
- ❖ Due vigilance will be kept for protecting the wildlife that may still be there.
- ❖ Adoption of mitigation measures identified for different stages of the project will be keenly monitored to further enhance the environmental performance of the GAWPL-WPGC.

The IEE has recommended appropriate mitigation measures to address the above concerns, and to keep the residual impacts within acceptable limits.

Findings and Recommendations

On the basis of the overall impact assessment, more specifically, nature and magnitude of the environmental and socioeconomic impacts and their residual impacts identified during this IEE study, it is concluded that the proposed project is unlikely to cause degradation of the already degraded environment at Deh Kohistan 7/1. There would be almost negligible gaseous emissions and liquid effluent discharges that could alter the quality of airshed and watershed respectively.

Establishment of a series of wind farms having over 200 WTGs by AEDB would however modify the the ecosystem of Deh Kohistan 7/1 in Jhimpir. This alteration of ecosystem should be looked at as upgradation of, and value addition to the degraded land through sustainable development initiatives, in addition to arresting the process of over-exploitation of the already impoverished land. This would be possible only if the proposed activities are carried out as mentioned in this report, and the mitigation measures included herein are effectively implemented in their entirety by adopting the Environmental Management Plan.

The key recommendations pertaining to the environmental and social performance of the proposed project are as follows:

- ❖ The EMP as well as IFC's HSE Guidelines should be made part of the contracts awarded by GAWPL for the proposed project.
- ❖ Environmental and social management capacity should be developed.
- ❖ GAWPL should develop its Environmental and Social Policy, which should demonstrate the sound environmental and social management practices throughout its operations.
- ❖ GAWPL should adhere to the environmental legislation and regulations for environmental and social assessments during the operation of the WPGC.
- ❖ GAWPL and its contractors should as much as possible engage local labor and no child labor.

Environmental Management Plan

An Environmental Management Plan (EMP) has been developed to provide an implementation mechanism for the mitigation measures mentioned above. The EMP provides for an environmental management system (EMS) for environmental and social management during the project, and defines the roles and responsibilities of different operators. The EMP includes a mitigation plan, and a monitoring plan, in the context of the environmental and social management of the project.

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INITIAL ENVIRONMENTAL EXAMINATION

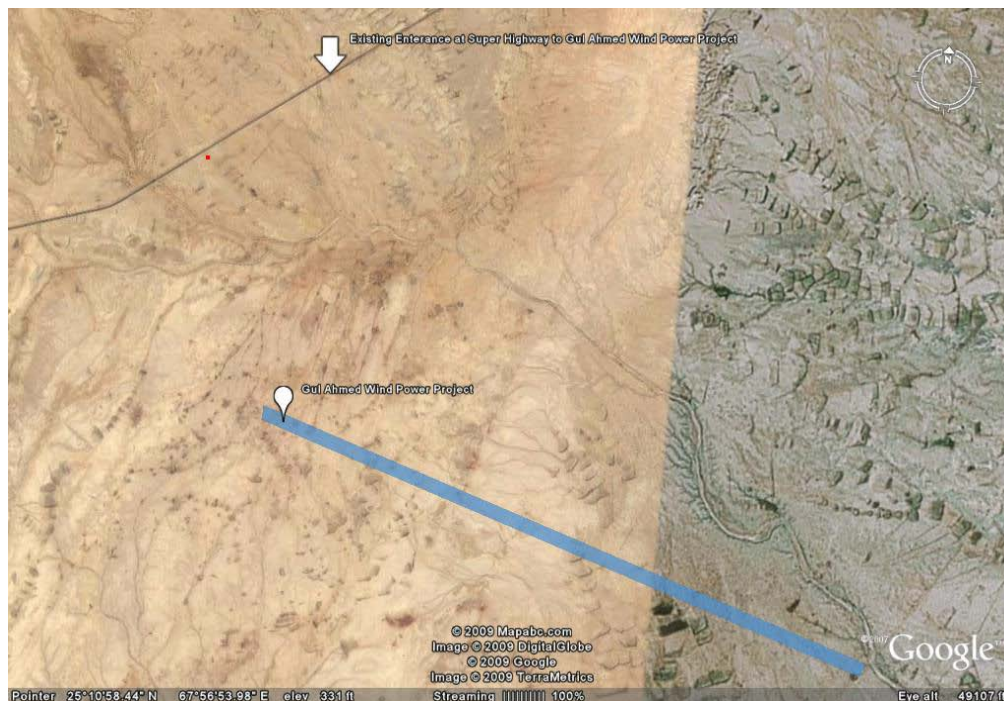
50 MW GUL AHMED WIND POWER GENERATION COMPLEX

DEH KOHISTAN 7/1, JHIMPIR, DISTRICT THATTA

1.0 INTRODUCTION

1.1 **NAME OF PROJECT:** Establishment of Wind Power Generation Complex
At Jhimpir, District Thatta

1.2 **LOCATION:** Project site is located about 4 km off Super Highway (M-9) at approximately 110° SE in Deh Kohistan 7/1 Taluka Thatta (Union Administration Jhimpir), District Thatta



1.3 Project Proponent

The Project Proponent: Gul Ahmed Wind Power Limited (GAWPL) is an associate company of Gul Ahmed Energy Limited. The Directors of Gul Ahmed Wind Power Limited are also Directors of Gul Ahmed Energy Limited (GAEL). They were among the first to set up captive power generation system in 1988-89 in their Gul Ahmed Textile Mills. They were also among the first few Independent Power Producers (IPPs) to respond to the National needs of energy supplies by setting up Gul Ahmed Energy Limited in 1994. Till to-date the GATM captive power plants are meeting the requirements of Gul Ahmed Textile Mills (GATM), and GAEL (IPP) is meeting KESC dispatch requirements successfully and efficiently.

The Chief Executive of Gul Ahmed Energy Limited was also Chief Executive of Gul Ahmed Textile Mills Ltd. for over 19 years. Here he inducted the captive power generation system in 1988-89. It is through his untiring efforts that the Gas and Diesel/Furnace oil based Power Generation systems viz. 35 MW and 136 MW Power Plants are operational in GATM Landhi, and GAEL in Korangi Industrial Area respectively.

1.3.1 VISION

GAWPL aims to be synonymous with a future oriented outlook, and provide technologically advanced systems of power production and services that set the standard in quality and environmental compliance. Offering a broad spectrum of power production systems it intends to enter into the renewable energy production systems that include wind energy.

1.3.2 GAWPL Vision is to become a world class, professionally managed, fully integrated, customer focused, Power Production Company, offering environment friendly systems and services to its customers.

1.3.3 MISSION

GAWPL mission is to continuously provide quality and environment friendly Power Production system to its customers, and exceeding their expectations through credibility, economy and services.

1.4 OBJECTIVES OF THE PROJECT

The main objectives of the 50 MW Wind Power Generation Complex are to:

- Utilize the potential of wind capacity identified by the AEDB at the Gharo-Jhimpir corridor and utilize the technology of wind power generation to reduce the emission of Greenhouse gases including CO₂ in Pakistan through net energy gain,
- Establish a wind power generation facility in accordance with GoP's policy and guidelines on development and generation of Alternative or Renewable Energy, being implemented through the AEDB, the Organization that has issued the Letter of Intent (LoI) dated May 13, 2006.
- Respond to the national need to produce power from Alternative or Renewable Energy sources that are alternative to thermal and hydro power production systems. and
- Utilize the hitherto unexploited wind energy potential which is the only resource left with this ecologically degraded land.

1.5 NEED FOR THE PROJECT

1.5.1 Energy Overview

Electricity demand in Pakistan had already exceeded supply in the year 2002. With rapid growth in GDP, it was estimated that the generating capacity will have to escalate by 50 percent by 2010 in order to meet the expected demand. Rising oil consumption and leveling off in oil production together with inadequate refining capacity has left Pakistan (a) with shortfall of over 3500 MW in its theoretically maximum capacity of 17,793 MW, and (b) heavily dependent on petroleum product imports from Middle East.

Natural gas accounts for the largest share of Pakistan's energy use, amounting to about 50 percent of total energy consumption. With depleting reserves of both oil and gas, Pakistan is already on the brink of becoming a natural gas importer. Pakistan

currently consumes all of its domestic oil and natural gas production as is evident from the following Tables:

Consumption Trend in Pakistan

Primary Energy sources	Annual Average Consumption
Fossil fuels	
Natural Gas	1106 bcf
Petroleum Oil	15.2 Million tons MT
Coal	6.8 Million tons MT
Nuclear Sources	Equivalent of 1.2% energy

Source: Economic Survey Pakistan 2007-8

Trend of Consumption of fossil fuels in National Energy Mix

Year	1996-97	2006-7	Trend
Fuel	Fuel	Share	
Gas	29%	41%	Increase
Oil	48%	29%	Decrease

Source: Economic Survey Pakistan 2006-7

Consumption of fossil fuels in National Energy Mix

Domestic	186 bcf	15%
Commercial	31 bcf	1.2%
Transport	56 bcf	4.6%
Fertilizers	304bcf	20.7%
Power Generation	434bcf	36.8%
Others		20%
Total		100.0%

Source Economic Survey Pakistan 2006-7

Useable Energy Availability Scenario in Pakistan

Fossil fuels	
Gas Reserves	31.266 Trillion cft
Crude Oil	339 Million barrels
Coal	185 Billion Tonnes
Renewable sources	Over 50,000 MW

Source: Economic Survey Pakistan 2007-8

A number of technical and non-technical; operational and management constraints e.g. rise in oil price entailing high cost of power production; technical faults in grids; inadequate water storage in reservoirs; unforeseen drastic reduction in Chenab river water flow after the commissioning of Baglihar Dam, have compounded into energy crisis and the capacity is not achieved. The thermal:hydel mix is largely eschewed and presently oil has a share of 83.8 percent in meeting the primary energy needs, while the share of hydroelectric power, coal and nuclear energy is merely 11 percent, 4.6 percent and 0.2 percent, respectively.

In view of the limitations on national reserves of oil and gas besides the unpredictable flow of water to meet the energy demands, and in consideration of the urgent need to

normalize the commercial, industrial and agricultural activities, it is considered essential to broaden the outlook on the energy mix and besides exploring indigenous sources that are renewable as well as non-renewable, also increase the share of the renewables as alternative to petroleum oil and gas that is presently the main (83.8%) source of fuel.

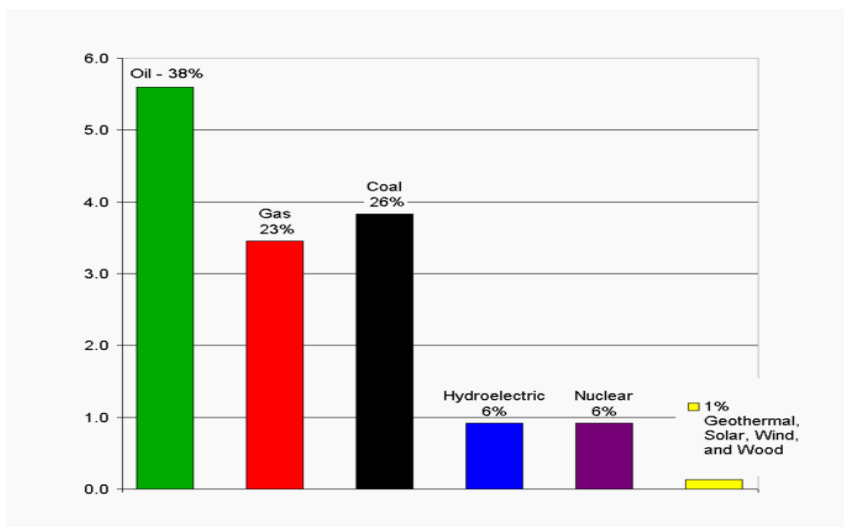
The use of extensive coal reserves in Thar and the commissioning of Sonda-Jherruck Coal based power production system will, however, take time. Likewise the slow but steady switch over to the expensive yet politicized nuclear power generation from Chashma III and Chashma IV with Chinese support is not likely to offer an immediate solution. The GoP is therefore exploring several options including pipeline and liquefied natural gas (LNG) import to meet the natural gas demand, enhancing refining capacity of the refineries, enhancing the use of renewable energy systems including hydroelectric power generation and wind energy.

In view of the shortfall in the conventional energy resources the GoP had taken the initiative to establish the Alternative Energy Development Board (AEDB) and to establish Wind Power production systems as one of the alternative renewable sources. The Gharo-Jhimpir Corridor was identified to harness the potential of this renewable source and thus to meet the rapidly growing demand of the industries, commercial organizations and the urban housing sector.

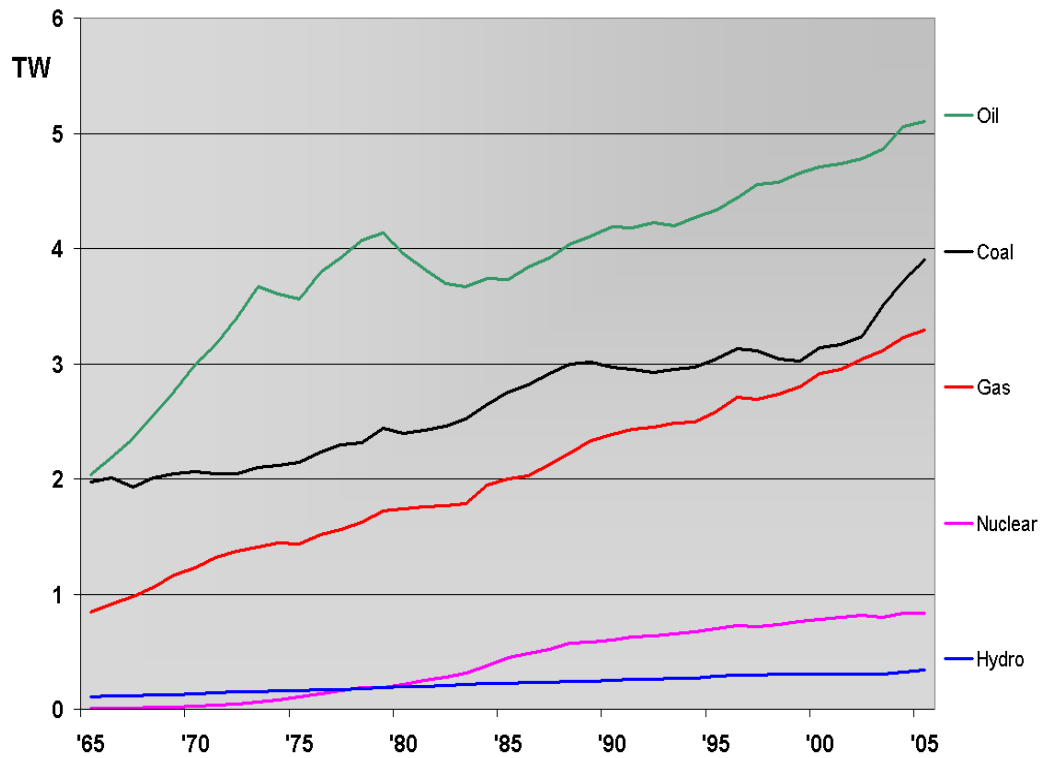
1.5.2 Global Energy Supply Scenario

Global Demand Forecast:

- Wind and solar power-generation system combined will match conventional generation systems by 2025
- Wind power generation capacity will reach 7,500GW by 2025
- Conventional power stations will be phased out completely by 2037
- Demand for energy supply is expected to rise by 50 per cent globally by 2030
- Low-carbon energy industry is set to be worth \$3 trillion per year by 2050.



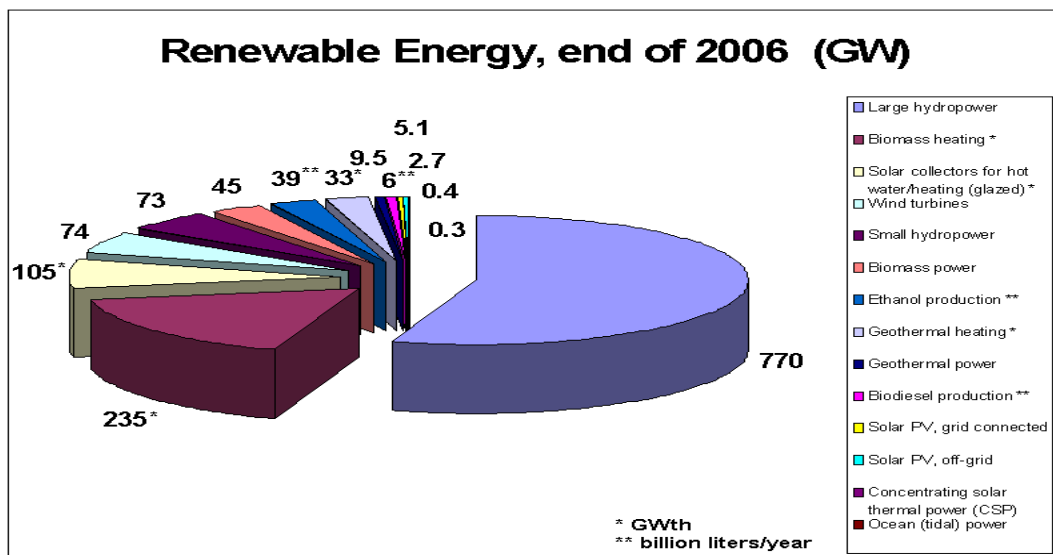
Worldwide Energy Supply in Terawatts TW



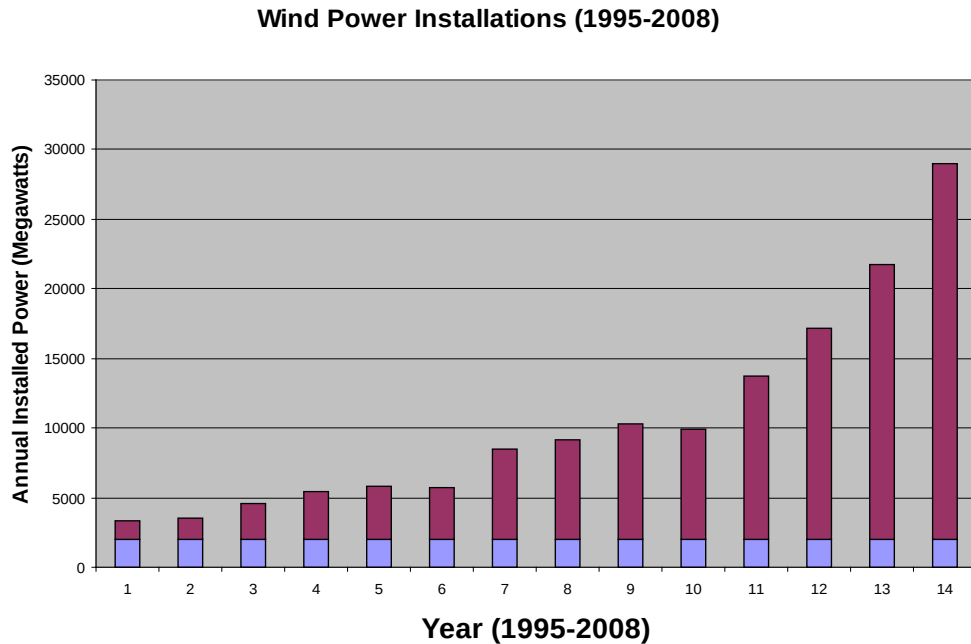
Rate Of World Energy Usage In Terawatts (TW), 1965-2005

The following are the alternative renewable energy sources that renew and do not deplete:

- Solar radiation
- Biomass
- Wind
- Ocean wave energy
- Tidal Energy due to earth's rotation
- Geo-thermal energy due to heat of earth's interior.



For environmental and commercial reasons, the answer lies in harnessing Solar and wind energy potential both of which have immense potential in Pakistan. Solar energy is, however, yet to mature as a viable alternative even in the industrialized countries. On the other hand there has been a steady rise in the installed capacity of wind power production systems. The global rise in wind power production is shown in the following figure:



Germany has taken a lead in this connection and has been supported by Europe and many states in USA besides Canada in successfully generating clean and cheap wind energy. China and India have followed suit with considerable success, knowing fully well the growing demand and increasing limitations of relying on power generation technologies dependent on petroleum oil and water. Malaysia and Indonesia have also realized this potential, given their vast coastal areas.

Geographically, Pakistan is ideally placed in the tropics and has a number of wind corridors. According to estimates based on the survey tremendous potential of about 43,000 MW exists for generating wind energy in the 9,700 km² area in (i) Jamshoro, Nooriabad, Talhar and Ketu Bandar corridor, and (ii) Thatta, Thana Bola Khan, Hyderabad and Gharo sites that are placed respectively in the excellent category and good category for generation of wind power. The site allotted to Gul Ahmed Wind Power Generation Complex is placed in the Jhimpir/Thatta Wind corridor and considered suitable for wind power generation.

1.6 BENEFITS OF WIND FARM DEVELOPMENT

Significant environmental benefits can be gained by installing a wind farm.

Carbon Dioxide Emissions and Pollution

Wind power generation does not require fuel for turbine operation, and has no emissions directly related to electricity production. As such operation of wind turbines does not produce CO₂, SO₂, NO_x or particulate matter or any other form of air pollution. The manufacturing, transportation, construction at site and installation,

however, does consume resources and it is here that energy-intensive processes, generally using fossil fuel are involved.

The following indicative figures relate to a 100 MW installed capacity and the production of 1 kg of CO₂ for the generation of each 1 kWh of electricity.

- CO₂ (a major contributor to the “greenhouse effect”) 310,000 tonnes/year
- SO₂ (Sulphur Dioxide is a constituent of acid rain) 4,750 tonnes/year
- NO_x (Nitrous Oxides are a constituent of acid rain) 2,300 tonnes/year

Producing energy from the proposed wind farm will prevent these emissions being produced elsewhere in Pakistan, thus helping the GoP’s environmental initiatives.

Developing a renewable energy resource will lessen the need to use fossil fuels such as coal. This conforms with the keenness of GoP to increase the share of renewable energy in electricity production, and its commitments to Kyoto Protocol. Reduction in the gas emissions from fossil fuel generation will be achieved, although the amount obviously depends on the wind farm installed capacity.

Net Energy Gain

The energy return on investment (EROI) for wind energy is equal to the cumulative electricity generated divided by the cumulative primary energy required to build and maintain a turbine. The EROI for wind ranges from 5 to 35, with an average of around 18. EROI is strongly proportional to turbine size, and larger late-generation turbines are at the high end of this range, at or above 35. This suggests that higher capacity wind turbines are likely to bring better EORI and also improved return on investment with improved wind speed.

It is worth making a note that since energy produced by a WTG is several times energy consumed in construction, there is a net energy gain. It is estimated reductions in CO₂ emissions range from 0.33 to 0.59 tonnes of CO₂ per MWh. The energy used for construction is produced by the wind turbine within a short period of operation. Thus the initial carbon dioxide emissions are paid back within a few months of operation.

1.6.1 Establishment of the wind power generation system would:

- Reduce carbon dioxide emission through net energy gain
- Benefit Alternative Energy Development Board in achieving the objectives of the Government of Pakistan Policy and Guidelines on development and generation of Alternative or Renewable Energy for Power Generation – 2006 to involve the private sector in generation of power through renewable resources.
- Benefit the National electricity production system in making renewable energy available to the National Grid of the WAPDA, the main stakeholder.
- Reduce vulnerability to volatile utility prices.
- Contribute to enhancement in quality of environment of Deh Kohistan and restore the status of the area as the major user of wind power by producing sustainable form of energy.
- Contribute to enhancement in quality of life of the people resident in the area that has lost its water, surface soil, vegetative cover, besides the fauna and is left with meager resources of its own, except the wind that has the desired velocity that can be utilized for power generation.

1.7 CURRENT STATUS OF PROJECT

The following milestones have been achieved:

- GAWPL has obtained the Letter of Intent (LOI) dated February 11, 2008 from the Alternative Energy Development Board (AEDB) for development of 50 MW Wind Power Generation Complex (WPGC) at Deh Kohistan 7/1, Union Administration Jhimpir, 140 km to the northeast of Karachi City.
- GAWPL has acquired possession of 647 acres of land sub-leased by AEDB and leased by Government of Sindh (GoS) from the GoS in Taluka Thatta, Jhimpir area in District Thatta, which is accessed from the Super Highway M-9 at 55km to Hyderabad.
- Feasibility Report for establishment of the 50 MW Wind Power Generation Complex (WPGC) at the said location is under preparation.
- The WPGC will be located within the area bounded by the following coordinates:

S. No.	Longitude	Latitude
1	25° 10' 12.09"	67° 54' 25.15"
2	25° 10' 19.86"	67° 54' 25.98"
3	25° 08' 30.78"	68° 00' 44.76"
4	25° 08' 28.99"	68° 00' 46.29"
5	25° 08' 23.36"	68° 00' 42.72"

- Wind measurement is being performed at the site by installing three 80 m high measuring masts at the following Geodetic Coordinates:
 1. Mast B1: 391771, 2783696
 2. Mast B2: 395140, 2782632
 3. Mast B3: 398602, 2781536
- The masts have been provided with wind anemometers one each at 35 m, 50 m, 65 m, and (2) at 80 m height. The Wind Monitoring station with NRG Wind speed and Wind direction sensors and NRG-Symphonie Data Logger started monitoring the wind velocity and direction at heights of 35m, 50m, 65m and 80m since September 2008.

1.8 ENVIRONMENTAL IMPACT ASSESSMENT

The Environmental Impact study for the establishment of 50 MW GAWPL WPGC has been carried out in the project planning phase for the Feasibility Study to fulfill the requirement of Section 12 of the Pakistan Environmental Protection Act (PEPA) 1997. This Initial Environmental Examination Report has been designed to address the regulatory requirements of responsible provincial authority viz. EPA Sindh against the requirement of Pakistan Environmental Protection Act 1997, and to make it acceptable to AEDB, PPIB and WAPDA as well as the sponsors investing in its establishment and operation.

Assessment of environmental impact for an IEE which would satisfy the EPA Sindh and the Sponsor viz. GAWPL, demands detailed description of present status of microenvironment and macroenvironment in terms of the base line data, including land use pattern. These requirements were spelled out by GAWPL in the Scope of

Work assigned to Research and Development Consultants (R&DC) who have responded to them in the following chapters of this IEE Report.

1.8.1 METHODOLOGY

This IEE has been conducted using a multidisciplinary approach according to the following basic principles:

- Desktop research
- Field data collection
- Consultation with stakeholders
- Identification and evaluation of the potential and associated environmental impacts of the Project
- Recommendation of impact mitigation measures
- Development of cost-effective social and environmental management plan for the project life cycle

Specific requirements of the study have been incorporated in this report to meet Environmental Protection Agency's requirements and objectives. A brief discussion of the approach is as follows:

1.8.2 INCEPTION ACTIVITIES

For an effective inception and implementation of the project, and to clarify issues, objectives, scope of the study and consultants' approach and methodology were discussed at the outset. The project activities started after receipt of the Work Order to Proceed by the client on February 09, 2009.

The project team was assembled and project activities were planned for timely and effective completion. An inception meeting was held between R&DC and the client at GAWPL office, to finalize the study approach and methodology. A schedule of activities agreed between the parties was prepared.

1.8.3 COMPOSITION OF TEAM

List of Consultants and Associate Members

1. Dr. Mirza Arshad Ali Beg – Ph.D. Senior Environment &EIA Specialist, Environmental Sociologist and C.E.
2. Mr. Farrukh Aamir Beg – B.E. (Mechanical), MBA, Associate Consultant
3. Dr. Mohammad Abdullah – Ph. D. (Social Sciences), Associate Consultant
4. Dr. Nergis Yasmi, – Geologist, Environmentalist, Assistant Professor Bahria University, Karachi Campus, Associate Member
5. Dr. Badar Munir Ghauri, – Ph.D. Environmental Engineering, Air Quality Specialist, Deputy Chief, SUPARCO
6. Mughal Sharif, – MSc Ecologist, Environmentalist, Bahria University, Karachi Campus, Associate Member

This IEE Report has been prepared by Research & Development Consultants (R&DC). For the purpose of conducting the environmental assessment and preparing the Report, Team Leader of the Project Dr. Mirza Arshad Ali Beg carried out most of the assessment besides obtaining baseline data on air quality and carrying out noise level measurements. Team Leader is a senior environmentalist, well versed with the requirements of Environmental Impact Assessment studies. His associates Mr. Mughal Sharif, Engr. Farrukh Aamir Beg, and Dr. Abdullah Khan assisted him in collecting field data and desk studies including data analysis and compilation as well as Report preparation, while services of SUPRCO Team led by Dr. Badar Munir Ghauri and of the team comprising Dr. Nergis Yasmin and Mr. Mughal Sharif Environmental Research Centre, Bahria University were hired for Air Quality Monitoring, Water quality and Noise Level Measurements and Modeling.

1.8.4 Scoping/Consultation Meetings with Stakeholders

The scoping meetings are required as per the Guidelines on Preparation of IEE/EIAs to obtain understanding on the issues sensitive to the area and maximum information on the environment of the area, stakeholders were contacted and discussions were held with them to clarify issues:

- Sindh Environmental Protection Agency
- Ministry of Environment and Alternative Energy Government of Sindh
- SUPARCO
- IUCN – Pakistan
- WWF – Pakistan
- Sindh Wildlife Department
- Ministry of Local Government & Rural Development
- Department of Archaeology, Government of Pakistan
- Meteorology Department

Proceedings of the Consultation Meetings are included in a subsequent chapter.

1.8.5 Review of Legislative Requirements

The objective of this sub-task is to obtain information on all legislations pertaining to the establishment of the proposed wind power production system. For this purpose the relevant legislative framework was reviewed and the relevant laws, guidelines including the Equator Principles and IFC Environmental, Health, and Safety Guidelines for Wind Energy (2007), applicable to establishment of wind power generation complex listed in chapter 2.

1.8.6 Collection of Baseline Data

The objective of this task is to establish the background environmental conditions of the project area. This includes but is not limited to topography, geology, hydrogeology, hydrology, climate, flora and fauna, socio-economic conditions, archaeology, present infrastructure facilities and future proposed development plans for the project area. Information describing the existing environment was gathered from different sources including the client, statutory bodies, local interest groups and published work. During this stage, both primary and secondary data were obtained. The published data were obtained from various sources to establish environmental background conditions and trends. This includes:

Physical conditions - including topography, geology, soils, surface and groundwater resources and climate;

Ecological resources - including flora and fauna, particularly in respect of rare or endangered species, protected areas or other areas of significant environmental importance;

Human and economic development – including settlements, socioeconomic conditions, infrastructure and land use;

Heritage aspects – including sites of cultural, archaeological or historical significance.

Detailed maps of the site and other details on the project including Wind velocity data were provided by GAWPL Officials.

1.8.7 Impact Assessments

This is the main task of the study that is intended to identify all possible adverse environmental impacts that might result from establishment of the wind power generation complex and assessed the severity of these impacts. Necessary Mitigation measures were identified and developed for impacts of moderate or minor severity, if any. The following sub tasks were undertaken:

a) Identification and Evaluation of Impacts

The objective of this task is to systematically consider the likely or possible significant impacts on the environment arising from establishment of the petroleum products storage facility and to assess the risks associated with these impacts. In order to do so, the information collected as part of the previous tasks, analyzed collectively for validity and objectivity before identifying the impacts. The identification of impacts was a key activity in the environmental assessment process, which was done, based on the professional judgment of our experienced team supported by national and international guidelines.

The objective is also to evaluate the significance of each impact identified in the preceding sub-task in terms of its severity and the likelihood of its occurrence. The assessment of severity would consider the nature, magnitude, extent and location, timing and duration and reversibility of the potential impact. Likelihood or probability of occurrence would be assessed in a qualitative manner. The significance of the impacts would then be assessed in terms of the effects on the natural ecosystem, level of public concern and conformance with legislative or statutory requirements.

The impact evaluation process prioritized each potential impact; screened out insignificant or inconsequential impacts and formed the basis for the development of the environmental mitigation and monitoring program for all significant impacts.

b) Identification of Mitigation Measures

The objective of this task is to identify practices, technologies or activities that would prevent or minimize all significant environmental impacts and propose physical and procedural controls to ensure that mitigation is effective. On the basis of the impact evaluation performed in the previous two tasks, changes or improvement in practices in the planned activities have been suggested, where

practical, to prevent and control unacceptable adverse impacts resulting from normal or extreme events.

An emergency response and reporting plan as well as monitoring program has been developed and institutional arrangements for monitoring suggested.

c) Methodology Adopted for Impact Assessment

The normal format of Environmental and Health & Safety Audit was adopted by R&DC who followed the basic checklist of parameters during the reconnaissance survey of the microenvironment and macroenvironment, conducted on February 10, 2009 and surveys undertaken subsequently by R&DC officials, SUPARCO officials and Bahria University officials and the findings used for the subsequent desk study.

The reconnaissance surveys and meetings were arranged by GAWPL Officials to discuss the magnitude of the Project in the light of requirement for environmental assessment study, to review the status of environment at the site and to evolve a work plan for collecting baseline data needed for the Rapid Assessment of status of environment of the microenvironment and macroenvironment.

Relevant information and baseline data for the environmental assessment and impact of the 50-MW GAWPL-WPGC on the ambient air quality, noise level and water, wastewater quality, land use, socio-economic condition of the neighbourhood were generated by Team organized by R&DC. The primary and secondary data available from publications and unpublished information have been used for assessment of the present status of the microenvironment and the impact of the current activity on the macroenvironment and for classifying the allotted land as wasteland, with its airshed having air quality characteristic of unpolluted environment.

The collected data have been used for identification of:

- Hazards posed to safety, health and the environment and risks involved in different activities during construction, and operation phases of the project
- Mitigation and control measures to be implemented during the project in order to minimize the adverse impacts of the 50-MW GAWPL-WPGC on the environment
- Residual Impact and post-operation evaluation of performance on completion of Project
- Compiling the outcome of above steps and screening the potential environmental impacts by applying the checklist method using professional judgment to prepare the IEE report according to EPA guidelines.

In making the assessment of the present status of the microenvironment, due account has been taken of the isolated environment of Deh Kohistan 7/1 Taluka Thatta (Jhimpir Corridor) off the Super Highway M-9. Environmental assessment of the impact of activities during the pre-construction, construction and operation phases of the project on the microenvironment and macro environment as well as classification

of the environment as polluted or otherwise, have been based on professional judgment on the likely alteration in the quality of ambient air, water and soil, as well as wastewater and other wastes discharged. These assessments address the environmental issues pertaining to microenvironment and macroenvironment in the light of Pakistan Environmental Protection Act 1997⁽¹⁾ and Guidelines for the Preparation of EIA⁽²⁾ and World Bank and IFC Guidelines, effective July 1998^(8,9).

(b) Methodology Adopted for Social Aspects

R&DC along with Officials of GAWPL held consultation based on the detailed contents of the Project with Sindh EPA. This fulfilled an essential requirement of the IEE/EIA Process that GAWPL as Project Proponent started consultation with Sindh EPA to establish the need of Project and of conducting an IEE.

Environmental and social considerations being an essential component of the implementation phase of this project, the following points were underscored for implementing the IEE recommendations:

- Identifying the need, if any, for involuntary resettlement and for land acquisition and to prepare an appropriate Involuntary Resettlement Program
- Reducing the impact on the living environment during the construction period, selecting appropriate construction methods and construction schedule

Accordingly the IEE study has:

- Conducted public consultation at the early stage
- Held stakeholders meetings during the study
- Understood in detail the concerns of Persons resident in the villages that are outside the area sub-leased to GAWPL

In consideration of

- Land having been sub-leased to GAWPL for installation of Wind Power Generation Complex and payment for land acquisition made to the AEDB, Government of Pakistan,
- Consultation Meetings with the residents of villages that are located outside the leased land, which does not require land acquisition or involuntary resettlement, and
- Insignificant impact on the ecology and living environment,

It is implicit that there would be no need for involuntary resettlement or acquisition of Land.

1.9 CATEGORIZATION OF PROJECT

The Project meets the criteria set by the GoP in its 'Policy for Power Generation Projects, 2002': "To encourage and ensure exploitation of indigenous resources, which include renewable energy resources, human resources, participation of local engineering and manufacturing capabilities"⁽³⁾.

¹ Pakistan Environmental Protection Act (PEPA) of 1997

² Pakistan Environment Protection Agency (Review of IEE & EIA) Regulations, 2000

⁸ IFC Procedure for Environment & Social Review of Projects, December 1998

⁹ IFC Environmental, Health, and Safety Guidelines for Wind Energy (2007)

By generating 50 MW electricity, the WPGC Project will, according to the Pakistan Environmental Protection Agency Review of Initial Environmental Examination and Environmental Impact Assessment Regulations, 2000^(1,2), be placed in Category A, Schedule II, List of projects requiring Initial Environmental Examination required for medium size projects including power production units of size 50 MW or less, and not EIA that is required for large projects including power production units of size over 200 MW.

1.10 THIS REPORT

The present IEE Report has been prepared in accordance with the requirements of Pakistan Environmental Protection Act (PEPA) of 1997⁽¹⁾ as well as Environment Protection Agency (EPA)⁽²⁾ It has taken due cognizance of:

- Policies, Regulations and Guidelines framed by EPA^(1,2),
- Private Power Infrastructure Board, PPIB⁽³⁾,
- Reports identifying existing barriers to Wind Energy Use⁽⁴⁾,
- Alternative Energy Development Board for setting up and operating Power Production units⁽⁵⁾.
- American Wind Energy Association Bulletin #4: Wind Energy Resources⁽⁶⁾
- Studies on impact of wind farms on bird life⁽⁷⁾, besides
- Equator Principles⁸
- IFC Performance Standards on Social and Environment Sustainability and
- IFC-Environmental, Health and Safety Guidelines for Wind Energy 2007.

This IEE Report for 50 MW GAWPL-WPGC has been designed to:

- Address the regulatory requirements of responsible provincial authority viz. EPA Sindh,
- Be acceptable to the proponents as part of feasibility studies, and subsequently in its establishment and operation, and to Sindh EPA, against the requirement of Pakistan Environmental Protection Act 1997.
- Address the Equator Principles applicable to Category A Projects that require an IEE
- Address the IFC-Environmental, Health and Safety Guidelines for Wind Energy 2007.

The Report has focused on making certain that:

- Requirements of Screening the potential environmental impact of the project in respect of detailed description of present status of microenvironment and macroenvironment in terms of base line data, including land use pattern have been responded.
- There is no negative environmental impact accruing from this project on the physical and living environment or ecology, and no resettlement of population or land acquisition is involved,

³ GoP Policy for Power Generation Projects, 2002, Private Power and Infrastructure Board Ministry of Water and Power Government of Pakistan, I'bad

⁴ Commercialization of Wind Power Potential in Pakistan, Identification of Existing Barriers to Wind Energy Use, Hagler Bailly Pakistan, 2003

⁵ Pakistan Government Policy for Development of Renewable Energy for Power Generation – 2006

⁶ American Wind Energy Association (<http://www.awea.org>).

⁷ Birdlife.org (<http://www.birdlife.org/news/news/2006/02/norway.html>) Wind farm causes eagle deaths

- If there is a negative impact, it is mitigated as much as possible through specified design and construction procedures, and
- Any residual short term or long term negative impact is identified clearly and made known to all those likely to be affected.

1.11 STRUCTURE OF IEE REPORT

The IEE Report has been structured on the standard format as prescribed and approved by the EPA for the purpose of submission and review by the competent authority. The Report is presented in the following chapters and sequence:

Chapter 1	-	Introduction,
Chapter 2	-	Overview of National and International Legislation and Guidelines relevant to GAWPL Project and to this IEE Study
Chapter 3	-	Description of GAWPL Project.
Chapter 4	-	Description of baseline information (Physical, Ecological, Socio-economic Environment) of the GAWPL Project
Chapter 5	-	Screening of Potential Environmental Impacts and mitigation measures
Chapter 6	-	Scoping and Public Consultation, Findings and Recommendations, Conclusions and Economic Analysis
Chapter 7	-	Environmental Management Plan

CHAPTER 2

2.0 POLICY LEGAL & ADMINISTRATIVE FRAMEWORK

This Chapter describes the policy, legal and administrative framework in addition to the institutional set-up relevant to the environmental and social assessment of the GAWPCL WPGC project. The Chapter also includes the environmental and social guidelines of the national, international donors and other organizations.

2.1 NATIONAL LEGISLATION

The Constitution of the Islamic Republic of Pakistan confers concurrent legislative power on the Federation and the Provinces to legislate in respect of ecology, environment and environmental protection. Prior to promulgation of Pakistan Environmental Protection Ordinance (PEPO) of 1983 and the passage of Pakistan Environmental Protection Act (PEPA), 1997, Pakistan had laws that contained provisions for environmental protection, these laws dealt with land use; water quality; air quality; noise emission; liquid effluent, solid waste and toxic as well as hazardous substances handling and disposal; marine environment; fisheries; forest conservation; mineral resources development, energy, public health etc. The laws include¹:

- Pakistan Penal Code, 1860
- Canal Drainage Act, 1873
- Motor Vehicle Ordinance, 1965: and the Motor Vehicle Rules, 1969
- Factories Act, 1934
- West Pakistan Fisheries Ordinance, 1961
- Forest Act, 1927
- Boilers Act, 1923
- Pakistan Petroleum (exploration and production) Rules, 1986
- Antiquities Act, 1975
- West Pakistan Epidemic Diseases Act, 1959

A critical review of all relevant National Legislation and International Guidelines, the following in particular, was carried out to identify legislative requirements that have to be addressed in the present IEE².

2.1.1 Pakistan Environmental Protection Ordinance, (PEPO) 1983

The Pakistan Environmental Protection Ordinance (PEPO) 1983 was the first piece of legislation specifically established to tackle the issue of environment. This Ordinance provided for the establishment of a Council to frame policies on standards for the environment, and the establishment of an agency to implement the policies and enforce the standards.

¹ Industrial Policy and Environment in Pakistan, United Nation Industrial Development Organization.

² Pakistan Environmental Legislation and NEQS, Major Environmental Legislation's, Pakistan Environmental Assessment Procedures.

As a result the Federal Government of Pakistan established the Pakistan Environmental Protection Council and the Pakistan Federal Environmental Protection Agency (FEPA). The Ordinance permitted FEPA to delegate powers to any Government agency and it is understood that under this power the NWFP, EPA and Punjab EPA were set-up in 1989. One particular task of the FEPA was to set National Policy and Standards.

Under the provisions of PEPO 1983, the FEPA established the National Environmental Quality Standards (NEQS) that were gazetted as Statutory Notification in 1993. These standards are applicable to all development projects through all phases of pre-construction, construction and operation. NEQS have been issued for liquid effluents and for industrial gaseous emissions and also for municipal effluents, motor vehicle exhausts and noise emissions.

Pakistan Environmental Protection Act was introduced in December 1997 to provide for protection, conservation, rehabilitation and improvement of the environment, for prevention and control of pollution and for sustainability of all development activities. The Act includes the following additional clauses that are pertinent to establishment of GAWPGC Project:

- S.R.O. 339 (1)/2001 – In exercise of the powers referred in Section 33 of the PEPA 1997 (XXXIV of 1997), Pak – EPA has, with the approval of the Federal Government introduced “Pak-EPA (Review of IEE and EIA) Regulations, 2000.
- Clause 14 – “Handling of Hazardous Waste” requires anyone who generates, collects, consigns, transports, treats, disposes of stores, handles or impacts any hazardous waste has to have a permit to do so from FEPA.
- Clause 16 – “Environmental Protection Order” permits FEPA to enforce protection measures and remediation where contamination of the environment has taken place. Where an order is not carried out, FEPA has the authority to carry out the required works and to recover the costs from the person responsible for the source of environmental contamination.
- Clause 18 – “Offences by Bodies Corporate” identifies individual responsibility and liability to prosecution where contravention of an Ordinance is committed by a body corporate.
- Clause 30 – “Ordinance to over-ride other laws”, takes precedence over other laws in effect at the time.

2.1.2 Pakistan Environmental Protection Act, 1997

Pakistan Environmental Protection Act (PEPA), the basic Environmental Legislation in the country, was enacted in December 1997 with the objective of "protection, conservation, rehabilitation and improvement of environment for the prevention and control of pollution, and promotion of sustainable development". The following major steps were taken subsequent to the passage of PEPA 1997:

- The Pakistan Environmental Protection Council (PEPC) was reconstituted to give more representation to Provinces, trade and industry and NGOs.

- Two Environmental Tribunals were set up, one in Lahore and the other in Karachi. The Karachi Tribunal has its jurisdiction in the Provinces of Sindh and Baluchistan, while the Lahore Tribunal has jurisdiction over the Provinces of Punjab, NWFP and the Federal Capital Territory.
- Three of the four Provinces designated Environmental Magistrates under the provision of Section 24 of the PEPA 1997.
- Federal Government delegated powers to Provincial Governments for implementation of the Act.
- A system for self-monitoring and reporting for industry was developed, which includes a Self-Monitoring and Reporting Tool (SMART). SMART is a software and information package to streamline data reporting. This would facilitate monitoring and networking with industries and Federal and Provincial EPA's.
- A National Coordination Committee headed by the Director General, Pakistan Environmental Protection Agency was constituted under Section 7(k) of the PEPA, 1997 to supervise implementation of the environmental policies and enhance inter Provincial coordination.
- Analytical methods and sampling procedures were formulated.

2.1.3 Pak-EPA Review of IEE and EIA Regulations 2000

Pakistan Environmental Protection Agency Review of IEE and EIA Regulations, 2000 promulgated under PEPA 1997 was enforced in June 2000. These Regulations define the applicability and procedures for preparation, submission and review of IEE and EIA. These Regulations also give legal status to the Pakistan Environmental Assessment Procedures prepared by the Federal EPA in 1997.

Accordingly the Environmental Protection Agencies, including Sindh-EPA are bound to conduct a preliminary scrutiny and reply within 10 days of the submittal of the IEE/EIA report. These regulations require submission of a monitoring report to the concerned EPA after completion of the construction, followed by quarterly monitoring reports during operations.

2.1.4 National Environmental Quality Standards (NEQS)

Pak EPA under the provision of PEPO of 1983 issued the National Environmental Quality Standards (NEQS) for municipal and liquid industrial effluent, industrial gaseous emissions and motor vehicles exhaust and noise in 1994. It required all units coming into production after 1st July 1994 to comply with the standards. Those already in production at the time of S.R.O were required to comply starting 1st July 1996. The Pak EPA could not implement the NEQS for many reasons, including lack of implementation capacity and resistance from industry.

With the legislation of PEPA-1997 the Pak EPA revised the NEQS with full consultation of the private sector, industrialist, trade and business associations, and NGOs. Revised standards cover discharges limits of effluents into inland water, sewage treatment plant and the sea. These NEQS are listed in Annexure 1-3. The NEQS for municipal and liquid

industrial effluent standards cover 32 parameters, while for industrial gaseous emissions they specify limits for 16 parameters, and the standards for motor vehicles prescribe maximum permissible limits for smoke, carbon monoxide and noise. The NEQS are primarily concentration based. The limits on industrial effluents are neither industry specific nor have they any relationship with the quantum of production. The NEQS prohibit dilution, but this needs keen monitoring for effective implementation.

2.1.5 Pakistan NCS and its Implementation Status

National Conservation Strategy (NCS) is the primary policy document of the Government on national environmental issues. The NCS had, in 1992, identified 14 core areas including conservation of biodiversity; pollution prevention and abatement; soil and water conservation; and preservation of cultural heritage, and recommended immediate attention to these core areas in order to preserve the environment.

The major objectives of the NCS were improved efficiency in the use and management of resources, conservation of natural resources and sustainable development. The NCS had a clear set of priorities and 14 core program areas for implementation during the 1990s. In addition, a total of 68 specific programs were identified in these areas, each with a long-term goal and expected outputs and resource investments required within the next decade. Each program had communication, extension, research and training components, and each of the 8th (1993-98) and 9th (1998-2003) five-year Plans had been developed with the overall development framework envisaged in the NCS in view.

2.1.6 National Environmental Policy (2005-15) Key Issues

An overview of the key environmental issues facing Pakistan is presented below:

- Per capita water availability in Pakistan has been decreasing at an alarming rate. In 1951, the per capita availability was 5300 cubic meter which has now decreased to 1105 cubic meter just touching water scarcity level of 1000 cubic meter.
- Almost all fresh water resources are severely polluted due to discharge of untreated industrial and municipal wastes. Pollution of coastal waters due to waste discharges and oil spills coupled with reduced freshwater flows is resulting in declining fish yields.
- About 55 percent of population has access to a relatively safe drinking water source. Potable water quality, assessed against WHO standards, fails to meet all the specified criteria, confirming evidence of extremely high pollutant loads.
- Approximately 35 percent of population has access to adequate sanitation facilities.
- Air pollution is on the rise, especially in urban areas. Recent surveys conducted by Pakistan Environmental Protection Agency revealed presence of very high levels of suspended particulate matter (about 6 times higher than the World Health Organization's guidelines). 'Smog' also seriously affects almost entire Punjab during December and January every year.

- Noise pollution has become a serious issue in major urban centers.
- Of about 54,850 tons of solid waste generated daily in urban areas, less than 60 per cent is collected. No city in Pakistan has proper waste collection and disposal system for municipal, hazardous or healthcare wastes.
- The deforestation rate has been estimated at 0.2-0.5 percent per annum. Forest cover, which was 4.8 percent of total land area in 1992, could hardly be increased substantially despite all efforts.
- Degradation and encroachment of natural forests, rangelands and freshwater and marine ecosystems are resulting in loss of biodiversity. At least four mammal species, including tiger, swamp deer, lion and Indian one-horned rhinoceros, are known to have become extinct from Pakistan while at least 10 ecosystems of particular value for the species richness and uniqueness of their floral and faunal communities are considered to be critically threatened.
- Desertification affects over 43 million hectares of land annually.
- Pakistan is a highly energy in-efficient country. It uses approximately same amount of energy to generate 1 dollar of GNP as the USA.

The above situation has arisen due to a number of factors including high population growth rate, prevailing poverty, unplanned urban and industrial expansion, insufficient emphasis on environmental protection in the government policies, lack of public awareness and education and lack of institutional capacity and resources for effective environmental management

2.1.7 The Self-Monitoring and Reporting System

A system for self-monitoring and reporting for industry has been developed, which includes a self-monitoring and reporting tool (SMART). SMART is a software and information package to streamline data reporting. This is intended to facilitate monitoring and networking with the industrial and the Federal Provincial EPAs. A national coordination committee headed by the Director General, Pak-EPA has been constituted under section 7(K) of the PEPA, 1997 to supervise the implementation of the environmental policies and to enhance inter-provincial coordination. Analytical methods and sampling procedures have been formulated.

The self-monitoring and reporting system (SMRS) of the Pak-EPA takes into account the resources and interests of both the EPA and industry. It classifies industries into categories A, B, and C, each corresponding to a specified reporting frequency. Category A) industry will report the effluents and emission levels every month, Category B) industry quarterly and Category C) industry biannually. The industries are required to have their effluents tested by a Pak-EPA certified/accredited laboratory and the results entered in the electronic format and the data sent to the respective Provincial EPA by e-mail or on a floppy disk.

2.1.8 Pollution Charges

The modalities for implementation of pollution charges were adopted by consensus among all stakeholders including representatives of industry, government, environmental

NGOs and academic researchers. The consensus was on adoption of a market based approach, i.e. pollution charges or taxes combined with fiscal incentives to industries, rather than a command and control approach through regulations to ensure compliance with NEQS. The implementation of the Pollution Charges Program has not been enforced due mostly to non-technical reasons.

If and when implemented, the pollution charge payable by an industrial unit will be in accordance with guidelines to be prepared by the Pak-EPA. Industrial units liable to pay pollution charges will themselves be responsible for ensuring the correct calculation, reporting and payment.

2.1.9 Pakistan Environmental Assessment Procedures

Pursuant to the provisions of the PEPA of 1997, all Government Ministries, Departments, Agencies and Establishments and private sector project sponsors are required to prepare the Initial Environmental Examination (IEE) and the Environmental Impact Assessment (EIA) prior to the approval of their proposals for the projects. The primary purpose of the environmental assessment process is to provide proponents and decision makers, as well as members of the public, with an understanding of the potential environmental effects of the proposed action, so as to avoid or minimize adverse effects, bearing in mind the costs and benefits of using the environmental resource in this particular project wherever possible. The Pak-EPA has developed a complete package of Environmental Assessment Procedures.

2.1.10 National Environmental Action Plan (NEAP)

Environment is high on the National Agenda of the GoP. This is reflected in the Government priorities and strategies formulated and adopted in the National Environmental Action Plan (NEAP). The primary objective of NEAP is to initiate actions and programs for achieving a state of environment that safeguards public health, promotes sustainable livelihood, and enhances the quality of life of the people in Pakistan. The NEAP identifies four primary areas, (1) Clean air (2) Clean water (3) Management of solid waste (4) Ecosystem management. The plan also presents five additional areas of concern (i) Management of fresh water resources (ii) Marine pollution (iii) Toxic and hazardous substances handling and disposal (iv) Energy conservation and management (v) Compliance with international treaties and protocol.

2.2 International Treaties and Conventions

Pakistan is signatory/member to various international treaties and conventions on conservation of environment and protection of wildlife. The country is obliged to adhere to the commitments specified in these treaties. The United Nations Conference on Environment and Development (UNCED), 1992³ emphasized on Protection, rational use and development of resources; preventing further degradation and reducing the risk of

³ <http://www.unep.org/unep/partners/un/unced/home.htm>

long term irreversible effects; conservation of biodiversity, and sustainable use of genetic resources.

World Heritage Convention⁴ obligates the states to ensure identification, protection and transmission of natural heritage to future generations. A world heritage site is a site (natural or cultural) recognized by the international community (World Heritage Convention founded by the General Conference of UNESCO in 1972) as possessing universal value, and coming under a collective responsibility.

Other international conventions and programs to which Pakistan is a party relate to biodiversity conservation, for all of which there is a national legislation. Three conventions dealing with species are:

- a) Convention on Conservation of Migratory Species of Wildlife Animals, adopted in Bonn, Germany in 1979 which Pakistan ratified in 1987;
- b) Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES), signed in Washington in 1973 of which Pakistan became a party in 1976;
- c) Convention on Biodiversity (CBD), signed in Rio de Janeiro in 1992 which Pakistan ratified in 1994.
- d) Convention on Wetlands of International Importance especially as Waterfowl Habitat, signed in Ramsar in Iran in 1971, to which Pakistan became a party in 1978; and
- e) Convention Concerning the Protection of the World Culture and Natural Heritage, signed at United Nations Educational, Scientific and Cultural Organisation (UNESCO), Paris in 1972.

2.2.1 International Convention on Biodiversity

The International Convention on Biodiversity was adopted during the Earth Summit of 1992 at Rio de Janeiro. The Convention requires parties to develop national plans for the conservation and sustainable use of biodiversity, and to integrate these plans into national development programmes and policies. Parties are also required to identify components of biodiversity that are important for conservation, and to develop systems to monitor the use of such components with a view to promoting their sustainable use.

2.2.2 The Biodiversity Action Plan

The key to protecting the biological heritage of Pakistan lies in the involvement of local people, and in the support provided by competent institutions for conservation and sustainable use. The Government of Pakistan has recognized the importance of these measures in the preparation of the National Conservation Strategy and in becoming a signatory to, and in ratifying, the Convention on Biological Diversity (CBD) in 1994. Developing the Biodiversity Action Plan for

⁴ <http://www.unesco.org/whc/intro-en.htm>

Pakistan, 2000 has been the most significant direct steps towards addressing the biodiversity loss.

2.2.3 Convention on Wetlands of International Importance, (RAMSAR) 1971

Pakistan is a signatory to the RAMSAR Convention. The principal obligations of contracting parties to the Convention are:

- To designate wetlands for the List of Wetlands of International Importance
- To formulate and implement planning so as to promote wise use of wetlands
- To carry out Environmental Assessment before transformations of wetlands, and to make national wetland inventories
- To establish nature reserves on wetlands and provide adequately for their wardening and through management to increase waterfowl populations on appropriate wetlands
- To train personnel competent in wetland research, management and wardening
- To promote conservation of wetlands by combining far-sighted national policies with coordinated international action, to consult with other contracting parties about implementing obligations arising from the Convention, especially about shared wetlands and water system
- To promote wetland conservation concerns with development aid agencies
- To encourage research and exchange of data

So far 18 sites in Pakistan have been declared as wetlands of International Importance or RAMSAR Sites. Of these, there are about 45 game sanctuaries and reserves spread over an area of 0.90 million hectares in Sindh. None of these wetlands have been included within or close to the project area. Kinjhar (Kalri) Lake with an area of 13,468 ha is a Wildlife Sanctuary situated at 24°47' N. 68°02'E. This, the largest freshwater lake in Pakistan is an internationally important area for breeding, staging and wintering water birds, is more than 15 km from GAWPL Project site

2.2.4 IUCN Red List

IUCN has published red list, it includes those species that are under potential threat of extinction. These species have been categorised as endangered, vulnerable in decline, lower risk species and data deficient species that may be at risk of extinction in the wild. Red list of mammals found in Pakistan is attached in the Annexures. No faunal species that fall under the IUCN Red List category were observed during the three-days surveys at the site for the EIA study.

2.3 POLICY AND LEGISLATION

A review of the status of various environmental issues in the national context suggests that the GOP, GoS and NGOs in Karachi and different districts of Sindh,

including Thatta are aware of the environmental problems, and issues that are raised when the impact on the environment surfaces up both while the development projects are underway and when completed. The Pakistan Environment Protection Ordinance, which became an Act, PEPA in 1997, governs the policies of the GoP and GoS on environmental issues.

A number of guidelines on environmental protection are in use in Pakistan. One of them is the set of comprehensive “Sectoral Guidelines for Environmental Reports” prepared by FEPA in 1997. Some of the relevant FEPA guidelines include:

- Policy and protection for filing, review and approval of environmental assessment.
- Guidelines for preparation and review of environmental reports.
- Guidelines for public participation.
- Guidelines for sensitive and critical areas.

The Ministry of Housing and works (Environmental and Urban Affairs Division) prepared EIA guidelines for selected industrial and power related projects with the assistance of the Asian Development Bank (ADB) in 1986. These guidelines have been endorsed by the FEPA, but they usually have significant relevance when ADB loans are involved, and with the various ADB Environmental Guidelines for Development Works.

2.3.1 Guidelines for Public Consultation

These guidelines are part of a package of regulations and guidelines. Public consultation provides assistance throughout the environmental assessment of projects by involving the public and thus ensures better and more acceptable decision-making. Public involvement with a positive attitude and desire to use the information gained during consultation to improve the proposal, leads to better outcome, and lays the basis for ongoing positive relationship between the entrepreneur and public.

2.3.2 Pakistan Government Policy for Power Generation Projects - 2002

Pakistan Government Policy for Power Generation Projects – 2002 aims: “To encourage and ensure exploitation of indigenous resources, which include renewable energy resources, human resources, participation of local engineering and manufacturing capabilities.

2.3.3 Pakistan Government Policy for Development of Renewable Energy for Power Generation – 2006

Pakistan Government Policy for Development of Renewable Energy (RE) for Power Generation – 2006 envisages mainstreaming of renewable energy by

employing small hydro, wind and solar technologies in the development plans of the country. The policy comprises three phases viz. short term, medium term, and long term. Short term phase covered the period up to June 2008. The AEDB/GoP invites investment from private sector for four categories:

- a) Independent power projects (IPPs) for supply of power to grid only
- b) Captive-cum-grid spillover power projects. (i.e. self-use and sale to utility).
- c) Captive power projects (i.e. self or dedicated use) and
- d) Isolated grid power projects (i.e. small, stand—alone).

To encourage generation through renewable resources, small projects for self-use will not require any permission from the government, and will also be able to sell surplus power to Distribution Companies under the policy.

The small renewable energy projects will also not require tariff determination from NEPRA. It has been allowed that wind and solar projects, irrespective of size of the plant (even more than 50 MW) will be handled by Alternative Energy Development Board. The power purchaser will bear the wind risk as well.

2.3.4 Financial Incentives

The financial incentives offered for small renewable energy projects include exemption of customs duty and sales tax on machinery, equipment and spares meant for the initial installation or for Balancing, Modernizing and Replacement or expansion after commissioning of projects for power generation utilizing renewable energy resources. Exemption has been allowed also from income tax, including turnover tax and withholding tax on imports of machinery and equipment.

2.3.5 Salient Features of Policy

The Policy invites investment from the private sector for following categories of projects:

- ia. Independent power projects of IPPs (for sale of power to the grid only).
- ib. Captive cum grid spillover power projects. (i.e. for self-use and sale to utility).
- ic. Captive power projects (i.e. for self or dedicated use).
- id. Isolated grid power projects (i.e. small, stand-alone)
- ii. Except for Category (a) above, these projects will not require any LOI, LOS, or IA from the Government.
- iii. Electricity purchase by NTDC/CPPA from qualifying renewable resources at one location and receive an equivalent amount for own use elsewhere on the grid at the investor's own cost of generation plus transmission charges (wheeling).
- iv. Net metering and billing allowed to enable a producer to sell surplus electricity at one time and receive electricity from the grid at another time and settle accounts on net basis. This will directly benefit the economics

- of small scale, dispersed generation and optimize capacity utilization of installed systems.
- v. Delicensing and deregulation of small scale power production through renewable resources (up to 5 MW for hydro and 1 MW for net metered sales) to reduce the transaction costs for such investments. This will be particularly beneficial from micro, mini and small hydro as well as solar-based electricity production.
- vi. Simplified and transparent principles of tariff determination.
- vii. Insulating the investor from resource variability risk, which is allocated to the power purchaser.
- viii. Facilitating project proponents in obtaining carbon credits for avoided greenhouse gas emissions, helping improve financial returns and reducing per unit costs for the purchaser.

These guidelines are in line with the Government's open door policy for inviting private investment into the country.

2.3.6 Policy Goals and Development Strategy

Specific goals of Renewable Energy (RE) Policy are to:

- i. Increase the deployment of renewable energy technologies (RETs) in Pakistan so that RE provides a higher targeted proportion of the national energy supply mix, a minimum of 9,700 MW by 2030 as per the Medium Term Development Framework (MTDF), and helps ensure universal access to electricity in all regions of the country.
- ii. Provide additional power supplies to help meet increasing national demand.
- iii. Introduce investment-friendly incentives, and facilitate renewable energy markets to attract private sector interest in RE projects, help nurture the nascent industry, and gradually lower RE costs and prices through competition in an increasingly deregulated power sector.
- iv. Devise measures to support the private sector in mobilizing financing and enabling public sector investment in promotional, demonstrative, and trend setting RE projects.
- v. Optimize impact of RE deployment in underdeveloped areas by integrating energy solutions with provision of other social infrastructure, e.g., educational and medical facilities, clean water supply and sanitation, roads and telecommunications, etc., so as to promote greater social welfare, productivity, trade, and economic well being amongst deprived communities.
- vi. Help in broad institutional, technical, and operational capacity building relevant to the renewable energy sector.
- vii. Facilitate the establishment of a domestic RET manufacturing base in the country that can help lower costs, improve service, create employment, and enhance local technical skills.

2.3.7 Type & Category of 50 MW Wind Power Project

Power Production units of capacity less than 200 MW are placed in Schedule I, List of projects requiring an Initial Environmental Examination (IEE), of the

Pakistan Environmental Protection Agency Review of Initial Environmental Examination and Environmental Impact Assessment Regulations, 2000⁽²⁾. Units producing more than 200 MW are placed in Schedule II of the said regulation, while small units of less than 50 MW capacity are placed in Schedule III, requiring an Environmental Assessment Statement.

When EPAs accord their approval, they do so subject to certain conditions such as:

- Before commencing construction of the project, the proponent is required to submit an undertaking accepting the conditions.
- Before commencing operation of the project, the proponent is required to obtain from the EPA a written confirmation of compliance with approval conditions and requirements of the IEE.
- Submission of Environmental Management Plan (EMP) and Environmental Monitoring Plan for confirmation of environmental compliance.
- Submission of monitoring report to the EPA concerned after completion of construction, followed by annual monitoring reports during operations.

The EPAs are required to issue confirmation of compliance within 15 days of the receipt of a request and complete documentation.

The EIA approval issued by EPAs is valid for three years from the date of its accord.

2.3.8 Guidelines for Preparation of EIAS

PEPA 1997 suggests proponents of projects to follow the guidelines for preparation of EIAs as prescribed by the Federal Agency. Federal EPA has, in all such cases where specific guidelines have not been prescribed, allowed the World Bank guidelines to be followed for development projects. World Bank's Operational Directive requires the following Environmental Considerations for Development Projects:

2.3.8.1 Direct Environmental Impact

- Direct environmental impacts of the development project that may occur at regional and local level or the macro environment and at the site scale or the microenvironment.
- Major Land Use Changes that may have occurred at the macro level, as a result of past activities for locating the residential colonies, urbanization or industrialization.

2.3.8.2 Non-conforming settlements

- Settlements that may have emerged at the macro level, as a consequence of the establishment of the communication, industrial and housing sectors e.g. Katchi Abadis.

- Micro level changes in the settlements due to encroachment, reallocation of sites, urbanization of the Goths, construction of roads and highways, industrial and transportation activities.
- Description of environment of Katchi Abadis, encroachments, and socio-economic status of the settlements.
- Observations on the direct impact on present environment created by man-induced land use changes and suggestions if they will create any displacement of existing land uses.

2.3.8.3 Involuntary Resettlement

- If there are settlements which will have to be displaced or relocated temporarily or permanently.
- The size of units, and of the inhabitants of the area, identification of the need to relocate them.

2.3.8.4 Indirect Environmental Impacts

Environmental impacts of an indirect nature caused by:

- Development induced by the project
- Emergence of Katchi Abadis,
- Establishment of wayside commercial activity resulting from location of railway stations, industrial and residential activity and Urban Sprawl.

2.3.8.5 Environmentally Critical Areas

It has to be seen if the project location is in the vicinity of any environmentally critical sites that could be threatened by undertaking it. Such sites include habitats, forests, water bodies, wetlands, endangered species of plants etc.

2.3.8.6 Danger to the Project Site from hazardous Natural Conditions

EIAs have to take cognizance of siting of the project to see if the Project site is located on unstable soil or areas of sub-surface conditions, or of highly saline soils or those that may be subject to landslides. They have to identify the mitigation measures that are needed or have already been taken to protect the site from the hazardous natural conditions such as those occurring in floodplains, estuarine areas, seismic zones etc.

2.3.8.7 Seismicity Considerations

EIAs have to identify active faults in the region that may have been responsible for seismic activity.

2.3.8.8 Hazards to the Project Site from Air, Noise and Water Pollution from the adjacent Land Uses

Likely impact of industrial and transportation activity in the macroenvironment of the Project site on the microenvironment of the wayside stations, traffic intersections to be estimated to see if the level of air pollutants and noise are high and if water pollution is a problem that may demand treatment of wastewater discharges and if there are industries in the vicinity that are major water users.

2.3.8.9 Hazards to Adjacent Residential Areas from Air, Noise and Water Pollution due to Project Location

Likely impact of emission of gaseous pollutants, high noise levels and water-oil mixtures and wastewater discharges from operation of Project on microenvironment of the project area should be estimated. Mitigation measures for emissions, appropriate silencers and noise barriers and water-oil separators, may be recommended in case the level of emission and discharges exceed the NEQS.

2.3.8.10 Hazards to Adjacent Residential Areas & Infrastructure from Electromagnetic Radiation (EMR) due to Installation of Transmission Lines/Towers & Project Location

Likely impact of electromagnetic radiation from wind turbines/transmission lines/pylons on the residential areas and infrastructure including roads, highways, schools, hospitals in the neighbourhood from operation of Project on microenvironment and macroenvironment of the project area should be estimated. Mitigation measures for minimizing the impact may be recommended in case the level of EMR exceeds the NEQS or available standards.

2.3.8.11 Destruction of Historic or Cultural Resources, Degradation of Cultural Property, Historical Monuments and Living Monuments

EIAs are required to identify traditional societies, minorities, gender bias, historical, architectural, archaeological and cultural sites and estimate possible impact of project activity during construction and operation on them.

2.3.8.12 Site Scale Impacts

Degradation of Habitat:

- The potential impact of project on rare and endangered plant and animal species and/or their critical habitat need to be identified.
- Depletion and/or Pollution of Freshwater and Groundwater Resources resulting from activities pertaining to the establishment or operation of the Project need to be identified.

- Identification of vegetative cover on the existing landscape and assessment of its possible degradation as a result of unnecessary removal or mechanical damage.

2.3.9 Environmental and Social Guidelines

Two sets of guidelines, the Pak-EPA's guidelines and the World Bank Environmental Guidelines are reviewed in this Report. These guidelines address the environmental as well as social aspects relevant to the proposed project.

2.3.9.1 Environmental Protection Agency's Environmental and Social Guidelines

The Federal EPA has prepared a set of guidelines for conducting environmental and social assessments. The guidelines derive from much of the existing work done by international donor agencies and NGOs. The package of regulations, of which the environmental and social guidelines form a part, includes the PEPA 1997 and the NEQS. These guidelines are listed below.

- Guidelines for the Preparation and Review of Environmental Reports,
- Guidelines for Public Consultation,
- Guidelines for Sensitive and Critical Areas,
- Sectoral Guidelines.

It is stated in the Pakistan Environmental Protection Agency Review of IEE and EIA Regulations, 2000 that the EIA or IEE must be prepared, to the extent practicable, in accordance with the Pakistan Environmental Protection Agency Environmental Guidelines.

2.4 ADMINISTRATIVE FRAMEWORK

Environmental issues are governed by three levels of the government viz. Federal, Provincial and Local Government. The Ministry of Environment and Local Government is the Ministry at the Federal level, which oversees the affairs of the environment in the country. The Provincial Governments have designated the Ministries of Local Government to oversee matters related to the environment at the provincial level. The Provincial EPAs are directly under the respective Provincial Ministry of Local Government and Environment. Sindh EPA is placed under the Ministry of Environment and Alternative Energy, GoS.

2.4.1 Institutional Setup for Environmental Management

The apex environmental body in the country is the Pakistan Environmental Protection Council (PEPC), which is presided over by the Chief Executive of the Country. Other bodies include the Pakistan Environmental Protection Agency (Pak-EPA), provincial EPAs (for four provinces, AJK and Northern Areas), and environmental tribunals.

The EPAs were first established under the 1983 Environmental Protection Ordinance; the PEPA 1997 further strengthened their powers. The EPAs have been empowered to receive and review the environmental assessment reports

(IEEs and EIAs) of the proposed projects, and provide their approval (or otherwise).

The proposed projects would be located in the Sindh Province. Hence this IEE Report will be sent to the Sindh EPA for review and issue of No Objection Certificate (NOC).

- 2.4.2** The GoS involvement in local government and municipal affairs has been devolved to the Environment Department of the Union Council, Taluka and District Government. However, the devolution program has not been implemented since an environment officer, required to oversee the environmental issues has not been appointed. Coordination of the environmental monitoring activity continues as a provincial subject and is assigned to Provincial EPAs, in this case EPA Sindh, which has been duly authorized to enforce environmental compliance.

The main organizations responsible for providing services in the areas where the GAWPGC Project is being established include the (1) Alternative Energy Development Board (AEDB) and (2) District Government of Thatta which is the local government authority comprising the Union Administration Jhimpir.

- 2.4.3** AEDB has, for the development and generation of Alternative or Renewable Energy through GAWPL, procured land in Jhimpir area from the Government of Sindh pursuant to the Colonization and Disposal of Government Lands (Sindh) Act, 1912 under terms and conditions set out in the Master Lease Deed, and further agreed to lease by way of agreement to sub-lease, the land measuring 647 acres to GAWP Company Limited.

- 2.4.4** The representative institutions of the District Government, Taluka and Union Administration are headed by a Nazim and assisted by a Naib Nazim. The District Coordination Officer, DCO is responsible, among other things for planning and development, for maintenance of roads and transport, and for land control, including katchi abadis. The District Government is theoretically responsible for physical planning, town planning, environment, and maintenance of infrastructure facilities. However, these functions continue to be performed by the respective ministries of the Provincial Governments. This is evident from the MNA and MPA of Jhimpir-Thatta area being the public figures most powerful in the constituency.

Other organizations which need to be consulted include the Sindh Wildlife Department, Forestry Department and the Telecommunications and Civil Aviation Departments.

Sindh Wildlife Department is responsible for protection of wildlife in the Province. The Department's concerns are limited to areas designated as game reserves, national parks or wildlife sanctuaries and to protecting species afforded

protection under the law. So long as the law is not being contravened they have no official interest in activities carried on outside game reserves, national parks and wildlife sanctuaries. The Department nevertheless has the powers to halt illegal activities outside the protected areas.

2.5 SINDH WILDLIFE PROTECTION (SECOND AMENDMENT) ORDINANCE, 2001

Sindh Wildlife Protection Ordinance 1972 was enacted to protect Sindh's wildlife resources directly, and its other natural resources indirectly. It classifies wildlife by degree of protection, i.e., animals that may be hunted on a permit or special license, and species that are protected and cannot be hunted under any circumstances. The Ordinance specifies restrictions on hunting, and trade in animals, trophies, or meat. The Ordinance also provides for the creation of three classes of special protected areas: National Parks (Section 15), Wildlife Sanctuaries (Section 14), and Game Reserves (Section 16).

Sindh Local Government Ordinance, 1979, gives urban local Councils the power to require schemes for adequate and safe drainage and disposal of wastes and effluents (for specified waste and effluent qualities).

The 2001-Amendment to Sindh Wildlife Protection Ordinance (1972) allows carrying out activities for exploration of oil and gas in wildlife sanctuaries of national park areas in the province. The Ordinance relates to oil and gas exploration activities in Kirthar National Park, which was declared protected area under Sindh Wildlife Protection Ordinance 1972.

The Wild Birds and Animals Protection Act, 1992, the West Pakistan Wildlife Protection Ordinance 1959, the Wildlife Protection Rules and the Forest Act, 1927 provide for the protection of flora and fauna in the territory, including vegetation and protected forests.

2.6 ANTIQUITY ACT 1975

The Antiquities Act of 1975 ensures the protection of cultural resources in Pakistan. The act is designed to protect antiquities from destruction, theft, negligence, unlawful excavation, trade, and export. Antiquities have been defined in the Act as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments, etc. The law prohibits new construction in the proximity of a protected antiquity and empowers the Government of Pakistan to prohibit excavation in any area that may contain such articles of archaeological significance. Under the Act, the project proponents are obligated to:

- Ensure that no activity is undertaken in the proximity of a protected antiquity

- If an archaeological discovery is made during the course of the project, it should be reported to the Department of Archaeology, Government of Pakistan.

2.6.1 IMPLEMENTATION OF ANTIQUITY ACTS

At the time of independence, the Ancient Monuments Preservation Act 1904 was the only piece of legislation affording legal protection to our cultural patrimony. Immediately thereafter, the Antiquities Export Control Act 1947 was also enacted so as to regulate the traffic in antiquities both within and outside the country. During the course of administering these laws, it was observed that they did not provide the desired protection.

Both these acts were replaced by the Antiquities Act 1968. The new act was based on Egyptian law, although some of its provisions could not find a place in 1968 Act, said to have been inconsistent with the fundamental rights as per our constitution. Thus, a new act of 1975 was enacted in order to remove certain shortcomings in the old act of 1968. And, further amendments were made in the Act of 1975 in 1978 and 1992.

The Act of 1975 is considered quite effective, provided it is administered properly. For its proper administration, the federal department of Archaeology needs adequate staff which has not been provided to it. For instance, the Talpur Committee set up by the Government of Pakistan in 1979, besides other measures recommended that vigilance at a particular monument/site should be round the clock by turn of eight-hour duty. The factual position is that at many sites, there are no watchmen at all. At places like major site of Makli (in Thatta district), the watch and ward staff is not in its full strength. And, its result is obvious (theft cases of antiquities and trespassing of the site through construction of a private road by a landlord). Certain shortcomings are, of course, there in the Antiquity Act 1975. In this context, Section 22 of the Act may be amended so as to give powers to the Director General of the Department of Archaeology to stop new construction or to demolish anything within 200 feet of the protected monument.

Besides, the civic agencies authorized to grant permission for new constructions must also keep in view the provisions of the Act. It can also be suggested that the Act must be further amended to make compulsory registration of the antiquities and, the owner of the property be made responsible for preservation of the antiquity.

- ### **2.6.2**
- The Forestry Departments manage official forestry reserves and has expressed concern about the level of woodcutting, which has taken place as a result of construction of access roads for transportation of sand and gravel, besides oil and gas exploration.

Other government agencies' concern about the project is not directly with environmental aspects. Such agencies include the Telecommunications and Civil Aviation Departments.

2.7 APPROVAL AND LEASES REQUIREMENTS

- All development activities are now required by law to obtain a No Objection Certificate (NOC) from the provincial EPA or Federal EPA, as the case may be.
- Power Production Units based on Renewable Energy sources are required to obtain a No Objection Certificate (NOC) from the Alternative Energy Development Board. However, in order to encourage generation through renewable resources, small projects for self-use will not require any permission from the government, and will also be able to sell surplus power to Distribution Companies under the Renewable Energy Policy - 2006.
- The small renewable energy projects also do not require tariff determination from NEPRA. It has been allowed that wind and solar projects, irrespective of size of the plant (even more than 50 MW) will be handled by Alternative Energy Development Board. The power purchaser will bear the wind risk as well.
- Approvals/leases are required from Local Government, Highway Department, and Irrigation Departments for installation of transmission lines and their crossing of highways, roads, canals and public property. Approvals will also be needed from Civil Aviation Authority as well as Telecommunication Authority in case the project is sited near or under the aircraft flyway zone. Each of these departments has individual requirements for grant of approvals.

2.7.1 Approvals/leases will have to be obtained before commencement of work at the Project site, from almost all of the following authorities/organizations:

- Sindh Wildlife Department
- National Highway Authority
- Water And Power Development Authority (WAPDA)
- Pakistan Telecommunication Company Limited (PTCL)
- Civil Aviation Authority, and
- Telecommunication Authority

2.8 OTHER GUIDELINES AND STANDARDS

Following national, international, federal and provincial guidelines need to be followed for preparing the IEE/EIA Reports.

2.8.1 GOP Environmental Assessment Guidelines for Energy Sector

These guidelines provide comprehensive information on Environmental Impact Assessment (EIA) for the Energy Sector in Pakistan. The guidelines have been

prepared by IUCN, the World Conservation Union, in association with WS Atkins Environment (UK) in response to a request from the Environment and Urban Affairs Division of the Government of Pakistan.

2.9 INTERNATIONAL GUIDELINES

Most of mega projects are internationally funded i.e. the donor agencies are international agencies and they do require international environmental guidelines and procedures to be followed in the materialization of the project.

2.9.1 WORLD BANK GUIDELINES ON ENVIRONMENT

The principal World Bank publications that contain environmental guidelines are listed below:

- A. Environmental Assessment-Operational Policy 4.01. Washington, DC, USA. World Bank 1999
- B. Environmental Assessment Sourcebook, Volume I: Policies, Procedures, and Cross- Sectoral Issues. World Bank Technical Paper Number 139, Environment Department, the World Bank, 1991
- C. Environmental Assessment Sourcebook, Volume III: Guidelines for Environmental Assessment of Energy and Industry Projects. World Bank Technical Paper No. 154, Environment Department, the World Bank, 1991
- D. Pollution Prevention and Abatement Handbook: Towards Cleaner Production, Environment Department, the World Bank, United Nations Industrial Development Organization and the United Nations Environment Program, 1998

The first two publications listed here provide general guidelines for the conduct of an IEE, and address the IEE practitioners themselves as well as project designers. While the Sourcebook in particular has been designed for the Bank projects, and is especially relevant for the impact assessment of large-scale infrastructure projects, it contains enormous information which is useful to environmentalists and project proponents.

2.9.2 EQUATOR PRINCIPLES

The Equator Principles (EP) comprise a series of standards for the management of environmental and social issues in financing development projects globally. Once adopted by banks and other financial institutions, the Equator Principles commit the adoptees to refrain from financing projects that fail to follow the processes defined by the Principles. The private sector banks which developed the Equator Principles chose to model the Equator Principles on the environmental standards of the World Bank and the social policies of the International Finance Corporation (IFC). The Equator Principles have become the *de facto* standards for banks and investors on assessment of major development projects around the world.

Project financiers may encounter social and environmental issues that are both complex and challenging, particularly with respect to projects in the emerging markets. The Equator Principles Financial Institutions (EPFIs) have consequently adopted these Principles to ensure that the projects they finance are developed in a manner that is socially responsible and reflects sound environmental management practices. By doing so, negative impacts on project-affected ecosystems and communities are avoided where possible, and if these impacts are unavoidable, they are to be reduced, mitigated and/or compensated for appropriately. It is believed that adoption of and adherence to these principles offer significant benefits to institutions, their borrowers and local stakeholders through their borrowers' engagement with locally affected communities. It is therefore recognized that the role of the institutions as financiers affords them opportunities to promote responsible environmental stewardship and socially responsible development.

EPFIs therefore consider reviewing these principles from time-to-time based on implementation experience, and in order to reflect ongoing learning and emerging good practice. These principles are intended to serve as a common baseline and framework for the implementation by each EPFI of its own internal social and environmental policies, procedures and standards related to its project financing activities. The institutions will not provide loans to projects where the borrower will not or are unable to comply with their respective social and environmental policies and procedures that implement the Equator Principles.

The Equator Principles apply to projects over 10 million US dollars. The Principles state that adopting financial institutions will provide loans directly to projects only under the following circumstances:

❖ **Principle 1: Review and Categorization**

The risk of the project is categorized in accordance with internal guidelines based upon the environmental and social screening criteria of the IFC. Projects are classified, relating to social or environmental impacts, in Category A (significant impacts), Category B (limited impacts) and Category C (minimal or no impacts).

❖ **Principle 2: Social and Environmental Assessment**

For all medium or high risk projects (Category A and B projects), sponsors complete an Environmental Assessment, the preparation of which must meet the National and International requirements and satisfactorily address the key environmental and social issues.

❖ **Principle 3: Applicable Social and Environmental Standards**

The Environmental Assessment report addresses baseline environmental and social conditions, requirements under host country laws and regulations, applicable international treaties and agreements, sustainable development and use of renewable natural resources, protection of human health, cultural

properties, and biodiversity, including endangered species and sensitive ecosystems, use of dangerous substances, major hazards, occupational health, and safety, fire prevention and life safety, socio-economic impacts, land acquisition and land use, involuntary resettlement, impacts on indigenous peoples and communities, cumulative impacts of existing projects, the proposed project, and anticipated future projects, participation of affected parties in the design, review and implementation of the project, consideration of feasible environmentally and socially preferable alternatives, efficient production, delivery and use of energy, pollution prevention and waste minimization, pollution control (liquid effluents and air emissions) and solid and chemical waste management.

❖ **Principle 4: Action Plan and Management System**

Based on the Environmental Assessment, Equator banks then make agreements with their clients on how they mitigate, monitor and manage those risks through a 'Social Environmental Management Plan'.

❖ **Principle 5: Consultation and Disclosure**

For risky projects, the borrower consults with stakeholders (NGOs and project affected groups) and provides them with information on the risks of the project. The borrower has to consult the project affected communities in a structured and culturally appropriate manner. The process will ensure free, prior and informed consultation for affected communities.

❖ **Principle 6: Grievance Mechanism**

The borrower will establish a grievance mechanism as part of the management system.

❖ **Principle 7: Independent Review**

For Assessment, preparation of Assessment Plan and consultation process.

❖ **Principle 8: Covenants**

Incorporation of Covenants linked to compliance. Compliance with the plan is required in the covenant. If the borrower does not comply with the agreed terms, the bank will take corrective action, which if unsuccessful, could ultimately result in the bank cancelling the loan and demanding immediate repayment.

❖ **Principle 9: Independent Monitoring and Reporting**

An independent expert is consulted during the life of the loan for Category A and, if necessary in Category B.

❖ **Principle 10: EPFI Reporting**

Each EPFI commits to report publicly at least annually about its implementation processes and experience on Equator Principles.

2.9.3 This IEE study has adequately addressed the Equator Principles applicable to non-risky projects as stated hereunder:

Principle 1 Review and Categorization: The study has reviewed the National and International Laws and Guidelines on different environmental aspects and has categorized the GAWPL Project in Category B (limited impacts).

Principle 2 Social and Environmental Assessment: The Study has been prepared to respond to the National and International requirements and to satisfactorily address the key environmental and social issues.

Principle 3 Applicable Social and Environmental Standards: For the purpose of this IEE study, primary data on the baseline environmental and social conditions have been generated to address the requirements of National laws and regulations; applicable International Treaties and Agreements; sustainable development and use of renewable natural resources; protection of human health, cultural properties, and biodiversity and other physical, ecological and socioeconomic issues required to be addressed under this Principle.

Principle 4 Action Plan and Management System: Chapter 5 of this study screens the potential environmental impacts and proposes/provides Mitigation Measures to reduce the severity of impact. The study also includes the Environmental Monitoring and Management Plan, Contingency Plan and Disaster Management Plan.

Principle 5 Consultation and Disclosure: Being a non-risky project of category the public consultation is limited to the scoping sessions with stakeholders and an extensive socioeconomic survey of the villages/hamlets that are all outside the boundary of the Project area. The surveys and consultation meetings have established that no resettlement or temporary relocation or acquisition of land is involved.

Principle 6 Grievance Mechanism: This Principle will not apply since no resettlement or temporary relocation or acquisition of land is involved.

Principle 7 Independent Review: Being placed in Category B, an independent review may not be needed.

Principle 8 Covenants: The IEE has incorporated Covenants linked to compliance. Moreover, No Objection Certificates are issued to Proponents of Project under conditions of compliance with the Mitigation and Performance Monitoring Plan. Needless to say that if the proponent does not comply with the agreed terms, the concerned EPA is authorized to take corrective action.

Principle 9 Independent Monitoring and Reporting: This Principle may not be applicable to the GAWP Project since it is a low impact project.

Principle 10 EPFI Reporting: The concerned EPFI may safely commit to report publicly at least annually about its Equator Principles implementation processes and experience.

2.9.4 IFC PERFORMANCE STANDARDS ON SOCIAL AND ENVIRONMENTAL SUSTAINABILITY

International Finance Corporation (IFC) applies the Performance Standards to manage social and environmental risks and impacts and to enhance development

opportunities in its private sector financing in its member countries eligible for financing. The Performance Standards may also be applied by other financial institutions electing to apply them to projects in emerging markets. Together, the eight Performance Standards establish standards that the client is to meet throughout the life of an investment by IFC or other relevant financial institution:

- Performance Standard-1: Social & Environmental Assessment and Management System
- Performance Standard-2: Labor and Working Conditions
- Performance Standard-3: Pollution Prevention and Abatement
- Performance Standard-4: Community Health, Safety and Security
- Performance Standard-5: Land Acquisition and Involuntary Resettlement
- Performance Standard-6: Biodiversity Conservation and Sustainable Natural Resource Management
- Performance Standard-7: Indigenous Peoples
- Performance Standard-8: Cultural Heritage objectives have been set in the IFC performance standards to achieve sustainable development.

These objectives are given below:

- To identify and assess social and environment impacts, both adverse and beneficial, in the project's area of influence
- To avoid, or where avoidance is not possible, minimize, mitigate, or compensate for adverse impacts on workers, affected communities, and the environment
- To ensure that affected communities are appropriately engaged on issues that could potentially affect them
- To promote improved social and environment performance of companies through the effective use of management systems.

2.9.5 IFC PERFORMANCE STANDARDS (PS)

PS 1: Social and Environmental Assessment and Management System

This Performance Standard seeks to: i) identify and assess social and environment impacts in the project's area of influence; ii) avoid, minimize, mitigate, or compensate for adverse impacts on workers, affected communities, and the environment; iii) ensure that affected communities are appropriately engaged on issues that could potentially affect them; and iv) promote improved social and

environment performance of the project through the effective use of management systems.

Under this Standard, the project is required to establish and maintain a social and environmental management system appropriate to the nature and scale of the project and in accordance with the level of social and environmental risks and impacts. The management system is required to incorporate the following elements:

- Social and Environmental Assessment;
- Management program;
- Organizational capacity;
- Training;
- Community engagement;
- Monitoring; and
- Reporting.

The present study has been conducted to fulfill the above requirements, in addition to the ones defined by the national legislation (discussed in **Section 2.2** above).

PS 2: Labor and Working Conditions

This PS seeks to establish, maintain and improve the worker-management relationship; promote fair treatment, non-discrimination and equal opportunity for workers, and compliance with national labor and employment laws; protect the workforce by addressing child labor and forced labor issues; and promote safe and healthy working conditions, and to protect and promote the health of workers.

The proposed project and its contractors will be required to adhere to this PS, in particular with regard to employment of child labour.

PS 3: Pollution Prevention and Abatement

The PS 3 seeks to avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities, and to promote the reduction of emissions that contribute to climate change. The Standard requires the project to consider during its entire lifecycle ambient conditions and apply pollution prevention and control technologies and practices that are best suited to avoid or, where avoidance is not feasible, minimize or reduce adverse impacts on human health and the environment while remaining technically and financially feasible and cost-effective.

PS 3 will be applicable to all stages of the GAWPL Project. Various aspects of pollution prevention and abatement of the proposed project are discussed in this report.

PS 4: Community Health, Safety and Security

The PS 4 seeks to avoid or minimize risks to and impacts on the health and safety of local community during the project lifecycle from both routine and non-routine

circumstances, and to ensure that the safeguarding of personnel and property is carried out in a legitimate manner that avoids or minimizes risks to the community's safety and security. The PS requires the project to evaluate the risks and impacts to the health and safety of the affected community during the design, construction, operation, and decommissioning of the project and establish preventive measures to address them in a manner commensurate with the identified risks and impacts.

The present assessment addresses the requirement of PS 4 for the proposed project, and evaluates the impacts of GAWPL Project on health and safety of the local community. The Environmental Management Plan also addresses company community aspects.

PS 5: Land Acquisition and Involuntary Resettlement

This PS aims to address the adverse impacts associated with land acquisition and involuntary resettlement caused by the project. The PS seeks to:

- avoid or at least minimize involuntary resettlement wherever feasible by exploring alternative project designs
- mitigate adverse social and economic impacts from land acquisition or restrictions on affected persons' use of land by: (i) providing compensation for loss of assets at replacement cost; and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected
- improve or at least restore the livelihoods and standards of living of displaced persons
- improve living conditions among displaced persons through provision of adequate housing with security of tenure at resettlement sites.

The proposed GAWPL site is barren land being further degraded by stone excavation, and does not support economic activities such as cultivation of major or minor crop. Moreover there is no settlement or hamlet within the allotted land area. Land acquisition by the GAWPL Project will therefore not cause any involuntary resettlement.

PS 6: Biodiversity Conservation and Sustainable Natural Resource Management

The PS 6 seeks to protect and conserve biodiversity, and promote sustainable management and use of natural resources through adoption of practices that integrate conservation needs and development priorities.

The present environmental assessment addresses the potential impacts of the GAWPL Project on the biodiversity. This IEE has recommended measures for the conservation of flora, fauna and other natural resources.

PS 7: Indigenous People

The PS 7 seeks to address the impacts of the project on the indigenous people. Specifically, the objectives of the PS are to:

- ensure that the development process fosters full respect for the dignity, human rights, aspirations, cultures and natural resource-based livelihoods of Indigenous Peoples
- avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not feasible, to minimize, mitigate, or compensate for such impacts , and to provide opportunities for development benefits, in a culturally appropriate manner
- establish and maintain an ongoing relationship with the Indigenous Peoples affected by a project throughout the life of the project
- foster good faith negotiation with and informed participation of Indigenous Peoples when projects are to be located on traditional or customary lands under use by the Indigenous Peoples
- respect and preserve the culture, knowledge and practices of Indigenous Peoples

No indigenous people - with a social and cultural identity distinct from the existing dominant society that makes them vulnerable to being disadvantaged in the development process of the GAWPL Project are known to exist in and around the proposed site. No such people were found in the area during the present study either. Therefore, this PS is not applicable for the proposed project.

PS 8: Cultural Heritage

The objectives of this PS are to protect cultural heritage from the adverse impacts of project activities and support its preservation, and to promote the equitable sharing of benefits from the use of cultural heritage in project activities.

No sites of cultural heritage are known to exist at or in the immediate vicinity of the proposed GAWPL Project location. There are also no indications of any old settlement in the area, nor is there any site covered under the listing of cultural heritage sites. This PS will therefore not be applicable to the GAWPL Project.

2.9.6 IFC and World Bank Environmental and Social Guidelines

The principal IFC and World Bank publications that contain environmental and social guidelines are listed below:

- Environment, Health and Safety (EHS) Guidelines (IFC, 2007)
- Pollution Prevention and Abatement Handbook 1998: Towards Cleaner Production (WB, UNIDO, and UNEP. 1999)
- Environmental Assessment Sourcebook, Volume I: Policies, Procedures, and Cross-Sectoral Issues (WB 1991).
- Social Analysis Sourcebook (WB, 2003).

In addition, IFC has also published sector-specific EHS guidelines for wind energy projects (IFC 2007).

Since the GAWP Project is likely to be funded by IFC, it will have to comply with the IFC's EHS guidelines during its different phases.

2.9.7 IFC- ENVIRONMENT, HEALTH & SAFETY GUIDELINES FOR WIND POWER

The IFC EHS Guidelines for Power Production systems are applicable to activities typically conducted by the relevant infrastructure operators dedicated to energy production, and transmission. The document is organised into two main areas, namely construction and maintenance of infrastructure as well as operation of relevant mechanical and electrical systems, such as the grid; and, wind turbine maintenance activities, including services, and other mechanical repair and maintenance.

The EHS Guidelines are technical reference documents that address IFC's expectations regarding the industrial pollution management performance of its projects. They are designed to assist managers and decision makers with relevant industry background and technical information. This information supports actions aimed at avoiding, minimizing, and controlling environmental, health, and safety (EHS) impacts during the construction, operation, and decommissioning phase of a project or facility.

The EHS Guidelines currently consist of the industry sector environmental guidelines contained in Part III of the World Bank Pollution Prevention and Abatement Handbook (PPAH) which went into official use on July 1, 1998 and a series of EHS guidelines published in the IFC web site between 1991 and 2003. As of April 30, 2007, the new EHS Guidelines can be found at <http://www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines>

The EHS Guidelines have become globally applied references for private sector development with their use extending well beyond World Bank Group operations to a diverse external community, such as other international financial institutions, regulators, industry, academics, and commercial banks, including the international banks that have adopted the Equator Principles.

Annexure 1

**NATIONAL ENVIRONMENTAL QUALITY STANDARDS^a FOR MUNICIPAL
AND LIQUID INDUSTRIAL EFFLUENT**
(mg/l, unless otherwise defined)

Sr. No.	PARTICULARS	Revised Standards			
		Existing Standards	Into Inland Waters	Into Sewage Treatment	Into Sea
1	Temperature/Temperature increase*	40°C	≤3°C	≤3°C	≤3°C
2	pH value	6 – 10	6 – 9	6 – 9	6 – 9
3	5-days Biochemical Oxygen Demand (BOD) at 20°C (1)	80	80	250	200**
4	Chemical Oxygen Demand (COD) (1)	150	150	600	600
5	Total Suspended Solids	150	200	400	200
6	Total Dissolved Solids	3500	3500	3500	3500
7	Grease and Oil	10	10	10	10
8	Phenolic Compounds (as phenol)	0.1	0.1	0.3	0.3
9	Chloride (as Cl)	1000	1000	1000	SC
10	Fluoride (as F)	20	10	10	10
11	Cyanide (as CN) total	2.0	1.0	1.0	1.0
12	An-ionic detergents (as MBAs) (2)	20	20	20	20
13	Sulphate (SO ₄)	600	600	1000	SC
14	Sulphide (S)	1.0	1.0	1.0	1.0
15	Ammonia (NH ₃)	40	40	40	40
16	Pesticides, herbicides, fungicides and insecticides	0.15	0.15	0.15	0.15***
17	Cadmium (4)	0.1	0.1	0.1	0.1
18	Chromium (trivalent and hexavalent) (4)	1.0	1.0	1.0	1.0
19	Copper (4)	1.0	1.0	1.0	1.0
20	Lead (4)	0.5	0.5	0.5	0.5
21	Mercury (4)	0.01	0.01	0.01	0.01
22	Selenium (4)	0.5	0.5	0.5	0.5
23	Nickel (4)	1.0	1.0	1.0	1.0
24	Silver (4)	1.0	1.0	1.0	1.0
25	Total Toxic Metals	2.0	2.0	2.0	2.0
26	Zinc	5.0	5.0	5.0	5.0
27	Arsenic (4)	1.0	1.0	1.0	1.0
28	Barium (4)	1.5	1.5	1.5	1.5
29	Iron	2.0	8.0	8.0	8.0
30	Manganese	1.5	1.5	1.5	1.5
31	Boron (4)	6.0	6.0	6.0	6.0
32	Chlorine	1.0	1.0	1.0	1.0

^a National Environmental Quality Standards as defined in Pakistan Environmental Protection Act, 1997.

1. Summing minimum dilution 1:10 on discharge, lower ratio would attract progressively stringent standards to be determined by the Environmental Protection Agency. By 1:10 dilution means for example, that for each one cubic meter of treated effluent the recipient body should have 10 cubic meter of water for dilution of this effluent.

2. Modified Benzene Alkyl Sulphate; assuming surfactant as bio-degradable.

3. Pesticides, herbicides, and insecticides.

4. Subject to total toxic metals discharge.

5. Applicable only when and where sewage treatment is operational and BOD₅=80 mg/l is achieved by sewer treatment system.

6. Provided discharge is not at shore and not within 10 miles of mangrove or other important estuaries.

SC Discharge concentration at or below Sea concentration.

* The effluent should not result in temperature increase of no more than 3°C at the edge of the zone where initial mixing and dilution takes in the receiving water body. In case zone is not defined, use 100 meters from the point of discharge.

** It is for industry only. For Municipal Corporations it is 80 mg/l.

*** Applicable on manufacturing units only.

Note: Dilution of gaseous emissions and liquid effluents to bring them to the NEQS limiting value is not permissible through excess air blowing into the gaseous emissions or through fresh water mixing with the effluent before discharge into environment.

Annexure 2

**NATIONAL ENVIRONMENTAL QUALITY STANDARDS
FOR INDUSTRIAL GASEOUS EMISSION**
(mg/Nm³, UNLESS OTHERWISE DEFINED)

Sr.	Parameter	Source of emission	Existing Standards	Revised Standards
1	Smoke (1)	Smoke opacity not to exceed	40% or 2 Ringlemann Scale or equivalent smoke number	40%
2	Particulate matter (2)	Boilers and furnaces: i) Oil fired ii) Coal fired iii) Cement Kilns iv) Grinding, crushing, clinker coolers & related processes, metallurgical processes, converter, blast furnaces and cupolas.	300 500 200 500	300 500 300 500
3	Hydrogen Chloride(3)	Any	400	400
4	Chlorine (3)	Any	150	150
5	Hydrogen Fluoride(3)	Any	150	150
6	Hydrogen Sulphide(3)	Any	10	10
7	Sulphur Oxides (4)	Sulfuric acid or Sulphonic acid plant Old Plants (other than Sulfuric/Sulphonic acid) New Plants (other than Sulfuric/Sulphonic acid)	400 400 1500	5000 1700
8	Carbon Monoxide (3)	Any	800	800
9	Lead (3)	Any	50	50
10	Mercury (3)	Any	10	10
11	Cadmium (3)	Any	20	20
12	Arsenic (3)	Any	20	20
13	Copper (3)	Any	50	50
14	Antimony (3)	Any	20	20
15	Zinc (3)	Any	200	200
16	Oxides of Nitrogen(4)	Nitric acid manufacturing unit Gas fired Oil fired Coal fired	400 400 600 1200	3000 400 600 1200

1. or 2 on the Ringlemann scale

2. Based on the assumption that the size of the particulars is 10 micron or more.

3. Any source.

4. In respect of emissions of sulphur dioxide and nitrogen oxides, the power plants operating on oil or coal as fuel shall in addition to National Environmental Quality Standards (NEQS) specified above, comply with the following standard.

Sulphur Dioxide: Sulphur Dioxide Background Levels Standards (ug/m3)

Background Air Quality Max.allowable (SO2 Basis)	Annual Average Interval	Criterion I Max.24 hours (Tons/day/Plant)	Criterion II Max. ground-level	SO2 increment ambient(ug/m3) (One year average)	Emission to
Unpolluted	<50	<200	500	50	
Moderately Polluted*					
Low	50	200	500	50	
High	100	400	100	10	
Very Polluted**	>100	>400	100	10	
* For intermediate values between 50 and 100 ug/m3 linear interpolations should be used					
** No project with sulphur dioxide emissions will be recommended.					

B: Nitrogen Oxides

Ambient air concentrations of nitrogen oxides, expressed as NO₂, should not exceed the
Annual Arithmetic Mean 100 ug/m³
(0.05 ppm)

Emission levels for stationary sources discharges, before mixing with the atmosphere, should be maintained as follows:-

For fuel fired steam generators as nanogram (10E-9 gram) per joule of heat input

Liquid Fossil Fuel	130
Solid Fossil Fuel	300
Lignite Fossil Fuel	260

Annexure 3

NEQS for Motor Vehicles Exhaust and Noise

Parameter	Standards (maximum permissible limit)	Measuring Method
Smoke	40% or 2 on the Ringlemann Scale during engine acceleration mode.	To be compared with Ringlemann Chart at a distance of 6 meters or more.
Carbon Monoxide.	New Vehicle = 4.5% Used Vehicle = 6%	Under idling conditions: non-dispersive infrared detection through gas analyzer.
Noise	85 db(A)	Sound meter at 7.5 meter from the source.

Source: Government of Pakistan (2000).

Annexure 4

WHO Ambient Air Quality Standards

Pollutant	Maximum Allowable Limit	Units	Averaging Time
CO	35	ppm	1 Hour
NO _x	106	ppm	1 Hour
SO ₂	134	ppb	1 Hour
PM ₁₀	70	µg/m ³	24 Hours

Annexure 5

WHO Drinking Water Quality Standards

Parameter	Unit	Normally Found in Freshwater/Groundwater	WHO Guidelines
pH	-		No Guideline
sdiloS devlossiD latoT (SDT)	gm/ertil		No Guideline
Turbidity			No Guideline
ssendraH latoT	gm/ertil CaCO ₃		No Guideline
tirtiNe etartiN/	gm/ertil		50 mg/l total nitrogen
edirolhC	gm/ertil		250 mg/l
Fluoride	gm/ertil	< 1.5 mg/l (up to 10)	1.5 mg/l
Sulphate	gm/ertil		500 mg/l
muidoS	gm/ertil		200 mg/l
iloC .E	lm/ufc		Zero

CHAPTER 3

3.0 DESCRIPTION OF PROJECT

3.1 THE PROJECT

Gul Ahmed Wind Power Limited WPGC will be located in Deh Kohistan 7/1 in Union Administration Jhimpir and in response to the Renewable Energy Policy of Pakistan:

- Establish a wind power generation facility in accordance with GoP's policy and guidelines on development and generation of Alternative or Renewable Energy, being implemented through the AEDB, the Organization that has issued the Letter of Intent (LOI) dated May 13, 2006, against which GAWPL has taken possession of land measuring 647 acres and installed three masts for recording the meteorological data, and
- Utilize the potential of wind capacity identified by the AEDB in Jhimpir, and help reduce the emission of Greenhouse gases including CO₂ in Pakistan through net energy gain by absorbing the transferred technology of wind power generation.

3.1.1 The Project Comprises development, ownership and operation of a 50 MW Wind Farm in Deh Kohistan 7/1 Union Administration Jhimpir, Taluka and District Thatta in Sindh, Pakistan. The National Transmission and Dispatch Company (NTDC), which is responsible for transmission and distribution of electricity in the country, will purchase the power generated by GAWPL.

3.2 PROJECT COMPONENTS

The project components comprise the following:

- Wind resource use assessment for macro-siting the Wind Farm in Ghara-Jhimpir Corridor and micro-siting the wind farm in Deh Kohistan 7/1 Union Administration Jhimpir
- Installation of three 80m high meteorological masts for collection of wind data
- Geo-technical survey
- Appointment of the main contractor for the project and signing of a memorandum of understanding (MoU) for selection of size of wind turbines on basis of wind classification arrived at from site specific meteorological data at Deh Kohistan 7/1.
- Finalizing the layout plan for siting the selected wind turbines
- Logistics
- Construction/improvement of Access and Internal road network linking all wind turbines
- Procurement and Installation of the finally selected Wind turbines, likely with a generating capacity of 1.5 to 2.5 MW having rotor diameter of 80 to 90 m and with each turbine mounted on a prefabricated steel tower such that the hub height is 80 to 90 m.
- Installation of corresponding number of unit step-up transformers mounted at the foot of each turbine tower
- Construction of 11 KV underground electrical collection system leading to the project sub-station

- Construction of operations and control building; substation and grid connection to NTDC 132 KV system.
- Plant O&M facility
- Operation of wind farm,
- Maintenance and decommissioning.

3.3 WORK SCHEDULE

The following landmarks have been achieved in this connection:

- LOI signed on May 13, 2006.
- Possession of 647 acres of land obtained as per agreement to sub-lease signed on March 28, 2008
- NOC for installation of Wind Masts obtained on July 31, 2008
- Wind Monitoring station with wind anemometers, one each at 35 m, 50 m, 65 m, and (2) at 80 m height together with wind velocity and direction sensors and NRG-Symphonie Data Logger commissioned from September 2008 to monitor meteorological data including wind velocity and direction.
- Geo-technical survey completed
- Environmental Impact Assessment Study under submission
- Pre-feasibility report under preparation.

3.3.1 The project will be executed in phases:

Phase 1: The first phase includes six months for obtaining permits and approval as well as project financing from Equator Principle Bank including International Finance Corporation (IFC) for arrangement of debt for which formation of a consortium is in progress to provide the finance.

Phase 2: Second Phase will involve the life cycle of the Project mentioned at para 3.2.

Construction of the Wind Farm will include the following activities:

- Grading of the field and Construction Office area (to serve as O&M building also);
- Grading and compaction of access road and site roads, turn-around areas and crane pads at each wind turbine location;
- Construction of the turbine tower foundations and transformer pads;
- Installation of the electrical collection system, generally underground but also some overhead lines;
- Assembly and erection of the wind turbines;
- Construction and installation of the substation;
- Plant commissioning and energizing.

Work on the project is expected to commence during the first quarter of the year 2010, with the construction of the access road and site preparation (civil works). The construction phase is expected to take 18 – 20 months. The schedule of activities is expected to be as follows:

- Civil construction - access roads: February 2010 - May 2010
 - Site roads: March 2010 – September 2010
- WTG foundations: March - November 2010

- Electrical construction: March 2010
- Turbine delivery: November - December 2010
- Installation of Equipment: December 2010 – May 2011
- Substation transformer(s) at site: February, 2011
- Substation commissioning: May, 2011
- Collection system commissioning: June 2011
- Turbine commissioning: July – September 2011

3.4 MACRO-SITE SELECTION

Pakistan Meteorological Department under the sponsorship of Ministry of Science and Technology collected data on wind speed, direction and temperature at a height of 10 meters and 30 meters at 40 different stations on coastline. The study shows that wind speed increases steadily on proceeding from Pasni (Balochistan) on the extreme west to Ketu Bundar (Sindh) near the Indus delta as shown in the following figure. It can be seen that in certain months the difference in wind speeds is as high as 6 meters/second (m/s) at a height of 30 meters during summer months.

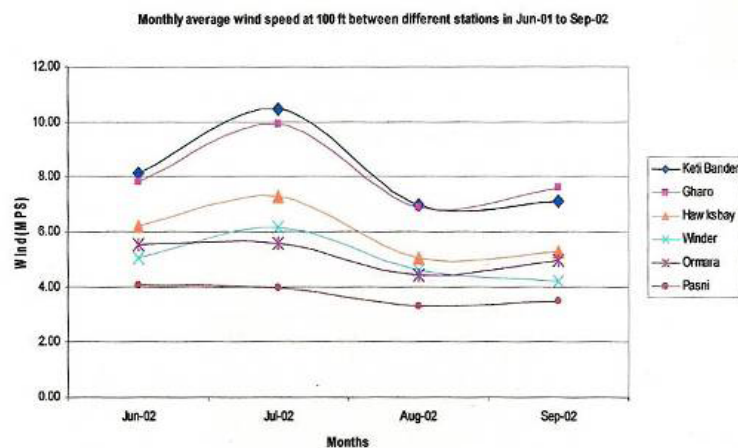


Fig. 3.1 Monthly wind speed data for towns in Pakistan during summer months.

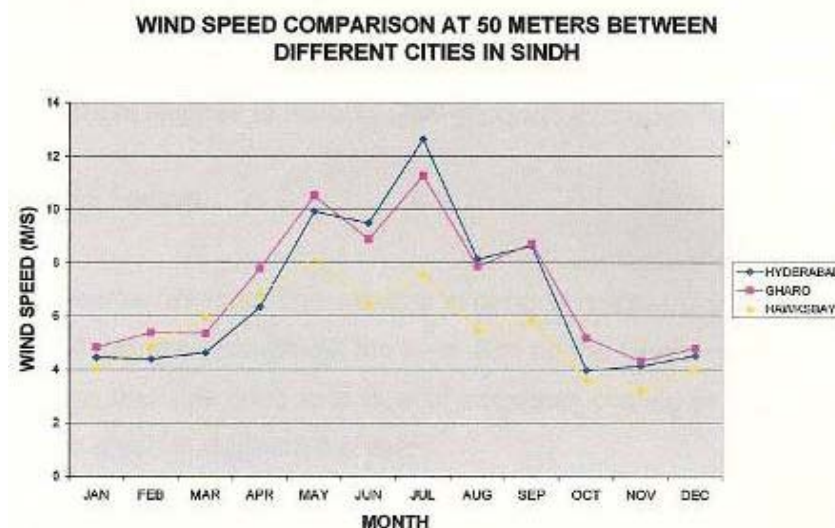


Figure 3.2

Subsequent Wind Power Potential Survey by Pakistan Meteorological Department (PMD) established the Gharo-Jhimpir wind corridor, the macro-site of GAWPL in 2007. The surveys identified tremendous potential for generating wind energy in this corridor that covers an area of about 9,700 km². The gross wind power potential of this region alone amounts to 43,000 MW. In view of the area utilization constraints, the exploitable electric power generation potential of the area is estimated at about 11,000 MW.

After getting the actual potential of wind energy established at the western end of the wind tunnel that includes the coastal belt of Gharo-Keti Bunder-Jhimpir sites, the AEDB proceeded by:

- ☐ Completion of pre-feasibility study of the site,
- Issue of 56 LOIs to national and international companies for generation of 700 MW power through wind energy by year 2010 and 9700 MW by year 2030.
- ☐ Submission of applications by seven companies to National Electric Power Regulatory Authority (NEPRA) for obtaining Generation License.
- ☐ Grant of Generation License to three companies.
- ☐ Offer of Land by AEDB at approximately Rs 700 per acre per year for life of the project in the wind corridor, and sub-lease of ☐ Land to 13 investors.
- ☐ Endorsement of Basic Wind Data collected at Gharo-Keti Bunder: 7 m/s annual average at approx. 65 meters, provided to AEDB by Pakistan Meteorological Department
- ☐ Under the Policy Guidelines the Power Purchaser would take the risk associated with wind availability i.e. underwriting of data provided by Pakistan Meteorological Department.
 - ☐ New Transmission Network from Mirpur Sakro to Thatta and another network from Deh Kohistan 7/1 to Jhimpir and Kotri to be constructed by power purchaser (NTDC) in order to sustain the load generated by Wind Power.

3.5 DETERMINATION OF WIND ENERGY POTENTIAL FOR MICROSITING

3.5.1 WIND SPEED MONITORING

The wind energy potential was determined for wind farm establishment by characterizing and classifying the wind and estimating the wind power density during the three-year survey period. Wind data were collected at 20 sites in the coastal belt as well as Jhimpir area of District Thatta, Sindh. It was found that at 50-metre height, annual average wind speeds were 8.5, 7.0, 7.0, 6.7 and 6.6 metres per second at Jamshoro, Keti Bandar, Nooriabad, Thatta and Gharo, respectively.

Tables 3.1, 3.2 and 3.3 show the benchmark established by the AEDB for the Gharo-Bhambore, Boharo (Gharo) and Jhimpir sites respectively. AEDB has concluded the agreement to sub-lease the land at both sites for establishment of wind farms. The data recorded for Bohara Monitoring station in the Keti Bunder-Gharo corridor by Midroc-Tussoni and reported by R&DC in the IEE Report (IEE for 50MW Wind Power Plant at Lakha Island at Boharo, 2007) in Table 3.2 show the monthly average wind velocity recorded during the windy month of August 2007 at the Boharo site.

The range of variation in wind velocity at 60 m is between a low of 2.1 m/s to a high of 19.9 m/s with an average of 9.12 m/s, while at 30 m it ranges between 1.4 m/s and 19.3 m/s with an average of 8.55 m/s. Thus there are minor differences in velocity between the 60 m and 30 m levels. High velocity winds of 6 to 8 m/s are dominant from May to August, which are the monsoon months.

Table 3.1 Monthly Wind Speed in Khuttikun and Bhambore Sites

Month	Mean Monthly Wind Speed (m/s)				
Height	30	50	60	67	80
January	4.25	4.70	4.90	5.02	5.24
February	4.50	4.98	5.18	5.32	5.55
March	4.77	5.28	5.50	5.64	5.89
April	6.39	7.03	7.29	7.46	7.75
May	8.29	9.05	9.36	9.56	9.90
June	8.79	9.50	9.78	9.96	10.25
July	8.83	9.59	9.89	10.08	10.40
August	8.20	8.89	9.16	9.34	9.63
September	6.63	7.28	7.54	7.72	8.01
October	4.22	4.68	4.87	5.0	5.22
November	3.59	3.98	4.14	4.24	4.43
December	3.96	4.38	4.56	4.67	4.88
Annual Average	6.0	6.6	6.8	7.0	7.3

Table 3.2 Wind Statistics For Boharo (August 2007)

	Level 1	Level 2	Level 3	Level 4	Level 5
Height above ground level (m)	80.0	80.0	60.0	30.0	10.00
Minimum wind speed (m/s)	2.1	2.1	1.8	1.4	1.1
Average wind speed (m/s)	9.12	9.12	8.96	8.55	7.89
Maximum wind speed (m/s)	20.0	19.9	19.7	19.3	17.8
Gust wind speed (m/s)	23	23	23	23	23
Average std deviation (m/s)	0.6	0.6	0.6	0.7	0.7
IEC (15m/s) turbulence intensity	6.8%	6.8%	6.9%	7.5%	8.5%
Average turbulence intensity	7.0%	6.7%	7.2%	8.0%	9.1%

Table 3.3 Monthly Wind Speed in Jhimpir Area^{3.1}

Month	Mean Monthly Wind Speed (m/s)				
Height (m)	30	50	60	67	80
January	4.25	4.70	4.90	5.02	5.24
February	4.50	4.98	5.18	5.32	5.55
March	4.77	5.28	5.50	5.64	5.89
April	6.39	7.03	7.29	7.46	7.75
May	8.29	9.05	9.36	9.56	9.90
June	8.79	9.50	9.78	9.96	10.25
July	8.83	9.59	9.89	10.08	10.40
August	8.20	8.89	9.16	9.34	9.63
September	6.63	7.28	7.54	7.72	8.01
October	4.22	4.68	4.87	5.0	5.22
November	3.59	3.98	4.14	4.24	4.43

^{3.1} AEDB website: Benchmark Wind Speed Tables (pdf)

December	3.96	4.38	4.56	4.67	4.88
Annual Average	6.0	6.6	6.8	7.0	7.3

It would be noted from Table 3.6 that the average monthly wind speed for the eight months from September 08 to April 09 is 7.11 m/s which is of the same order as recorded endorsed by AEDB^{3.1}.

3.5.2 WIND CHARACTERISTICS

Wind potential of different areas is usually characterized by assigning one of the seven wind classes, each representing a range of wind power densities or wind speeds at specific height above the ground. Standard wind class definitions are shown in Table 3.4.

TABLE 3.4: STANDARD WIND CLASS DEFINITION^{3.3}

Class	30 m Height		50 m Height	
	Speed m/s	Power W/m ²	Speed m/s	Power W/m ²
1	0- 5.1	0 -160	0 – 5.6	0 – 200
2	5.1 – 5.9	160 - 240	5.6 – 6.4	200 – 300
3	5.9 –6.5	240 - 320	6.4 –7.0	300 – 400
4	6.5 – 7.0	320 - 400	7.0 – 7.5	400 – 500
5	7.0 – 7.4	400 – 480	7.5 - 8.0	500 – 600
6	7.4 – 8.2	480 – 640	8.0 – 8.8	600 – 800
7	8.2 – 11.0	640 - 1600	8.8 – 11.9	800 – 2000

The following figures show that by international wind classification, power density places the Jamshoro, Nooriabad, Talhar and Ketu Bandar sites in the excellent category, while Thatta, Thana Bola Khan, Hyderabad and Gharo are placed in the category of good sites for generation of wind power.

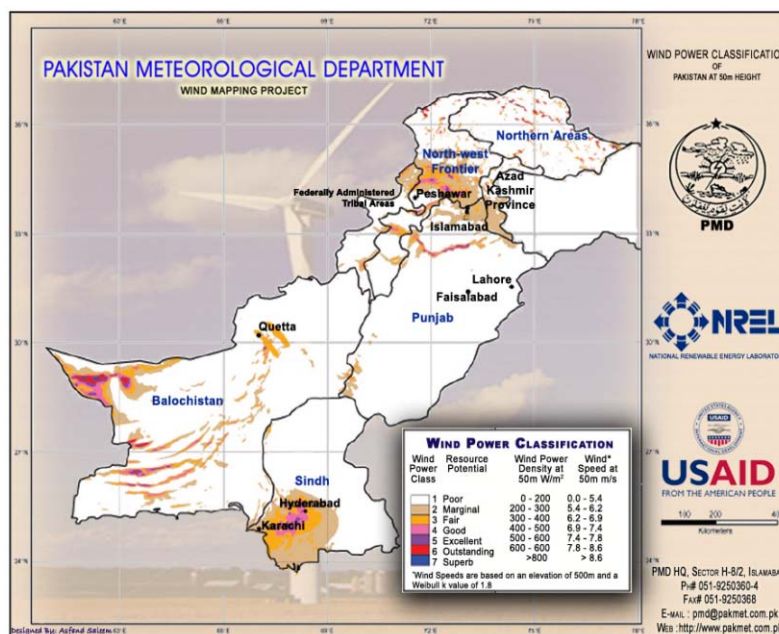


Figure 3.3: Wind Power Classification

^{3.3} Wind Power Classification of Pakistan, Pakistan Meteorological Department, Wind Mapping Project

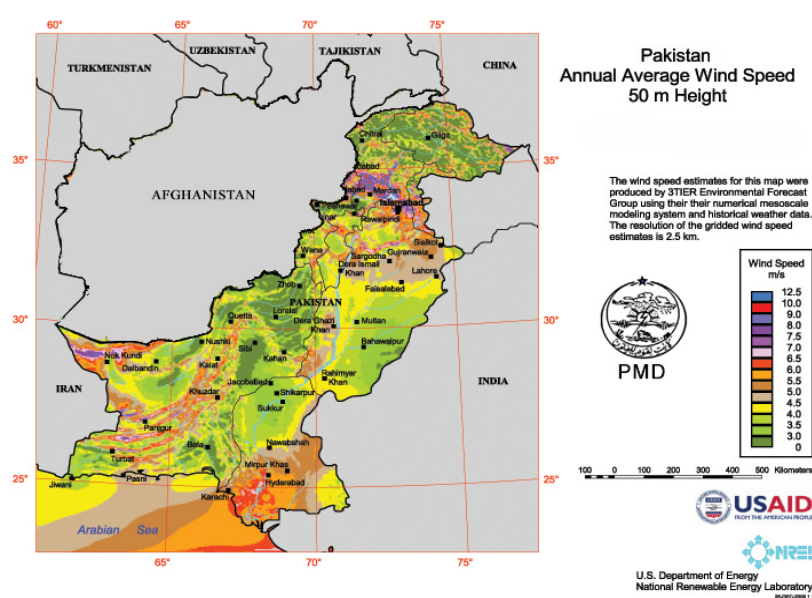


Figure 3.4: Annual Average Wind Speed at 50 m Height in Pakistan

3.6 SITING GAWPL WIND FARM IN DEH KOHISTAN

Site specific wind speed comparison was undertaken to focus on the site, and to finally select the wind corridor of Deh Kohistan 7/1 in Administrative Union Jhimpir as the preferred site.

AEDB has sub-leased land at the Jhimpir site to different proponents, including Gul Ahmed Wind Power Company Limited. The benchmark wind speeds recorded in Table 3.3 are based on Meteorological studies of the selected potential sites. According to the above Table, the annual average wind speeds of 6.0, 6.6, 6.8, 7.0 and 7.3 m/s are the benchmark wind speeds at 30m, 50m, 60m, 67m, and 80m height respectively at Jhimpir sites.

3.6.1 Wind power density

The amount of electricity produced by wind turbines depends on the amount of energy contained in the wind that flows through the area swept by the wind turbine blades in a unit of time. This energy flow is the wind power density (W/m^2), which depends on (wind speed)³ i.e. wind density cubed, which implies that the power contained in the wind increases very rapidly with wind speed. However, below a certain minimum speed, the turbine does not have enough wind to operate, whereas above a certain speed its output levels off or begins to decline. In very high winds the turbine is shut down to prevent damage to it.

Available annual wind power densities (W/m^2) at Jamshoro, Nooriabad, Talhar, Ketu Bandar, Thatta, Thana Bola Khan, Hyderabad and Ghara were recorded at 770, 454, 445, 374, 373, 371 and 350 watts per square metre, respectively. For the Jhimpir sites the wind power densities corresponding to the benchmark wind speeds recorded in Table 3.3 are expected to be 216, 287.5, 314, 343 and 389 respectively. This places the GAWPL site in class 4 at 50 m height and class 3 at 80 m height in the wind resource classification system.

3.6.2 WIND TURBINES^{3.2}

The site allotted to Gul Ahmed Wind Power Generation Complex will, for using the winds in class 3 at 80m height, set up wind turbines. The turbines will use the following sub-system to catch the wind → Conversion of wind density to kinetic energy → rotational motion → drive an electric generator or alternator → generate electricity without creating environmental pollutants.

3.6.2.1 Turbine subsystems include:

- Rotor component which includes the blades that convert the wind's energy into rotational shaft energy;
- Nacelle (enclosure) containing a drive train, usually including a gearbox* and a generator includes the electrical generator, the control electronics, for converting the low speed incoming rotation to high speed rotation suitable for generating electricity;
- Tower, to support the rotor and drive train; and
- Electronic equipment such as controls, electrical cables, ground support equipment, and interconnection equipment.

*Some turbines do not require a gearbox

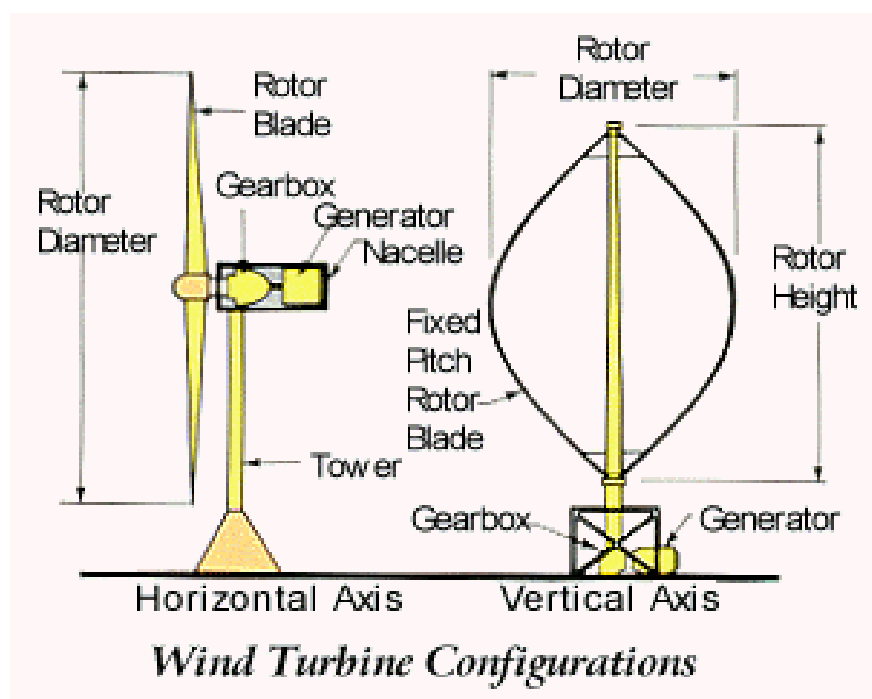


Figure 3.5: Wind Turbine Configurations

Wind turbines vary in size. The following chart shows the historical variation in turbine sizes and the amount of electricity they are each capable of generating (the turbine's capacity, or power rating).

^{3.2} American Wind Energy Association, http://www.awea.org/faq/wwt_basics.html

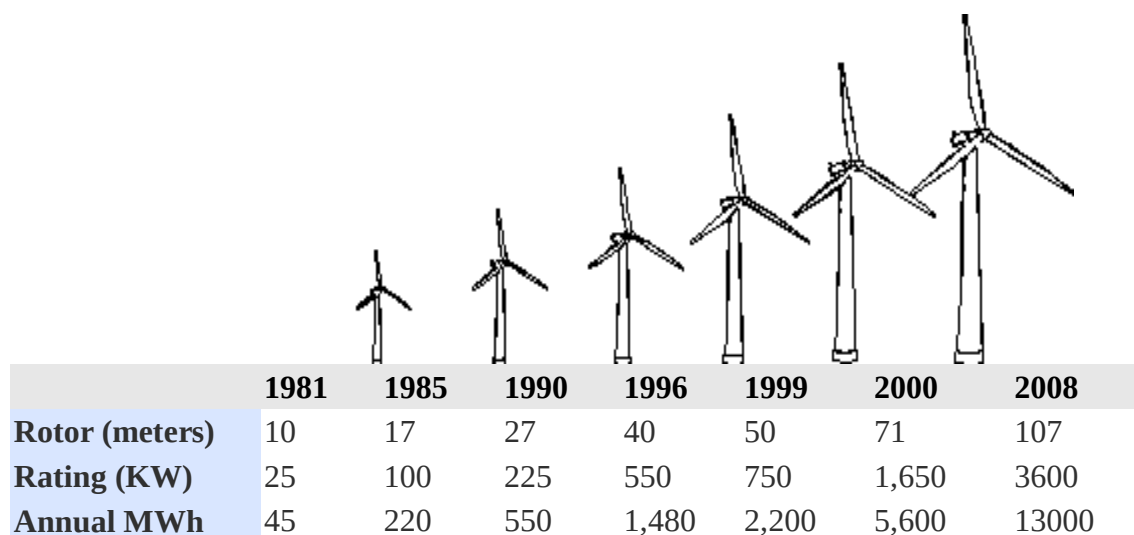


Figure 3.6: Historical Variation of Size & Capacity of Wind Turbines

Wind farms being developed currently use large wind turbines for sites in class 5 and above. For class 3 and 4 areas wind turbines adapted to run more efficiently at lower wind speeds are being developed. Specifications for 1.5 and 2.5 MW wind turbines are given in Table 3.5.

In view of the GAWPL site being placed in class 3 at 80 m height, and also in consideration of large swept area required for large turbines and also available at the allotted site the Project can opt for Wind Turbines with generating capacity of 1.5 to 2.5 MW having rotor diameter of 80 to 90 m mounted at the hub height of 80 to 90 m.

Table 3.5 Typical Specifications for 1.5 MW & 2.3 MW Wind Turbine

Power	1.5 MW	2.3 MW
Voltage	690V	690V
Frequency	50 Hz	50 Hz
Number of Blades	3	3
Length of Blades	34 m	45 m
Tip Chord	0.80 m	0.8 m
Root Chord	2.40 m	3.5 m
Surface Gloss	Semi-matt	Semi-matt
Surface Color	Light Grey (matching the background)	Light Grey (matching the background)
Hub Height	80 m or site specific	80 m or site specific
Rotor Speed	10.6 – 19 rpm	6-16 rpm
Rotor Diameter	70 m	93 m
Rotor Tilt	5 degrees	6 degrees
Swept Area	3000 m ²	6800 m ²
Cut-in Speed	3 m/s	4 m/s
Cut Out Wind Speed	25 m/s	25 m/s
Maximum 2 s gust	55 m/s	55 m/s

3.6.3 Performance of Wind Turbines

Performance of wind turbines depends on the average wind speed and its variability besides topography of the site.

3.6.3.1 Variability of winds

Performance of wind turbines is constrained by large variations in the average wind speed at the site. Unusually gusty or turbulent winds can cause extra wear and tear on wind turbine components and increase repair and maintenance costs. Variations occurring over hours to days, being essential for wind resource evaluation, are being recorded continuously at the monitoring stations at the inland Jhimpir site.

3.6.3.2 Wind speed dependence on height

Increase in wind speed with height, known as wind shear depends mainly on atmospheric mixing and roughness of terrain. Atmospheric mixing follows a diurnal cycle often causing wind speeds to increase in the daytime and decrease at night. At a height of approximately 10 meters, the diurnal variation can be very pronounced; as the height increases to approximately 50 meters, it weakens or even disappears. The terrain at GAWPL site slopes from 80 m amsl to 60 m towards the Harolo Nai. The descending wind under such conditions gain momentum and in conjunction with low roughness and the flat open area at GAWPL site also affects wind shear allowing it to gain speed.

The wind shear is being measured at GAWPL site by monitoring wind speeds at four heights of the tower. Since wind turbines produce much more power in stronger winds, the most favourable position would be one facing the wind squarely. With current wind turbine technology, the optimum tower height for the selected wind machines would be attained at the height of 80 meters. The wind speed and other meteorological conditions at 80 m height at the GAWPL site are recorded in Table 3.6:

Table 3.6: Meteorological Data from GAWPL Mast

Month	Speed m/s at 80m Height	Direction at 78m (Degree °)	Temperature Mean °C	Pressure Mean (mbar)	Humidity Mean (RH %)
September 08	9.25	246.66	31.42	990.50	58.59
October 08	6.74	259.25	30.60	995.90	49.41
November 08	7.08	4.96	25.59	998.90	34.80
December 08	6.74	21.04	20.26	1000.11	61.48
January 09	7.49	18.55	19.41	1001.00	54.47
February 09	5.95	319.26	23.69	998.10	44.33
March 09	6.32	286.36	28.01	995.50	43.11
April 09	7.27	275.48	31.49	993.50	30.13
All Data	6.84	332.46	26.31	996.68	47.04
Mean of Monthly Means	7.11		26.31	998.68	47.04

As a general rule of thumb, wind turbines are so installed on towers that the rotor blades are 10 m above any obstacle within 100 m of the tower. This is where the swept area needs to be considered. The swept area which forms the corridor of impact for any size of turbine would be taken into consideration while micro-siting the turbines.

3.7 GAWPL WIND POWER GENERATION COMPLEX

A detailed wind resource and micro-siting study is being conducted by the technical consultants for establishment of GAWPL-WPG Complex. The wind resource study has been based on data from the Meteorological Department, the 3 year survey of the Gharo-Jhimpir wind corridor, site data from Mid-Roc and Aga Khan Health Sciences Facility in Malir River Valley, and the site specific wind data from the Wind Mast that was set up by GAWPL at the site in September 2008.

The Monitoring Station established for the Wind Power Project at Deh Kohistan 7/1, Jhimpir started generating necessary data from September 2008. The data are being analysed as part of the wind resource assessment program and for micro-siting the wind turbines in addition to firming up the benchmark data provided by AEDB on wind characteristics, variation of wind speed over time, wind power density and to establish the wind energy potential in the GAWPL Project area in Taluka Thatta.



Figure 3.7: Wind data collection anemometer at GAWPL Site Deh Kohistan 7/1, Jhimpir.

Aerodynamic modeling will be used to determine the optimum tower height, control systems, number of blades, and blade shape. The weather station data when processed for wind classification and wind power density would recommend the appropriate size, design and positioning of the wind turbine for the wind farm at the Project site.

In the mean time, the geotechnical study, topography study and contour mapping, together with establishment of baseline in respect of air quality study, Fauna and Flora as well as socioeconomic studies for environmental assessment has been carried out. The environmental study has identified the constraints to and minor or insignificant

impact of installation of the wind power generation system and has recommended mitigation measures to minimize the few impacts.

The wind farm of 50 MW-GAWPL in Jhimpir Wind Corridor will comprise optimally sized wind turbine generators (WTGs) located suitably within the boundary demarcated by the following coordinates:

Table 3.7 GAWPL Site Coordinates

S. No.	Longitude	Latitude
1	25° 10' 12.09"	67° 54' 25.15"
2	25° 10' 19.86"	67° 54' 25.98"
3	25° 08' 30.78"	68° 00' 44.76"
4	25° 08' 28.99"	68° 00' 46.29"
5	25° 08' 23.36"	68° 00' 42.72"

The general layout and topography of the site is shown in the following Figure. The land has been allotted and sub-leased by AEDB. The Figure shows the location of the masts having wind anemometers at 35m, 50m, 65m, and 80m height. The allotted site has no obstruction in the predominant direction of wind and has been accepted because of its being perpendicular to wind direction.

Micro-siting of GAWPL Project has examined the location of wind farm with respect to its being outside the bird and bat migration flyways. GAWPL Wind farm will be sited peripheral to the flyway to Keenjhar Lake, which is at least 15 km from the Project site. The wind farm is expected to have the least impact on bird fauna. Aridity and deforestation activities have reduced the biodiversity to that of degraded land, while the rural community is resident in the hamlets that are over 1.5 to 3.0 km outside the allotted area. As such the wind farm will not have demonstrable impacts on local populations, and threatened or endangered species.

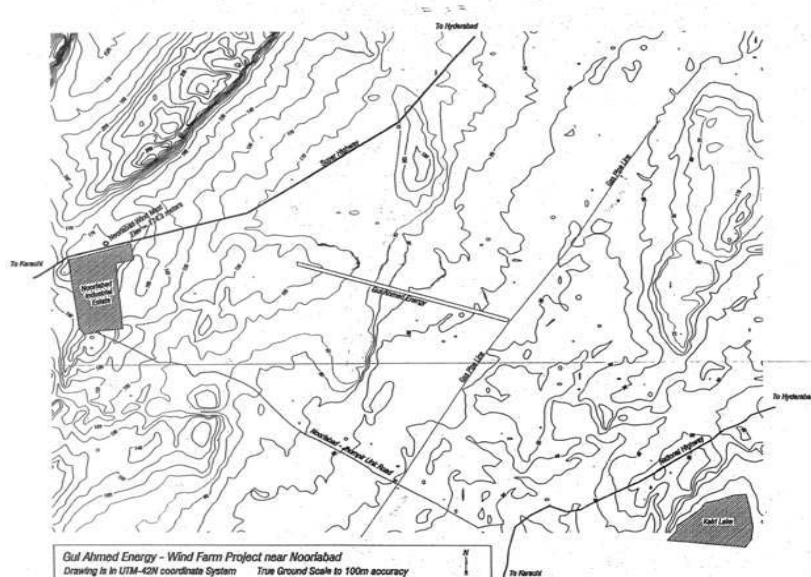


Figure 3.8: General Layout & Topography of GAWPL Site in Jhimpir Wind Corridor

Photographs of Terrain



Figure 3.9 Landscape of Jhimpir Wind Corridor North of 25°68°E



Figure 3.10 Landscape of Jhimpir Wind Corridor South of 25°68°E



Figure 3.11 Landscape of Jhimpir Wind Corridor West of 25°68°E



Figure 3.12 Sun set at Jhimpir Wind Corridor with Nooriabadin Background

3.7.1 LOGISTICS

Equipment, supplies and personnel will move in and out from the site using the access road and the Super Highway M-9. Heavy vehicles carrying the wind turbines and necessary equipment will operate from Port Qasim and take the link road to Super Highway M-9 for onward journey to Kohistan Hotel or alternate route to the site by the dirt road which will be upgraded to take the heavy load of towers (162 tons), rotor blades (60 tons), turbines (Nacelle 82 tons), machinery and equipment.

3.7.2 ACCESS ROAD

GAWPL Project site is accessed from Karachi through the Super Highway M-9, which passes through the Nooriabad Industrial Area. At 55 km to Hyderabad a dirt road takes off to Deh Kohistan 7/1. This dirt road has been developed by the local residents for transportation of sand, gravel, quarried stone, and fuel wood, from the degraded land in Deh Kohistan.

The dirt road from Kohistan Hotel passes by a major graveyard at running distance (RD) 0.4 km from Kohistan Hotel; an Eidgah at RD 1.1 km and a primary school at RD 1.2 km in Vakhio Jhakro village. It thereafter bypasses an abandoned tubewell belonging to the Jakhro tribe at RD 2.8 km, and agricultural fields at 3.2 km, 3.3 km, 5.0 km, and has to cross four dry nallas (streams) at RD 3.8 km, 4.0 km, 6.4 km, and 8.0 km. Metro Power Company Limited (MPCL) Project Mast B2 is located at RD 11.2 km. The MPCL Project site ends at RD 15.9 km, while the GAWPL Project site begins at RD 16.3 km.

Crossings over the four nallas and proceeding through MPCL make the above approach road longer than the alternative direct track to GAWPL Project site. This dirt track forks off at RD 3.8 from Kohistan Hotel and crosses only one nalla. This should be the preferred alternative because bedrock of the nalla is hard rock while the 4.9 km track after the nalla to GAWPL Mast B1 is rough and rocky terrain. This approach road/dirt track is being used by large and small trucks and heavy dumpers for transportation of sand/gravel/stone and wood. The bedrock is hard enough at the large

nalla at RD 3.8 to take still heavier load e.g. the heavy haul truck / trailers of extra large size, with multiple axles, as well as equipment that would be needed for construction at Project site. The track would however, have to be improved and leveled for the same purpose.

This route would require improvement/upgradation of 9 km of the dirt road, including 5 km of rough terrain for which the road will have to bypass an outcrop of hard rock. Construction of a bridge over the nalla will not be necessary since the bedrock is sufficiently hard to bear ground transportation. With ongoing development of wind projects in the area, alternate access road to site is anticipated.

3.7.3 VEHICLES AND TRAFFIC

Super Highway M-9 and the dirt road will be used by the GAWPL Project vehicles. The latter road will have to be improved by widening, spreading gravel and compaction of the road from Super Highway M-9 to the nalla at RD 3.8 km and about 5 km from the nalla to the site, besides construction of lay-byes for smooth movement of heavy transport vehicles. Additionally another 15 km internal road network will be constructed to connect the turbines at the wind farm.

Heavy vehicular traffic will operate mainly for delivery of turbines and for transportation of the batching plant and ancillaries. The latter process typically requires three to four flat bed trailers of 40-foot size with a load carrying capacity of 30 – 35 tons. The movement of the turbines and towers takes approximately two months and is expected to be from Port Qasim → link road → Super Highway M-9. Movement of vehicles for transportation of turbines and other needs during construction typically requires:

- Over 225 heavy haul truck / trailers of 60-foot size, with extended length and multiple axles having a load carrying capacity of 40 -70 tons, in addition to
- About 70 trucks /trailers of 20 – 25 ton capacity.
- A maximum number of 6 vehicles (4 axles and above) per hour, including the buses and coasters for movement of site staff during the construction period.

3.8 MAJOR CONSTRUCTION ACTIVITIES

Contract for construction will be awarded to an Engineering Firm of repute (EPC Contractor) to undertake the installation of turbines. The turbine supplier will have a supervising engineer onsite during the installation phase and the commissioning engineer during the start-up phase. Installation of the sub-station would be done by sub-contractors to the Engineering Firm. All other electrical work will be done by the contractor.

Work will commence with improvement of the 9 km - access road connecting the site with Super Highway M-9. The dirt road will require widening, spreading gravel and compaction to upgrade/ build to a standard that is suitable for the 60-foot flat bed truck in good weather conditions. Lay-bys will be built at suitable points for ease of crossing. Since the entire project area is flat, road gradient will not be an issue.

The roads within the project area shall be suitably compacted / strengthened to withstand the onset of torrential surface flow and land submergence/inundation.

The turbine foundation where necessary shall be built on pile foundations, with appropriate number of piles per location, built on detailed design, using standard piling practices.

3.8.1 SITING WIND TURBINES

Design standards for siting the wind turbines include spatial configuration, lighting, density of turbines, tower visibility and tower design.

Siting the wind turbines will take into account the slowing down of wind behind each turbine while converting wind energy into electricity, and space the turbines as far apart as possible in the prevailing wind direction. As a rule of thumb, turbines in wind parks are spaced somewhere between 5 and 9 RD apart in the prevailing wind direction, and between 3 and 5 RD apart in the direction perpendicular to the prevailing winds.

For the proposed GAWPL-50MW Wind Farm as an example using 33 WTG of 1.5 MW each with 70 m RD would be spaced 5 RD or ~350 m apart in the prevailing wind direction, and 3 RD or ~210 m apart in the direction perpendicular to the prevailing winds. The single row with ~33 WTG would thus be housed within the 11 km x 0.2 km strip of land measuring 647 acres allotted to GAWPL at Deh Kohistan 7/1 in Jhimpir. The dimensions mentioned here are tentative and will be subject to firming up with micrositing parameters arrived at final design stage.

3.8.2 ELECTRICAL COLLECTION SYSTEM

Power from the wind turbines being negotiated by GAWPL will generate about 600 volts. The power will run through a step-up transformer, which steps up the voltage to 11 kilovolts (kV). The power will then be fed into underground cables that will provide electrical connection among groups of wind turbines. The underground collection cables will feed the larger feeder lines that will run to the project substation. In locations where two or more sets of underground lines converge, pad-mounted junction panels will be utilized to tie the lines together into one or more sets of larger feeder conductors. At the project substation, the electrical power from the entire wind power plant will be converted to 132 kV and will be delivered to the interconnection substation, for being stepped up to appropriate voltage level.

3.8.3 SUBSTATIONS

The main function of the substations is to step-up the voltage so that electricity can be reliably interconnected to the surrounding power grid. Basic components of the substations are a control house, two main transformers, outdoor breakers, relaying equipment, high-voltage bus work, steel support structures, and overhead lightning suppression conductors. These elements are typically installed on concrete foundations. Each substation will consist of a graveled footprint area of approximately two to four acres, a chain link perimeter fence, and an outdoor lighting system. Direct strike lighting protections will be provided by using overhead shield wires and lightning masts connected to the switchyard ground grid. Overhead shield wires will be high strength steel wires arranged to provide shield zones of protection.

3.8.4 OPERATIONS & MAINTENANCE CENTER

Facility to house the operations and maintenance (O&M) section will be constructed as an integral part of the Project

3.9 CIVIL CONSTRUCTION

3.9.1 Civil works will include the following steps towards site preparation and establishment of wind farm:

- Clearing of vegetation from identified areas
- Filling and compaction of access roads/tracks
- Construction of auxiliary facilities such as site camp, equipment and supplies storage areas, water tank and water pits, fuel storage areas and waste pits.
- Construction of turbine foundations and crane pad

3.9.2 Campsite facilities will include supply of safe drinking water; drainage, sewerage, and septic tanks. Standard Operation Procedures will be followed to provide safe working environment compatible with human hygienic requirements and to maintain conditions necessary for storage of medicines, materials and equipment:

- o The construction campsite will cover an area of about 10,000 m² and will accommodate 4 construction trailers and 4 equipment storage trailers. There will also be vehicle parking and equipment staging areas.
- o The water storage tank will be lined with an impervious liner to prevent seepage and loss of water.
- o Sewage septic tanks will be lined. These will be periodically emptied into tankers for transporting the sewage to the nearest treatment facility. Gray water (from kitchen and washing areas) pits will not be lined, and water will be allowed to soak into the ground.
- o The wastewater from campsite will be discharged as per standard practice into separate sewerage lines and from there to → septic tanks → soak pit system. The quality of effluent discharged into soak pit system will be monitored for its BOD, COD and DOD level.
- o Camps for the construction crew will be established at a suitable site identified by Project Manager. The camps would accommodate around 400 to 500 personnel. The camp will be complete with living accommodation, mess and kitchen, prayer room, bathrooms and toilets, recreational facilities, fuel storage, water storage, etc. The camp will have its own power generation arrangements in the form of diesel generators.
- o At all locations involving construction activity, appropriate water and sewage treatment systems will be provided and no liquid or solid effluent or waste will be allowed to leave the site without treatment to bring the effluents within the acceptable limits. The parking area and workshop at the campsite will have a slop tank system to minimize the spread of oily drips.
- o Under normal operations there will be no gaseous emissions from the campsite, or operating areas. A small capacity, 2 MVA diesel generator, shall be installed for emergency power supply for the essential loads. Only when there is need for the diesel emergency generators would there be gaseous emissions from the sites, but such emissions would be well within limits as described in a subsequent section.
- o Storm water run off from the campsite will be suitably diverted through a storm water drainage system into an existing surface flow system.
- o Storm water run off from the wind farm will be harvested and ponded at a designated site for irrigating the surrounding open area.

- o The onsite fuel requirement of about 2 million liters will be met by transportation by tanker trucks. Onsite storage of fuel will be limited to daily requirements.
- o The onsite delivery of fuel or lubricant will be at designated site that will have an impervious base, with a dyke around to contain spills in case an accidental spill occurs.
- o The excavated earth, obtained during the piling procedure, will be used to construct the embankment for the road. The remaining material required for the road embankments will be from the site. The top layer of the road, *morum* type material or gravel and clay, will be procured from the site.
- o Installation of wind turbines, their accessories and equipment will start after completion of the above activities. Since all components will be prefabricated there would be need for assembly only. However, some fabrication will also take place at site.

3.9.3 Civil construction at wind farm site will involve the following components:

- (i) Turbine base that will be built on pile foundations, with about 14 piles per location, using appropriate drilling method for pile boring, and bentonite clay mixed with water during boring;
- (ii) Sub-station and campsite preparation,
- (iii) 9 km approach road, 15 km internal roads will involve the following three phases:
 - (a) Designing and Pre-Construction,
 - (b) Construction including compaction and upgradation
 - (c) Post Construction including operation of heavy vehicles

3.9.4 Construction activity as a major component of GAWPL Project is currently at the Pre-construction phase:

- The road design is under preparation
- Land acquisition from private parties has been found to be a non-issue, since as per the Sub-Lease Deed with the AEDB there is no un-surveyed land within the area enclosed by coordinates given in Table 3.7. It has been ascertained that the access road excludes private land and will not require land acquisition along the approach and internal roads.
- No trees will be felled, except removal of dead wood of shrubs as part of land clearance
- Suitability of the site with respect to stability and seismicity has been determined through soil surveys by geo-technical investigations. The allowable bearing capacity of the soil has been adopted as 1.70 tsf.
- Topographic survey for the following has been completed while detailed design is awaiting the negotiations with WTG manufacturers/suppliers:
 - Construction of site roads, turn-around areas and crane pads at each wind turbine location;
 - Construction of the turbine tower foundations and transformer pads;
 - Installation of the electrical collection system – underground and some overhead lines;
 - Assembly and erection of the wind turbines;
 - Construction and installation of the substation.

3.9.5 Major Bridge Construction Activities will not be involved but the following tasks have been included with the condition that they will be *subject to site requirement*:

- o Structural Excavation in Un-Classified Material including Disposal
- o Structural Backfill using Granular Material
- o Structural Backfill using Common Material
- o RCC in roof slab, beam, column & other structural members, *in situ* or pre-cast. Type B (1:1.5:3)
- o RCC in roof slab, beam, column & other structural members, *in situ* or precast. Type A (1:1:2)
- o Plain Cement Concrete Including Placing, compacting, Finishing, and Curing (Ratio: 1:4:8)
- o Reinforcement as per AASHTO M31: Grade 60 (TOR Steel Deformed Bars)
- o Providing and launching pre-stressed post tensioned girders with concrete cylinder strength of 5000 psi at 28 days including reinforcement and pre-stressing steel, grouting of tenders, complete all as per drawings.
- o Up to 21m long girders
- o Up to 17m long girders.
- o Bridge Expansion Joint
- o Expansion Joint for the movement range of +/- 60mm (Freyssinet joint N-65 or equivalent)
- o Elastomeric Bearing Pad 500mm x 300mm x 50mm
- o Cast in place Concrete Pile diameter 760mm
- o Test Pile- 760mm Diameter.
- o Pile Load Testing: Max Load 240 – 360 tons
- o Galvanized Mild steel Bar (diameter 25mm)
- o Perforated Concrete Pipe
- o Pile Integrity Testing
- o Confirmatory Boring including SPT's.
- o Samples lab test bore-hole logs
- o Provide Geotechnical Report
- o Riprap, class A
- o Grouted Riprap, class B
- o Filter Layer of Granular Material

For this purpose the general specification/details will be worked out in respect of type of structures, grade of concrete, and all other materials required for the Construction Phase of the Road and Bridge component (subject to final design) of GAWPL Project:

- Structures and materials will conform to standards recommended above and follow standard practice of civil works.
- Environmentally sound materials and goods will be selected, with priority being accorded to products meeting national and international standards.
- Traditionally well-tried materials will be chosen for provision of services for construction at the bridges.
- Construction site will be adequately isolated to prevent entry of public and general safety measures will be effectively imposed throughout the construction period.
- Temporary inconveniences due to construction works will be minimized through planning and coordination with local population and organizations in the neighbourhood.
- The foundations of bridge structures will be concrete on bearing soil. Bearing capacity, settlement, static and dynamic loading conditions have been determined while seismic conditions pertaining to placement of the site in zone

2A (Medium Intensity hazards) will be taken into account in the working designs that will be submitted for approval.

- The hydrology, geology and stability of soil will be verified again before laying the foundations.
- Environmental Performance Monitoring will be an essential component of the Project and will be governed through Environmental Management Plan (EMP), which will include Environmental Monitoring Plan.

3.9.6 The post-construction phase at the site will start after completion of the construction phase and will include:

- o Provision of safe drinking water, and solid waste disposal system at campsites for the operation area
- o Commissioning of the link roads and bridge (subject to final design) into the road network.

3.9.7 Installation phase will start with the arrival and movement of machinery and equipment to site, and will involve the following activities:

1. Transportation of Towers



Figure 3.13: Transportation of Tower

2. Installation of Towers



Figure 3.14: Installation of Towers

3. Assembly of Rotor Blades



Figure 3.15: Assembly of Rotor Blades

4. Installation of Nacelle and Blades



Figure 3.16 Installation of Nacelle and Blades

3.9.8 Staff Requirement during Construction Phase

It is estimated that direct manpower required during the construction phase will be about 200, which might increase to 600 during the construction period. About 100 support staff will be present in addition to the above. Expatriate workers are not expected to be on site. Unskilled jobs will be offered mainly to the local people particularly during the construction phase.

3.9.9 Supplies during Construction Phase

All supplies, both for construction and for the camp, will be transported by trucks from Hyderabad or Karachi. This will include all fuels and oils, drilling requirements,

spare parts for construction machinery and food and supplies for construction camp. Fuels and oils will be unloaded in designated areas.

Aggregate / sand will be procured from the Hub crusher area. A catering company will be contracted to supply the requirements to the campsite.

Fuel requirement during construction may be approximately 2 million liters which shall be met by transportation by tanker trucks. An onsite storage tank of 20,000 liters on storage wheels will be provided under due safety and security conditions for the daily ongoing activities.

3.9.10 Water Requirement during Construction Phase

An estimated 200,000 m³ of water will be required for civil works during the construction phase. The daily maximum will be around 40,000 liters of water for civil works, while the onsite storage capacity of water will be approximately 8,000 liters. This water will be obtained from Kalri Baghar Feeder from the distributary at Jherruck through water tankers. The camp will require 8000 liters of water each day. Potable water from the Nooriabad/Jhampir Pumping Station will be used for the camps. This water will be stored in a plastic tank.

3.9.11 Electricity

The expected maximum requirement of electricity for construction and the camp is estimated at 1500 KVA. Diesel generators will be used for power generation to operate the construction equipment and for the camp.

3.9.12 Emissions and Discharges during Construction Phase

- The daily fuel requirement will be about 6500 liters. This quantity of fuel will be responsible for daily emission of approximately 260 kg CO, 14 kg SO₂, 65 kg NO_x, and 14 kg Particulate matter, besides 16 tons CO₂. These emissions will be dispersed into the airshed of Deh Kohistan which is thus far in the category of unpolluted sites. The small quantity of emissions will not raise their level by sub-microgram units and would not degrade the environment.
- Emissions from the generators will be controlled by ensuring that the engines are always properly tuned and maintained, and the generators are so located that emissions are dispersed away from the camp and work areas.
- Noise emission from the vehicles and equipments will exceed 85 dB(A) but the same would be reduced to less than 85 dB(A) at 7.5 m from the source. Workers will be provided ear plugs and other safety equipment as PPE as safeguard against occupational hazards.
- The liquid effluents generated during the construction phase will include domestic sewage and grey water from camp operation.
- The sewage will be treated in septic tanks and soaking pits.
- The grey water from kitchens and washing areas will be directed to separate soaking pits.
- The storm water will be collected in ponds and either disposed of after appropriate treatment, or diverted to fields for vegetation/rejuvenation of local flora.
- The operation phase may generate a small quantity of oil/oily water during the maintenance of pumping stations. This will be treated in oil/water separators.

3.9.13 Waste Management

The solid waste generated by the project will consist of camp waste, garage waste, metal scrap, and excess construction materials.

- All efforts will be made to minimize waste generated during the construction period. The main types of waste that will be generated are:
 - Fuels and oils
 - Garage waste
 - Sewage
 - Camp waste
- The piling operation is not likely to generate any waste as only water based bentonite clay may be used during piling. As bulk concreting will be done using concrete pump wastage of concrete will be minimal.
- Fuels and oils will, if stored at site despite security reasons, be stored in containers in areas with impervious floors and surrounded by dyke walls.
- Recyclable materials will be periodically transported out of the site and sold / given to contractors. Non-recyclable material will be collected and disposed of by the contractor at designated landfill sites.
- Most garage waste, such as used spare parts, is recycled in Pakistan. All such waste will be collected and sold / given to contractors for disposal off-site.
- As part of the site preparation stage, a drainage and sewerage system will be constructed for the camp. The sewerage system will consist of soak pits for the collection of waste water from the camp kitchen and washing / ablution areas. Sewage from the toilets will go into lined septic tanks. Sewage and solid waste disposal trucks will be used to periodically remove the sludge, sewage and solid waste from the site.
- All combustible domestic waste will be collected and burned in a garbage pit, suitably fenced to prevent from being blown away. Any non-combustible and non-biodegradable waste, such as glass, metal and plastic, will be separated and transported out of the site area, where it will be sold / given to a contractor for recycling or disposal at designated sites.

3.9.14 CONSERVATION OF WATER

The Wind Farm facility as well as campsite will, in view of scarcity of water in the region, be instructed to execute the save water principle, and adopt recommended methods to reduce the usage of water, and use recycled water as much as possible. For example, the recovery of service water may be used for make-up water of circulating water system. The detailed design may consider diversion of the surface flow through the natural drainage system over the 2.2 km² area into the field for vegetation of the otherwise barren land.

3.9.15 FIRE-PROTECTION SYSTEM

Appropriate fire detection and fire fighting system and equipment shall be designed and provided throughout the wind farm.

Fire Safety and Security

According to the regulations of the authorities in charge of public security and fire fighting and the rescue procedure of emergency treatment, the facilities of an

independent rescue brigade at Nooriabad SITE will be availed. A dedicated ambulance shall be stationed at site for emergency needs.

3.10 ENVIRONMENT, HEALTH AND SAFETY

All the policy, procedures, and SOPs specific to HSE will be applicable to the contractors to be engaged for construction work. The contractors will be mandated to follow:

- HSE Policy of GAWPL and the HSE Guidelines of the IMF.
- Emergency rescue plan pertaining to safety and accidents including fall, will be established before start of construction activity according to the safety and protection rules of Pakistan.
- Trained persons will be appointed on the posts relating to implementation of emergency and rescue plan.
- Trained technicians and safety equipments will be installed for technical measures during construction and production.

3.11 Employment

This project will bring in employment opportunities for the local inhabitants. Approximately 600 people will be working during the construction phase while approximately 40 technical persons on shift basis shall be hired for operations at the wind farm and power plant during operational phase. This number will be in addition to those engaged at site for security and administrative duties.

3.12 OPERATIONAL ACTIVITIES

In-house as well as outsourced O&M activities will be carried out by trained staff for maintaining the availability of wind power and high performance.

3.12.1 Staff

- Reasonable accommodation shall be maintained at Nooriabad or Jhimpir for shift staff.
- Wind farm would need a maximum of 10 persons per shift in addition to the security staff.
- Security issues shall be outsourced and the level will be as per requirement at the site.
- An average of 2 staff vans and an ambulance will be kept at the site to meet the transportation and emergency needs.

3.12.2 Supplies

All supplies, both for operations and for the site staff, will be transported by trucks from either Karachi or the adjacent areas in Kotri or Hyderabad. This will include all fuels and oils, spare parts required for maintenance and food and supplies for the site staff. Fuels and oils will be unloaded in designated areas, which will have above ground storage for 1800 liters of fuel.

3.12.3 Water

850 liters per day of potable water will be required. This will be obtained from Nooriabad and stored in a tank of 12,000 litre capacity. The storage tank will be fitted with appropriate treatment units to obtain decontaminated water.

3.12.4 Waste Management

- o Waste oil and lubricant will be stored in containers in areas with impervious floors and surrounded by dyke walls.
- o Recyclable materials, including garage waste, will periodically be transported out of the site and sold/given to contractors. Non-recyclable material will be collected and disposed of by designated contractors.
- o Drainage and sewerage system constructed during the construction phase will be used during the operations phase of the project i.e. soak pits for the collection of waste water from kitchen and washing / ablution areas and septic tanks for sewage from the toilets.
- o Sewage and solid waste disposal trucks will be used to remove the sludge, sewage and solid waste from the site.

3.12.5 Noise

The desired noise level of 45 dB(A) would be achievable 1000 m from a turbine at 80 m hub height generating 100 – 105 dB(A).

3.13 Decommissioning Activities

The wind farm site, after having remained in operation for the lifecycle, estimated at 20 years will not lose its value as a wind power generation system. Its performance would on the other hand enhance the value of the site as a wind farm. This would demand upgradation rather than scrapping the plant and equipment or abandoning the site. What is anticipated is scrapping the existing steel structure and replacing it with a better system that may have developed in the mean time. Scrapping the site is therefore not envisaged. The towers and turbines may need replacement while the old ones will be sold as scrap to be appropriately disposed of.

However, if the site is to be abandoned much before the designed plant life of 25 years, decommissioning will be initiated by dismantling of the turbines, supporting towers O&M building / sub-station, and transporting them out of the project area. It is expected that this activity will take approximately 6 months and will require about 300 heavy haul trucks (60-feet size) for the turbine components in addition to 600 truck loads of other materials. The turbine components will be sold as scrap, and all the concrete will be broken up and removed to a landfill site. The stored fuel and oil, together with the containers, will be transported out of the site for sale / disposal at suitable landfill sites. The site road embankments, if any, will be leveled and the material spread evenly over the whole site. The site will be restored as far as possible to its original condition. The access roads may be left intact, if local people desire to use them. If not, they too will be dismantled and the land returned to its original condition.

CHAPTER 4

4.0 DESCRIPTION OF ENVIRONMENT OF GAWPL PROJECT SITE

4.1 GENERAL

The environmental baseline of the proposed GAWPL Project has been described here in terms of its macroenvironment and the microenvironment. The macroenvironment of the GAWPL Project comprises the Sindh Kohistan region of District Thatta where AEDB has decided to establish wind farms. The microenvironment on the other hand is the area bounded by the coordinates given in Table 3.5. For the purpose of description of baseline conditions of the macroenvironment the environmental profile of District Thatta has been presented. This is followed by the description of environmental condition of the microenvironment of the Project site.

4.2 THE MACROENVIRONMENT

Thatta District is spread over 17,355 km² or 1.735 million hectare and is located between 23°43' to 25°26'N and 67°05' to 68°45'E in Sindh, Pakistan. The district is bounded on the north by Dadu district, on the east by Hyderabad and Badin districts, on the south by Rann of Kutch area and the Arabian sea and on the west by Karachi District. According to the 1998 census of Pakistan, it had a population of 1,113,194 of which 11.21% were urban. The population of Thatta District is now (2008) projected at 1.469 million^{4.1}, with 778 thousand males and 691 thousand females.

The district is administratively subdivided into 7 tehsils (talukas or sub-district): Ghora Bari, Jati, Mirpur Bathoro, Mirpur Sakro, Shah Bunder, Sujawal, Thatta, Kharo Chan, and Ketu Bunder. These tehsils include 55 Union Councils, 7,200 villages and over 190,000 households with an average size of 6.5 persons per household. GAWPL Wind Farm would be sited in Taluka Thatta of the district.



Figure 4.1: Map of Pakistan with Thatta District highlighted in Red in Sindh Province

^{4.1} *Comparative Statistics of Sindh-08, Department of Statistics, Government of Sindh*

District administration in Thatta district is governed by the local government system comprising elected representatives and government functionaries. The District Government Thatta is headed by the District Nazim, who is an elected representative, and also by the District Coordination Officer (DCO) who is a government official. The seven talukas of District Thatta are governed by their respective Taluka Municipal Administration (TMA), while the 53 UCs of 7 talukas are governed by the Union Administration (UA).

Taluka Thatta has 13 Union Councils, 1107 villages, 61 revenue villages, 41,408 households with a population of 253, 748.

Table 4.1: Tehsils and Union Councils of District Thatta

Tehsil	Union Council	Total Ucs
Ghorabari	Garho, Khan., Kotri Allah Rakhio, Mahar, Uddasi	5
Jati	Begna, Gul Muhammad Baraa, Jati, Karamalik, Kothi, Murid Khoso	6
Mirpur Bathoro	Bachal Gugo, Banno, Darro, Darya Khan Suho, Jhoke Sharif, Laikpur, M.Bathoro, Mehar Shah	8
Mirpur Sakro	Bohara, Choubandi, Dhabeji, Gharo., Ghulamullah, Gujjo, Haji Ghirano, Karampur, Mirpur Sakro, Sukhpur	10
Sajawal	Ali Bahar, Bello, Bijora, Jar, Kinjhar, Sujawal	6
Shah Bander	Chuhar Jamali, Doulatpur, Goongani, Jungo Jalbani, Ladiun	5
Thatta	Chatto Chand, Doomani, Jherruck, Jhimpir, Jungshahi, Kalakot, Kalri., Makli, Onger, Sonda, Tando Hafiz Shah, Thatta-I, Thatta-II	13
Total Number of Tehsils = 7		Total Number of Union Councils = 53

4.2.1 Culture, Ethnicity and Castes

Thatta and its surroundings have rich culture, customs and traditions. During the Muslim rule, Thatta was one of the seats of learning, inviting scholars from Iran, Afghanistan and Central Asia, and of fine arts and handicrafts besides being a flourishing centre of continental trade in the East. The rise of Thatta as an important commercial and cultural centre was directly related to the patronage and policies of Jam Nizamuddin, who ruled in Sind's golden age as the leader of Samma Dynasty from 866 to 1461. The Samma civilization contributed significantly to the evolution of the prevailing architectural style that has been classified as Sindhi-Islamic. There is a strong community of Hindus in Jungshahi, Jhimpir and the adjoining Thano Bola Khan Union Administration of District Kotri, which bears testimony to the influence of ancient Sindhi culture as well as Hindu, Buddhism and other religious thoughts on the attitudes and approaches of the local communities.

The *Pirs* and *Murshids* (religious leaders, saints) in Thatta are held in high esteem and they enjoy the confidence of the rich as well as poor amongst the Muslims. Annual festivals or *urs* are held at all the shrines of saints regularly in which all people take part enthusiastically. Similarly, the Hindus also hold great confidence and reverence in *Thakurs* and *Brahmans* (the higher castes). The *Brahmans* usually perform spiritual rites of Hindus on special occasions.

The social setup in the rural areas exhibits a strong *biradri* (kinship) system, which defines the inter- and intra-community hierarchy and allegiance, and also plays an important role in conflict resolution at the local level. Every social group has its own *Sardar* (Chief), who represents the entire community. Most of the disputes among the community members are resolved at village level by the *Sardar*.

Following are the demographic indicators of District Thatta as per the 1998 census:

Religion: Islam 96.72%, Hinduism 2.89% (forming 7.96% of the urban population of the district), Christianity 0.18%, Ahamadiya 0.04%, Others 0.17%.

Majority of the population in the project area is Muslim and Sindhis. Most of the population in Thatta district belongs to Sayed, Samma, Jokhio, Palejo, Baloch, Rind, Khaskheli, Khawaja, Memon, Mallah, Mirbahar, Jat, Lashari, Burfat, Jamali castes.

Languages: Sindhi 85.66%, Urdu 11.20%, Punjabi 1.07%, Pashto 0.75%, Balochi 0.65%, Seraiki 0.10%, Others: 0.58%

Sindhi is the common language in the project area whereas Urdu is spoken in main urban centres of the district.

4.2.2 Urbanization

Going by status of urbanization given by urban: rural population ratio, which stands at 11.2:88.8 for District Thatta, this district is among the least-developed areas of Pakistan whose ratio of rural:urban population according to the 1998 census is 35:65. Adequacy in providing the benefit of development processes to the grass root level is invariably reflected in the level of urbanization of the area concerned. Since a share of 30% urban population in the total suggests a threshold stage of development and of over 45% suggests a take-off stage, the ratio for District Thatta suggests that it has yet to come out of the stage of under-development^{4.2}.

The underdeveloped status of the Thatta District is reflected by the land utilization pattern, type of dwelling units and availability of infrastructure facilities such as water supply and sanitation, roads, transportation in Jhimpir area, where GAWPL WGC will be sited. As expected the infrastructure facilities that upgrade the quality of life of the people of the area concerned are all highly deficient. The villages, union councils and the district as a whole bear a rural character and the status of degraded land.

4.2.3 Land Resources

The province of Sindh has an area of 14.09 Mha, out of which 5.69 Mha is cultivated, 1.43 Mha is culturable waste, 0.685 Mha is under forest cover, while 6.27 Mha is not available for cultivation. It has a total farm area of 3.45 Mha, which is covered by 801,983 farms, out of which 801,967 farms with an average farm size of 4.25 hectares, ha, constitute private farms. The average size of farms in Thatta district is 4.5 ha while the average cultivated area per farm is 3.1 ha. The cultivated area is the lowest at 69% in Thatta. The proportion of cultivated area per farm decreases as farm area increases from the average holding area of 3 to 5 ha to large holdings of 60 ha and over.

298,544 farms out of 801,967 or 37.2% in Sindh are fragmented into an average of 2.7 fragments. 15.5% farms are fragmented in Thatta, with a low average of 2.4 fragments for Thatta. Higher fragments of 4.8 to 5.6 are found only for farm size of 60 ha and over.

^{4.2} Mirza Arshad Ali Beg, Problems due to Urbanization in Pakistan, Chapter VIII in Democracy Displaced in Pakistan, Case History of Disasters of Social Pollution, Research & Development Publications, Karachi, 1998

According to tenure classification, the share of owner and tenant operated farms in Thatta district is almost the same as the provincial average of 51% and 42% respectively. The share of owner-cum-tenant operated farms is a low of 4% in Thatta compared with the provincial average of 8%.

The 18% uncultivated farm area in Sindh comprises a 92% share of culturable waste and 8% uncultivated land which includes 27,277 ha of forest area or a share of 4.4% in uncultivated area. The culturable waste includes 302,398 ha or 87% of the provincial farm area, waterlogged and salinized soil while the unculturable farm area includes 0.8% of the provincial forest cover. The degradation of land is more at the plain where the slope is less than the overall gentle slope of more than one foot to a mile to less than one foot to a mile. The latter incline is a characteristic feature of the rivers when they enter their delta stage. The composition of the soil also changes at this stage; it has more clay and silt than sand. The soil of the plains in Sindh is consequently less porous and permeable to water than in higher plains in the Punjab. This is a condition that provides poor drainage to the soil. Adequate mitigation measures in the form of a drainage system to restrict the movement of groundwater to the root zone, must be adopted if the land has to use irrigation water. The fields in the irrigated areas have not been provided with adequate drainage system, on the contrary the fields are ponded for irrigation and water is allowed to stand on the field for several days at each watering stage. This is particularly the practice for cropping rice and sugarcane. It is the rice growing areas, which have been particularly impacted by the irrigation system.

Thatta district has the culturable and unculturable farm area in the 69.2:30.8 proportion. 56,620 ha or 16.8% of district farm area is waterlogged and/or salinized, while 1.35% of the district farm area is under forest cover. This shows that irreversible alterations have occurred in the ecology of the district as a result of irrigation. Thatta is faced with a serious threat of waterlogging and salinity on the one hand and widespread deforestation in the district on the other hand.

4.2.4 Water Resources

The main source of water in the province of Sindh is surface run-off, river flow through the river Indus, and groundwater. Surface run-off is diverted and stored in tanks or *bandats*, which irrigate 7680 ha or 0.27% of the total cultivated area of 2.84 Mha. Springs and *rodkahi* system irrigate 1.05% of cultivated land. *Sailaba* or floodplain irrigation is practiced over 0.43% of the cultivated land while 0.456 Mha or 16% of the cultivated farm area constitutes the *barani* or rainfed area.

Tubewells provide service to 1.5% of the cultivated land. 0.23 Mha land was being irrigated by over 5000 tubewells in Sindh in 2006-07.

4.2.5 Irrigation

The major source of water in Sindh is River Indus which feeds the extensive irrigation network of the country. Water availability at canal head is 32 MAF for the *khari* season and 15 MAF in the *Rabi* season which makes a total of 47 MAF in case of normal rainfall and resulting canal flow. This water is diverted through the Guddu, Sukkur and Kotri barrages utilized for irrigation of 2.12 Mha land area in the year 2006-07 for cultivation. The Kalri Baghar Feeder originating from the Indus and

Keenjhar Lake provide the irrigation water to the area on the northwest of the Project site. There is a plan to divert about 5 MGD water from Jhimpir near Keenjhar lake, from where the water will be taken for Nooriabad Industrial Estate at N 25° 10' 30" 25.17504 and E 67° 47' 58" 67°.79'95.5". Nooriabad is at present getting its water supply of about 2 MGD from groundwater sources.

Availability of sweet groundwater in the area southwest of the Project site is quite limited. The thin layer of sweet water that exists over the brackish aquifer is under serious stress. This water is being supplied to the communities in and around Nooriabad, Jhimpir and much of Sindh Kohistan. Hence the usage of groundwater for the irrigation purposes is quite limited. While the perennial availability is only 62% in the province, it is restricted to only 19% in Thatta.

Degradation of land has occurred as a result of combined action of

- (i) an inefficient delivery system leading to evaporation losses to the extent of 7 to 10 MAF and seepage accounting for the loss of another 10 to 12 MAF,
- (ii) waterlogging and salinity, the imminent hazards due to excessive use of water by the landlords at the canal head or upper reaches of the distribution command area, inequitable sharing of water resources, thus depriving the landowners at the tail end of the canals by 50 to 80% of their legitimate share,
- (iii) lack of soil and water conservation practices which have caused deforestation and erosion of sediment due to indiscriminate removal of tree cover, and
- (iv) salinity owing to the salt content of the water which ranges from 0.4 to 0.45 ton salt for each hectare foot of water ponding over the fields; the 47 MAF water diverted into the irrigated fields thus adds about 18 tons salts each year.

According to the National Drainage Programme, the Left Bank Outfall Drainage, LBOD and Right Bank Outfall Drainage, RBOD have been adding 3.2 million ton, MT and 7.8 MT salts respectively. The Guddu canal system receives 0.7 MT salts, Sukkur system receives 4.3 MT while the Kotri system receives 2.8 MT. 5.0 MT out of the 7.8 MT received by the Guddu-Sukkur-Kotri commands is supposed to be flowing into the LBO Drainage system while the remaining 2.8 MT is continuing to accumulate in the irrigated land and decrease the yield of crops.

4.2.6 Agriculture

District Thatta, which comprises the macroenvironment of the Project site, extends from the hilly areas of Taluka Thatta to the coastal area of Gharo-Keti Bunder-Shah Bunder. It falls in the arid zone that has moderate temperatures, low rainfall, saline soils and poor drainage. The Project site is in the hilly region of Deh Kohistan which can only support subsistence agricultural activities or grazing.

4.2.7 Cultivation

Cultivation is one of the main livelihood activities of the people of the Thatta District. Almost all the households around irrigated areas possess some piece of land which is used for cultivation. Rice, wheat, sugarcane and tomato are main crops of the area. During *rabi* (winter) season, mostly wheat and vegetables are grown, whereas during *kharif* (summer) season, most of the farmers grow rice, sugarcane, vegetables and by the end of this season tomato is also cultivated.

Table 4.2: Area Under Major Crops in Thatta District

Crop	Sindh		Thatta	
	1998-99	2006-07	1998-99	2006-07
Rice	689.3	598,132	60,420	68,192
Wheat	1120	982224	10,646	11,889
Jowar(Sorghum)	95.6		414	
Bajra (Millet)	160		57	
Maize	9.3		207	
Gram	86.8		407	
Barley	22.3		9,362	
Rape seed & Mustard	93.4	67,743	858	2693
Sugarcane	261.6	214,691	23,836	25,356
Cotton	600.3	570,072	44	506

Cultivation methods are traditional in most of the area. Waterlogging and salinity problems have further reduced the already poor crop yields.

Farms using fertilizers are only 73% of the total in Sindh. For Thatta it is 55% where 20% of the farm area is fertilized with manure. Similar is the case with the use of pesticides. Only 23% of the provincial farm area is provided with pesticide cover. For Thatta district, the use is from 1 to 3% of the farm area.

The agricultural marketing practices are also traditional. Almost all the agricultural produce is sold out to the local wholesale dealers who dictate terms by keeping the farmer under debt. The produce is therefore required to be sold at a rate which is invariably lower than the market rate. Moreover the farmers are usually unaware of the open markets in larger towns and cities, and they find it convenient to sell their produce to the whole sale dealers at lower-than-market rates.

4.2.8 Livestock

Livestock is one of the key components of livelihood in the rural population of the area. The farmers in Thatta area keep a few heads of livestock, ranging from bullocks and cows, buffalos for milk, and poultry for eggs and meat. The communities in the Project area do not depend exclusively on livestock for their livelihood, since the prevailing impoverishment of resources, particularly those of water have dried up the rangeland which has compelled the farmers to look for other sources of income.

The total population of cattle and buffaloes together is much higher than the number of sheep and goats and thus is the principal livestock in Thatta district. The numbers of small ruminants in the arid areas of Kohistan is much larger and there are many more goats than sheep in all districts.

Table 4.3: Ownership (in 000) of livestock in Rural Households (1996-97)

District	Cattle		Buffaloes		Sheep		Goats		Poultry	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
Thatta	55.0	27.1	48.6	24.0	10.1	5.0	26.4	13.1	52.6	25.9

These statistics may be misleading, however. The extent to which poor, small farmers and tenants grow high value, minor crops and maintain large herds of cattle, sheep and goats remains unseen. Additionally the marketing system for specialty or minor crops or livestock includes small holder production.

Several commercial livestock and dairy farms also exist in Taluka Thatta e.g. the Emirates Dairy Farm in Deh Kohistan 7/1.

4.2.9 Fishing

Fishing is one of the important livelihood means of the local population in Thatta District, particularly along the coastal belt and the Keenjhar Lake. Fish farming or aquaculture is being practiced but not widely, primarily because this is a relatively technical pursuit which requires regular stocking, feeding, and protection from predators. The Directorate of Fisheries has established some fish-seed supply centers for providing fry and fingerlings to interested parties at nominal rates as well as for stocking government fish farms.

Fish with which there is good experience in Sindh include loberorohita (Rohu), Cinhina morigal (Morakha) and cattacatta (Theila) which can live harmoniously with one another. Theila is known as surface feeding fish whereas Rohu is column feeder and the Morigal searches for food at the bottom of impoundment and helps in keeping it clean. These fish give a good result in commercial production. Tilapia morrambica has been introduced and proven to be highly productive.

4.2.10 Infrastructure Facilities

Facilities that are necessary for the upgradation of quality of life are, with minor exceptions, the bare minimum throughout the province of Sindh. The total number of households in the province is 5.17 million as of 1998, out of which 2.9 million or 56% are in the rural areas while the remaining are in the urban areas. In Thatta District there are 223,743 households, 90.5% of which are in the rural area. This is in line with the suggestion based on rate of urbanization that the project area district largely bears a rural character and is underdeveloped.

4.2.11 Water Supply

The water supply and sanitation facilities are available to urban areas in Sindh but only to a limited extent while their access to the rural population is almost negligible. The cultivated area of 5.69 Mha out of the total of 14.09 Mha is the only one that can be considered to have freshwater available. Area comprising 1.43 Mha as culturable wasteland, including 0.685 Mha under forest cover and 0.302 Mha that has been lost to waterlogging and salinity, and 6.27 Mha, which is not available for cultivation do not have freshwater available to support human settlement. This is largely because the District Thatta has major areas under *barani* (rainfed) cultivation.

The cities, towns and a few talukas are the only ones, which have access to freshwater. Almost all the cities and towns of Sindh are faced with a deficient supply of freshwater and that includes the cities and towns located near the river Indus. Safe drinking water is a precious commodity and sanitation facility is a luxury that is hard to find in the rural towns and villages, more particularly in the underdeveloped or yet

to develop Sindh Kohistan. Accessibility to freshwater is limited to the rural population resident near the canals and even in that case it is restricted to perennial canals. Availability from perennial canals is only 62% in the province, and to only 19% in District Thatta. Large area of the district is un-irrigated and not cultivated. 85% area in Thatta is unirrigated that of course includes Sindh Kohistan, and hence it constitutes the segment that has limited availability of freshwater.

4.2.12 Roads

The total length of roads in Sindh is only 24,794 km which suggests that the road density is a mere 0.176 km/km² which is too inadequate to meet the transportation needs of the province particularly of the rural areas and Sindh Kohistan. The road length as of 1995-96 was 1,841 km with a road density of 0.20 in Thatta. This suggests that Thatta has a better road density than the provincial average. The share of high type in the total road length was 84% in Thatta. This shows that the farm to market roads which are classed among the low type are either non-existent or in shambles.

4.2.13 Transportation

The number of vehicles on road in the district as of 1998-99 was 2827 in Thatta as compared with 921,798 in the province of Sindh. The majority in the vehicle population comprised motorcycles and tractors. The number of cars was 242, motorcycles, buses, trucks and tractors was respectively 786; 66; 53, and 1,529 in Thatta compared with 413,950; 24,153; 10,997, and 11802 in the province. The data do not convey the exact number of vehicles on road since many of them are registered outside the district. They do, however, suggest that very few people own cars, jeeps and station wagons and those who have sought upgradation of quality of life have purchased motorcycles.

4.2.14 Fuel

Natural gas supply for use as fuel is available to only 0.25 million households while the remaining almost 5 million consumer households have to use kerosene oil or firewood for cooking their food. Forests yielding firewood have 0.422 Mha respectively under forest cover in Thatta. Mangrove forests in the coastal area of Thatta district and the woody vegetation on arid land are the main source of this firewood and it is for this purpose that they have been extensively denuded. The indoor pollution due to cooking with firewood has not been estimated but it is reported to be high since the stoves in use are not fuel-efficient.

Natural gas supply to the industrial area in Nooriabad was completed in the year 2002. It involved 23 km long transmission spur pipeline and a distribution network of 10.2 km. The source of energy viz. electricity is similarly deficient. Electricity is provided to only 1.6 million consumer households out of a total of 5.2 million. 1.01 million of the consumer households are in Karachi while only 0.6 million are in the urban and rural areas of Sindh.

4.2.15 Education & Literacy

The overall literacy rate according to official statistics is 34 percent. However, this was contested in the year 2005 by the Nazim of District Thatta who maintained that the literacy rate in the district was not more than 10 per cent despite provision of huge funds to the education department. However, this statement was contested by officials

of the education department who informed the Nazim that 140,855 students including 93,439 boys and 47,416 girls – were getting education from primary to higher level in 2,758 institutes through 5,592 teachers in the district. The data provided by the officials suggest that the teacher: student ratio is in the order of 1:25 whereas the desired ratio is 1:40. This suggests that many more teachers have been employed than needed or else not as many students turn up for primary education and relatively few for secondary and higher education.

The Table 4.4 shows the number of educational institutions and enrolment in Sindh and District Thatta:

Table 4.4 Number Educational Institutions & Enrolment In District Thatta

Province/District	NUMBER OF PRIMARY SCHOOLS BY SEX			
	1998-98		2006-7	
	Male	Female	Male	Female
SINDH	32,909	5,976	37048	7452
Thatta	2,262	298	2688	407
ENROLMENT OF PRIMARY SCHOOLS BY SEX				
SINDH	1,444,004	782,334	1970777	1314441
Thatta	63,856	26,831	95808	66276
TEACHING STAFF IN PRIMARY SCHOOLS (BOTH SEXES)				
SINDH			96243	Student:Teacher Ratio=34.1
Thatta			5139	Student:Teacher Ratio=31.5
NUMBER OF MIDDLE SCHOOLS BY SEX				
SINDH	74,955	46,437		
Thatta	50	32		
ENROLMENT OF MIDDLE SCHOOLS BY SEX				
SINDH	74,955	46,437		
Thatta	968	522		
NUMBER OF DEGREE COLLEGES BY SEX				
SINDH	92	46		
Thatta	1	1		
ENROLMENT OF DEGREE COLLEGES BY SEX				
SINDH	128,775	95,392		
Thatta	1,053	440		
Source: SEMIS.				

The figures given by the Department of Statistics GoS suggest that 162,084 students were enrolled in 3095 Primary schools with a student: teacher ratio of 31.5: 1 in the year 2006-7. This implies that there are on an average 52 students/primary school in District Thatta, whereas there should have been an optimum number of 205560 students in the institutions whose number is also low to achieve the goals of literacy rate of above 50 percent. The figures given officially also suggest that the 2758 institutions had an average 51 students and only two teachers in each institution,

implying that there is need for campaign to optimize the enrolment and also for employment of the desired number of teachers.

4.2.16 Healthcare Services

Healthcare Service Institutions are located in District Thatta in the towns and are not to be found in the far flung areas including Sindh Kohistan. The District Health Officer (DHO) is overall in-charge of all healthcare activities in District Thatta. Annexure 4.3 lists the details on number of Healthcare units and patients attended. It is observed that for a population of 1.469 million in the District, there are only 48 BHUs, 153 Dispensaries, 11 hospitals, 9 Mother and Child Health Centres, 9 Rural Health Centres, and 13 TB Clinics, thus making a total of 240 Healthcare Institutions.

The above analysis suggests that there is one healthcare unit to cater to the health of 6120 persons, compared with 9768 persons per healthcare institution in Sindh. For every 3,346 people there is one doctor available in the district and one doctor for 3,300 persons in Sindh Province, while for 27,717 population there is one nurse in the district compared with 9831 persons in the Province. These analyses indicate that availability of healthcare facilities including personnel in District Thatta is just as inadequate as in the rest of Sindh and for that matter also the other under developed areas of Pakistan.

4.2.17 Developmental Activities in the Area

The major development projects under consideration in District Thatta are allotment of additional land to the Nooriabad Industrial Area and provision of 5 MGD water from Keenjhar Lake. The Jherruck-Sonda Mine-mouth coal based power plant is under consideration by a Chinese firm, which has already obtained the NOC for EIA from Sindh EPA.

The Union Administration of the Councils undertake development works in respect of construction of water supply schemes, roads and of school buildings, but the same are at present awaiting release of funds.

4.2.18 Sites of Archeological, Historical, Cultural or Religious Significance

There exist a large number of sites of archeological, cultural, historical and religious significance in District Thatta. The major ones include the Makli Hills graveyard in the Thatta District. A list of these places located in the Thatta District is provided in Annexure 4.1. However, none of these places are at or near the proposed GAWPL WPG Complex site.

4.3 DESCRIPTION OF ECOSYSTEM OF GAWPL – WPGC MICROENVIRONMENT

The ecosystem of microenvironment of AEDB's Jhimpir Wind Corridor is enclosed in the Sindh Kohistan 7/1 area by Jhimpir 25°1'N 68°1'E; Meting-Jhimpir coal field along the Pakistan Railway Line between 25°03' - 25°07'30"N and 68°02' - 68°08'E; Jherruck 25°3'N 68°18'E and Jherruck-Sonda coal field 25°08'28"N, 68°13'38"E; Nooriabad 25° 10' 30"N 67° 47' 58"E - 25.17504N 67.79955E, and the Keenjhar Lake at 24°47'N68°02'E. It is in fact bounded by the mountain area on the north, and the two dry waterway viz. Layari Nai on the west and Harolo Nai on the east both draining into Keenjhar Lake beyond the Jhimpir-Meting coal field along the Pakistan Railway Line in the south.

The ecosystem of Jhimpir Wind Corridor, enclosed by the above coordinates includes the 14,169 acre land situated in Deh Kohistan 7/1 (Makan Gagan Waro, Banghan Khado, Ghattan, Doonhi Wari, Chakri) Taluka Thatta (Jhimpir area) leased to AEDB by Secretary to Government of Sindh (GoS). This land area has, as per description of site in Schedule of the Agreement of Deed of Lease made by the AEDB on February 11, 2008, the Metro Wind Power Project and mountain area including some un-surveyed land on the north; five wind power projects including Lucky Energy Private Limited on the immediate south, and the Railway line and Jhimpir Grid Station on the far south; Nala Harolo Nai on the east and local village and un-surveyed land on further east; Layari Nai and Sui Southern Gas Pipeline on the west and M/s Emirate Sheep farm on the far west.

Microenvironment of GAWPL-WPGC

The microenvironment of GAWPL's Wind Power Generation Complex (WPGC) site comprising the 11 km x 0.2 km strip GAWPL Project site is spread over 647 acres of land. It is situated within Deh Kohistan 7/1 Taluka Thatta (Jhimpir Area) over the following coordinates constitutes the land sub-leased by AEDB to GAWPL:

Table 4.5 Coordinates Demarcating Boundary of GAWPL SITE

S. No.	Latitude	Longitude
1	25° 10' 12.09"	67° 54' 25.15"
2	25° 10' 19.86"	67° 54' 25.98"
3	25° 08' 30.78"	68° 00' 44.76"
4	25° 08' 28.99"	68° 00' 46.29"
5	25° 08' 23.36"	68° 00' 42.72"

The ecosystem of the area sub-leased to GAWPL for establishment of 50MW-Wind Power Generation Complex (WPGC) has the Nala Harolo Nai and the Sui Gas Pipeline on the NEE end, Metro Power Company site on the north and northwest; the Lucky Energy site on the south and southwest, and the Nooriabad Industrial Estate, Jhimpir town, Harolo Nai, the Pakistan Railway line, Jhimpir Grid Station and National Highway on the far south. The Jhimpir – Meting coal field is on 214 km² area between Sonda-Jherruck and Lakhra coal fields.

The land here is a barren hilly tract, consisting of outlying spurs of the Kirthar Range. Cultivation is carried out wherever alluvial soil exists and near or along the numerous depressions where rain water carried by hill streams (nallas) can be stored. Cattle grazing, stone quarrying, gravel and sand collection and transportation, and wood cutting are the main occupation.

Urban Clusters in Microenvironment of GAWPL-WPGC

Jhimpir (Population 40,000), Meting (Population 2,000), Nooriabad (Population 4,000) and Jherruck (Population 5,000) are the main towns in the area in the microenvironment. Jhimpir is an old town of historical significance, rich in minerals and natural resources. The main source of income is fishing in Keenjhar Lake and hunting/catching wintering birds for at least 4 months of the year. Other sources of income are wage labour in coal mines, stone quarries, other menial labour and working at the Jhimpir railway station. Those who have received some education are in jobs at school, offices and industries in Nooriabad,

Industrial Area in Microenvironment of GAWPL-WPGC

Nooriabad is home to the Nooriabad Industrial Area on 5,342 acre area with 522 plots out of 1150 or 30 percent in occupancy. Textile units, light engineering, food processing, and chemicals manufacturing are the major types of industries in the area.

Lakes in Microenvironment of GAWPL-WPGC

Keenjhar Lake was created by providing a link between two natural lakes, “Keenjhar” and “Sunheri” meaning green and golden^{4.3}. Keenjhar and Sunheri were two smaller depressions, which were joined in 1958 by dynamiting the separating hills to make one lake; the “Kalri Lake”. Again in 1972 was renamed as Keenjhar Lake an artificial and tropical lake^{4.4}. It is situated nearly 120 km from Karachi, between 24°47'N and 68°02' E^{4.5}. This Lake is 27.35 km long. It receives water from river Indus by canal Kalri Baghar Feeder, originating from Ghulam Muhammad Barrage. The minimum depth of Lake is 4 meters and maximum depth of Lake is 8 meters and average depth of Lake is 7 meters.

Water Supply

Keenjhar Lake is the source of potable water for Karachi and also adjacent Union Administration Areas. The area of lake is about 124 km². There are small and large villages around the lake. Jhimpir is about 3 km from the site of an intake structure on the north west of the lake from where a pipeline is proposed to supply water to Nooriabad.

The existing water supply at Nooriabad is limited to extraction of about 2mgd from underground water sources. During dry spells this supply further falls down considerably. The limited supply of 2mgd is one of the reasons for the low occupancy rate of plots in Nooriabad Industrial Estate. Drilling of more tube wells is not viable since continuous extraction of water has already depleted the aquifer as is evidenced by the lowering of water table due to which quite a few wells have been rendered unproductive. The water intake structure at Keenjhar Lake near Jhimpir town is located at latitude 24°59'44.25" N and longitude 68° 00' 42.25" E. The water will be conveyed through 600 mm diameter pipeline along 30.62km of Nooriabad – Jhimpir Road, to waterworks area at Nooriabad.

Soils: Soil cover in Deh Kohistan area is very thin due to severe wind and water erosion. Most of the rocks contain limestone. Natural vegetation has almost disappeared e surface plain. The soils of the area in this region are shallow, strongly calcareous silt loam with weak structure. The slope of the mountains and hills comprises either bare rocks or has very shallow soils. The Lower parts of hills and higher parts of the plains have gravel soils with a strong zone of lime accumulation at 30 to 40 cm depth.

^{4.3} A. L. Korai1, G. A. Sahato1, K. H. Lashari1, S. N. Arbani, Turkish Journal of Fisheries and Aquatic Sciences 8: 259-268 (2008)

^{4.4} Michael, A.A. 1967. The Indus River: A Study of the Effects of Partition. New Haven, CT: Yale University Press, London, 328 pp.

^{4.5} Blatter, E., Mc. Cann, C. and Sabnus, T.S. 1929. The flora of Indus delta. Ind. Bot. Soc. Methodist. Pub. House, Madras, 173 pp.

Land use

From Jherruck to Kirthar Mountains the hilly track consists of hills and outcrops. The microenvironment of the Project site is presently highly degraded flat land. It is surrounded on all sides by unconsolidated gravel. Its physical, geographical, hydrogeological and sociological features portray the distinctive features of desertified arid land. Vegetation is xerophytic and is characterized by dried up thorny scrubs and poor grasses all over the region. The area is studded with rocky spurs and small mounds on barren lands with scant bushes and grasses in low lying areas.



Figure 4.2: Desertified arid land of Deh Kohistan

The most important land use in Deh Kohistan is grazing. Cultivation on deep valley soils depends mainly on spate irrigation practiced by diverting torrent water into fields which have high embankment, for ponding of water. The soil is seldom soaked with water to grow crops which have to mature usually on only one soaking. It rarely gets more than one watering. Jowar and bajra are the main crops in this region.

4.3.1 Access to Jhimpir Wind Corridor

The Jhimpir wind corridor can be accessed from Super Highway M-9 by Nooriabad-Jhimpir Link Road as well as by a dirt road from Kohistan Hotel at 55 km to Hyderabad. The latter route is shorter and is the preferred alternative for wind farms at the end of the wind farm Corridor. The wind farms can also be accessed from the National Highway through the Jhimpir Railway Station – Jhimpir Nooriabaad Link road. This, however, is a much longer route compared with the former and hence has not been considered.

Access to GAWPL WPGC Site

The GAWPL site is accessed from Super Highway M-9 at 55 km to Hyderabad. A dirt road from here crosses a large nalla at RD 3.8 and after bypassing a hillock and rough and rocky terrain it arrives at GAWPL Mast -1 at RD 8.7 Km from Super Highway.

The dirt road is being used by the local chiefs for transportation of sand, gravel and crushed stone. This dirt road passes by the following: a major graveyard at running distance (RD) 0.4 km from Super Highway; an Eidgah at RD 1.1 km and a primary school at RD 1.2 km in Vakhio Jhakro village. It thereafter bypasses an abandoned tubewell belonging to the Jakhro tribe at RD 2.8 km, and agricultural fields at 3.2 km, 3.3 km. At RD 3.8 km, the track forks off and after passing through 4.9 km of rough and rocky terrain it arrives at GAWP Mast B1. This route would require improvement/upgradation of 9 km of the dirt road, including 5 km of rough terrain for which the road will have to bypass an outcrop of hard rock. Construction

of bridge over the nalla shall not be necessary since the bedrock is sufficiently hard to bear heavy load of ground transportation.

4.3.2 Geology of Macroenvironment: Deh Kohistan

Topographically Deh Kohistan comprises the macroenvironment of Jhimpir Wind Corridor. It can be characterized as the piedmont colluvial fans. In regimen of fluvial erosion, the colluvial fringe has developed by merging of alluvial fans of individual streams depositing the erosional load of coarse sediments at the foot of each hillside. The deposits combined with material brought by sheet wash from hillsides has remained mostly unconsolidated, and under the process of weathering it has developed into good fertile soil where water is available. In dry or semi-arid conditions this shelving deposit of unconsolidated material has created badland topography of deeply scarred earth, unsuitable both for cultivation and habitation. Covered by sparse thorny shrubs, these however, serve as grazing grounds for goat and sheep.

The prevailing geologic conditions in the barren forefront of the Kirthar Range are the results of extensive inundation, depositions, coastal movements, and erosions over a long period of time in the geological ages. The geology of Deh Kohistan is closely related to the Himalayan orogeny that gave rise to intense deformation with complex folding, high angle strike-slip faults and crust thickening expressed in a series of thrust faults. The important tectonic changes which have had their influence in the region are not visible in the microenvironment but the macroenvironment has history of seismic activity in the past.

Topographic undulation of the microenvironment of Deh Kohistan 7/1 is substantially large with the relative height varying between 65 meters and 105 meters with the differential being 20 to 25 meters. The hilly areas are in the north and west while the low-lying and flat farm fields are located on the east. Absolute elevation of the ground is 15 to 37 meters. The highest point is located at an altitude of 37 meters on the hill, north of the boundary of initial wind farm area. The lowest point is located on the east near the Indus River at an altitude of 10 meters.

Geological Setting

According to AH Kazmi^(4.6), the region belongs structurally to Lyari embayment zone bordering the Kirthar fold in the southwestern part of the Thano Bulla Khan-Jhimpir area. A thick sequence of Tertiary sedimentary rocks mainly comprising limestone, shale, mudstone and sandstone, ranging in age from Eocene to Pleistocene underlie or are exposed throughout the area. The deposition of the sequence was in the remnant of the shallow Tethys seaway, which was gradually eclipsed as a result of the northward drifting of the Indian plate and its ultimate collision with the Eurasian plate to the north. The shoreline of the Indus plain had, during the Oligocene and Miocene era, a north-south orientation and extended from the area presently occupied by the Kirthar foredeep upto Karachi and beyond. A relatively shallow sea washed its shores.

Geological investigations of the area, according to Kazmi as well as DeJong^(4.7), suggest the presence of (Shallow marine Early to Middle Eocene Laki limestone and Late Eocene Tyon Formation) only Middle and Tertiary rock formations comprising fresh and slightly weathered recent and sub-recent shoreline deposits. Principal constituents of these deposits are the

4.6 Geology of the Indus Delta, AH Kazmi, in Marine Geology & Oceanography of Arabian Sea and Coastal Pakistan, ed. BU Haq, JD Milliman, Van Nostrand Reinhold Company, New York 1984

4.7 A. Farah and KA DeJong, Geodynamics of Pakistan, 1979

interbedded sandstone and shale together with subordinate amounts of large size gravels or conglomerate.

Geomorphology

Pediments and fluvial terraces at various levels in the landscape of Deh Kohistan 7/1 indicate that uplift is intermittent, because these surfaces only form during periods of vertical stability. In general the landscape of Kirthar Range is dominated by erosion while the stony plains are dominated by deposition^{4.8}.

The mountains of the Kirthar region have been cut by deep gorges that have passed onto a piedmont that is characterized by the following units: bedrock-cut pediments that are now dissected by alluvial fans which terminate in a plain, and finally a floodplain

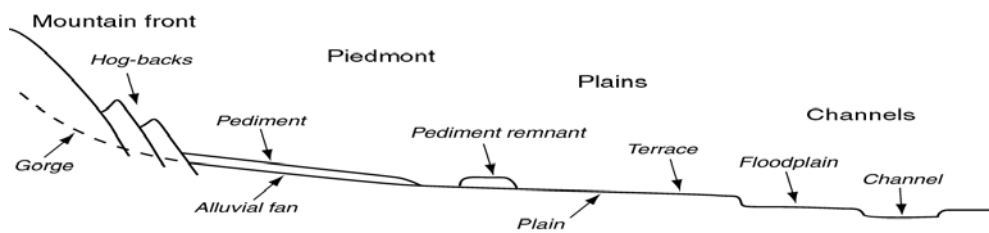


Figure 4.3: Geomorphology of Deh Kohistan

The piedmont plain is subdivided into plains cut in bedrock (pediments) and plains formed of alluvium (alluvial plains). Deh Kohistan is located in the Dissected Plain Unit.

The dissected plain geomorphological land unit is bounded by bedrock outcrops. The main difference between this land unit and the 'Plain' land unit is the degree of fluvial incision into this surface. Streams like Layari and Harolo Nai are deeply entrenched. The 'Dissected plain' surface is higher in the landscape than the 'Plain' surfaces, and the streams have therefore incised it more deeply in an attempt to maintain regular stream long profiles.

This indicates that even in the current arid conditions, the available discharge is sufficient to maintain a graded long profile. Another difference between this land unit and the 'Plain' land unit is the higher concentration of gravel lag on the surface. This is due to

- (1) Higher concentration of gravel in the underlying material,
- (2) The surface being older, has experienced a longer deflation history,
- (3) The surface is less likely to be inundated by water which may replace some of the deflated material on the 'Plain' land unit.

The GAWPL Project site in Deh Kohistan 7/1 can be more appropriately described as Plain with Stone Lag for which the local map term is 'Stony waste'. It is possible that the broader plains of the 'Plain' land unit originated as plains with a stone lag, that is, this unit is a less well developed form of the 'Plain' land unit. As the name suggests, these plains are covered with coarse pebbles and boulders, predominantly of limestone.

Evidence for deflation by wind

^{4.8} D. Fabel and I. Rutherford, Kirthar National Park Baseline Environmental Study, Chapter 2: Geomorphology

There are clear evidences of deflation by wind as a common natural process in the GAWPL Project macroenvironment. Evidence for this process is the ubiquitous gravel covered surfaces occurring throughout Deh Kohistan (e.g. the stony wastes). However, there is also evidence of high contemporary rates of wind erosion. This is shown by the elevated mounds of fine sand that occur around shrubs on the Plains Unit (Fig.). These mounds provide evidence of wind blown sand, but they also demonstrate that the surface has been deflated by tens of centimetres during the life of the plants.



Figure 4.4: Typical outcrops of bedrock known as inselbergs on the Plains Unit



Figure 4.5: Evidence of deflation: Plain with stone lag (known locally as stony wastes).



Figure 4.6: Edge of broken surface crust showing loss of material as a result of deflation.



Figure 4.7: Evidence of wind transport of sediment: Deposition of material around vegetation

Excavating the mounds shows that there is a distinct sedimentary change in the mounds. The upper sediments are unconsolidated, with distinct aeolian bedding planes. The lower sands are

consolidated, with indistinct bedding. The upper sediments are interpreted as recently deposited wind blown sands. The lower sediments are fluvial sediments deposited as distal units of alluvial fans. Fabel and Rutherford's interpretation of this stratigraphy is that the original surface of the plain has been deflated to a depth of about 15 cm to 20 cm during the life of the trees^{4.9}.



Figure 4.8: The road in Deh Kohistan showing the numerous paths taken by vehicles.

According to Enright and Miller^{4.10} the age estimates for *Prosopis cineraria* and other species growing on these mounds would be between 50 and 100 years. This suggests a deflation rate of between two and four mm per year on the Plains Unit between the trees. This is a minimum estimate, because it takes a maximum age for the trees, and assumes that the erosion has occurred progressively over the life of the tree. It is more likely that the erosion rate has increased over the last decades as grazing pressures have increased and more surface has been exposed.

Assuming that half of the Stony Plains Unit has been eroded to half of the estimated depth, this represents a volume of $30 \times 10^6 \text{ m}^3$ of sediment removed. This rate of erosion has more likely been increased owing to acute aridity in the macroenvironment of Deh Kohistan by wind erosion of the surface of its plains unit, estimated to be 2-4 mm per year.

Land Form Types at Microenvironment

A variety of landforms can be identified and mapped within the length and breadth of Deh Kohistan 7/1. These fall into two broad groups:

- Mountain Landforms which occur in the mountainous area in the north
- Low Lands comprising river valleys, their flood plains, alluvial plains, piedmont and exposed bedrock plains

The spurs of Kohistan plateaus running from the Kirthar Ranges, and the undulating land enclosed by Harolo Nai and Layari Nai as its boundary on the east and northeast, and the Keenjhar Lake form the boundary on the south. The stony waste sloping on the east towards Harolo Nai, on the west towards Layari Nai is almost entirely piedmont deposit on exposed bedrock or weathered bedrock surface, with:

- Denuded synclines as low hilly divides that are only an extension of the Sindh Kohistan Ranges of the Kirthar Mountainous region;
- Shallow synclines of the Harolo Nai and Layari Nai synclines and their flood plains;

^{4.9} Fabel, D. and Rutherford, I., Kirthar National Park Baseline Study, Chapter 2: Geomorphology, University of Melbourne, 2000

^{4.10} N.J. Enright and B.P. Miller, Kirthar National Park Environmental Baseline Study, Chapter 4: Flora

The structural foundations of the stony waste or plain of the microenvironment are furnished by two synclines occupied by the valleys of Harolo Nai and Layari Nai. The mountainous area in the north of the site is not much emphatic while folding is not visible with the result that elevations and dips of the strata are not identified.

General Geology and Stratigraphy

A sequence of lateritic clay and shale with beds of arenaceous sandstone of Laki Formation, named as Sonhari Member of Eocene age is found in Deh Kohistan, the microenvironment of proposed GAWPL-WPGC. The generalized stratigraphic sequence is as follows:

Laki Formation: This formation comprises cream colored to grey limestone, finely crystalline limestone with subordinate marl, lateritic claystone, siltstone and shale. It contains a rich fossil assemblage of foraminifera, gastropods, bivalves, echinoderms and algae. This Formation appears well developed in the Meting area of Deh Kohistan 7/1 that constitutes the GAWPL Project microenvironment. Geo-technical investigations during this IEE study show that the formation achieves thicknesses of 30 m and over. The lower contact of the formation is unconformable with Lakhra formation and is marked by Sonhari member. This is divided into members viz. Sonhari bed member, Meting limestone and shale member, and Laki Limestone member.

Sonhari Bed Member: This member is composed of limestone, sandstone, lateritic clays, and gypsiferous shales deposited in restricted marine environment. Limestone contains a large of marine fossils and re-crystallized into fine-crystal limestone etc. The soil has yellow color due to long-term weathering and has a lot of burrows. Sandstones are yellowish brown to light brown and dark grey in color and gritty at places with rounded and sub-rounded grains. Friable bands of silica sand occur in sandstone with variable thickness that passes gradually into buff, reddish ferruginous sand. Shales in this member are of different colors like dirty brown, grey and grayish black. Small bands of laterite occur in the middle part of the beds. There is a ferriferous quartzose sandstone or limonite bed in the bottom. The thickness of the member is about 10m. Clays are of different colors ranging from violet to reddish brown, yellowish brown, bluish grey, off-white, grey brown, and buff. They are silty, sandy and highly ferruginous with local patches of fireclay and lenticular lignite beds towards the coal fields of Jhimpir-Meting and Sonda.

Meting Limestone Member: The member consists mainly of creamy white nodular limestone, with subordinate sandstone in the upper part. The shale is grey, weathering dark rusty brown white kaolin clay or chalk, deposited in extensive marine environment. It contains foraminifera fossils, and plant debris.

Laki Limestone Member: This member consists of limestone which deposited in vast marine environment. The limestone has re-crystallized into crystalline limestone. It contains large numbers of foraminifer that has eroded off at the site. The limestone of this member has 25m thickness and is light yellowish grey, white and light grey, stained yellow to brown, and light grey at places. It is nodular hard, resistant and massive, and is characterized by steep scarps. There is a pseudo-conformity contact relation between Laki formation and underlying Lakhra formation.

Bore Hole Analysis

Typical analysis of borehole data generated for the GAWPL Project site show that the water table is deep down and much below 20m. It is assumed that the strata in the vicinity of water

table are dried up. The different strata of the soil comprise an initial 1 to 3 m of mostly soft materials like fine to coarse silty sand, followed by reddish brown hard claystone/siltstone fractured to 10 m, siltstone/claystone/limestone fractured in the following 15 to 20 m.

The borehole data for the site in conjunction with Rock Quality Designation (RQD) values indicate that most of the samples have RQD values lower than 30% which shows poor Rock Quality and low load bearing capacity. This would require appropriate mitigation measures in providing bored reinforced concrete piles to the depth of hard rocks with RQD values greater than 50%. It is therefore suggested that piles of the foundations of the towers should be laid at depth of sandstone which are hard and pose minimum risk to the liquefaction threat during major (> 7 on Richter Scale) earthquake.

Table 4.6: Quality of Soil from Bore Hole at 25°08'39.4"N 68°00'6.3"E

Depth (m)	Stratum Description	RQD
3.0	Brown, hard, silty Clay/shale Little sand, some limestone	
10.5	Reddish brown hard Shale/Claystone	14- 52 – 50 – 10
11	Brown friable Sandstone fractured	27
13.5	Brown medium hard Sandy Limestone with interlayers of siltstone fractured	Nil
16	Brown hard Sandstone/Conglomerate fractured	07 – Nil
17	Brown medium hard Sandy Limestone	07
18	Brown hard Silty Clay	07
22	Brown hard Sandstone with interlayers of limestone and siltstone fractured	Nil - 20
23	Greenish blue, hard shale, high plasticity	Nil
23.8	Yellowish brown, hard shale, high plasticity	Nil
31.5	Brown, medium hard chalky limestone, highly fractured	Nil –Nil- 20 – 19 - 08
33	Brown hard sandstone, fractured	Nil
35	Brown hard limestone, fractured	61

Table 4.7: Quality of Soil from Bore Hole at 25°08'55"N 67°59'10.5"E

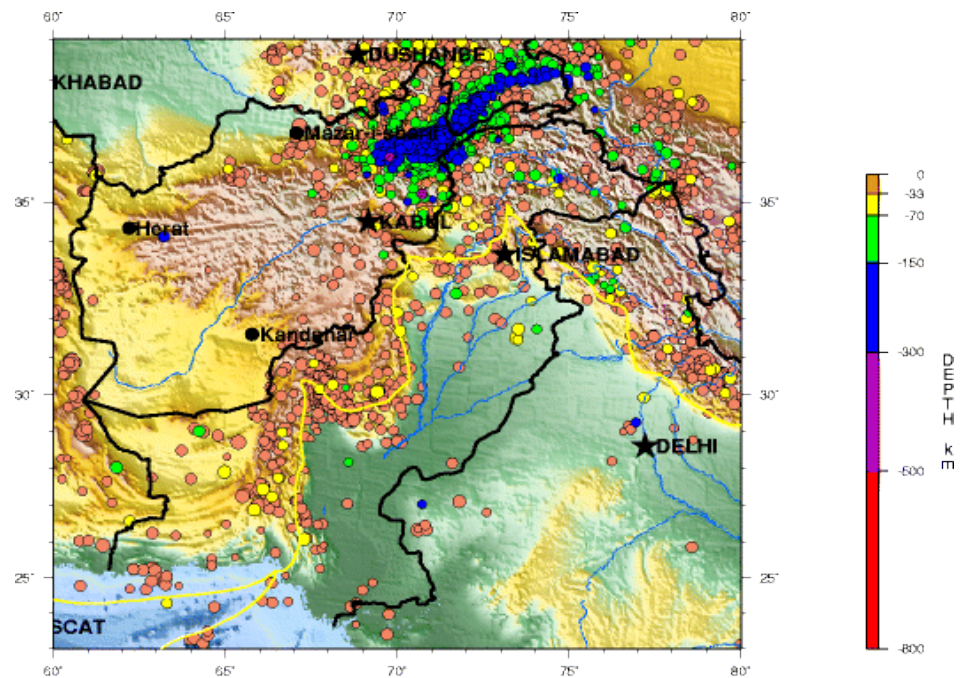
Depth (m)	Stratum Description	RQD
3.0	Brown, dense, fine sand, some gravel	
7.5	Reddish brown, medium hard Claystone/siltstone fractured	19 – nil – 26
9.0-10.0	Brown medium hard chalky Limestone fractured	15 – 22
12.0	Brown medium hard siltstone fractured	21
13.5	Chalky Limestone fractured	Nil
16.5	Brown friable Sandstone fractured	Nil – 35
19.5	Brown medium hard sandy Limestone highly fractured with interlayers of clay	16 –Nil
21	Brown very dense silty clayey sand	Nil - 07

26	Off white, hard, sandy, chalky limestone, fractured	Nil – 25 - 08
27	Greenish blue hard shale, high plasticity Yellowish brown hard shale, high plasticity	07
40	Off white, hard, chalky limestone fractured	16 – 07 – 06 – Nil – 07 – 09 – Nil – 06

Table 4.8: Quality of Soil from Bore Hole at 25°10'9.5"N 67°57'36.2"E

Depth (m)	Stratum Description	RQD
1.0	Brown, sandy Silt	
7.5	Off-white, hard Limestone fractured	07 – Nil – Nil- 09
12.0	Off-white, medium hard Limestone fractured	07 – 09 – Nil
30	Off-white, hard Limestone fractured	10 – Nil – 15 – 07 – 07 – 19 – 20 – 30 – 45 – 13 – 25 – 36

4.3.3 Seismicity & Natural Disasters

**Seismicity of Pakistan, 1990 - 2000****Figure 4.9**

The seismicity map of Pakistan Figure 4.9 as well as Table 4.3 show that the earthquake zones have been hit by earthquakes a number of times, but the depth of their epicenter is not usually lower than 33 km. The map also shows the yellow line, which marks the frequency zones as well as the fault lines. It also shows that the yellow line on entering the Arabian Sea bifurcates into a line that travels along the coastline while the other goes southwest. This indicates that there are quite a few other active faults in Lower Sindh, including a thrust-and-fold belt extending northward parallel to the transform fault separating India from Asia, and the Rann of Kuch fault system trending westward towards Jhimpir, Karachi city and Makran

Coast bordering the Arabian Sea. The map does not show the presence of the unique Mud Volcanoes, which are still active on the Balochistan coast.

Seismic activity in the macroenvironment of the GAWPL Project site is caused by the dynamics of slow but constant relative motion of the active Karachi Triple Junction (KTJ) of three major tectonic plates viz. the Indian Plate, the Arabian Plate, and the Eurasian Plate of the earth's crust. Their corresponding fault systems comprising a subduction zone, a transform boundary, and the ancient rift system, intersect in the general vicinity. Each produces a distinct type of ground motion and appears to have been reactivated, with an associated hazard risk that can be disastrous. Seismic activity in the region is the result of movement on one or more faults and mainly from intra-plate active faults, including the Karachi-Jati, Allah Bund-Rann of Kutch, Surjan-Jhimpir, and Pab.

The macroenvironment of GAWPL is about 200 km on the NEE, while Karachi lies approximately 160 km east of the triple junction. The western and north-trending arms of the triple junction sustain convergent and trans-current rates of 28-33 mm/yr respectively^{4.11}.

The presence of a recently discovered active Sonne fault indicates that the Arabian plate has been fragmented across the southwest corner of the triple junction defining a triangular plate: the Ormara plate^{4.12} whose velocity relative to the Arabian plate increases the subduction velocities by a few millimeters per year compared with the rate at the west. In addition to these clearly defined plate boundaries, other active structural zones have produced damaging earthquakes that have been felt in the macroenvironment of GAWPL site in Deh Kohistan in the past 200 years. They include the following faults:

(1) Karachi-Jati, (2) Surjan-Jhimpir, (3) Pab Fault (4) Hab Fault (5) Allah Bund-Rann of Kutch, (Figure 4.10).

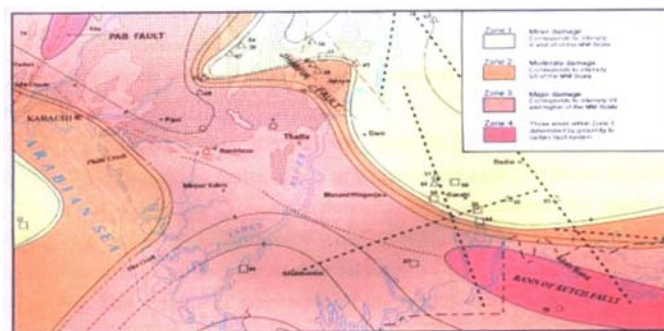


Figure 4.10. Seismic risk map of Karachi-Hyderabad Divisions,

Surjan Fault: These N-S trending dip-slip or bedding-plane faults are active along the Kirthar Range Front. This fault cuts across the Quaternary deposits on the north of Karachi and west of Lakhra. The southern end of this fault is intersected by the northwest trending Jhimpir Fault on the west of Jhimpir. The interaction of these two faults is characterized by at least four teleseismic events of shallow focal depth and magnitude 3-6. The maximum magnitude of the earthquake associated with the Surjan Fault is of the order of $M \approx 6-1$.

Jhimpir Fault: A number of epicenters are located on this N-W trending fault. The fault has produced an earthquake of $M \approx 5.6$ on Richter scale.

^{4.11} "Geodetically constrained Indian plate motion and implications for plate boundary deformation", Apel, E. R., Bürgmann, P. Bannerjee, and B. Nagarajan, 2006, *EOS, Transactions, American Geophysical Union* 85,52 T51B-1524 Fall meeting supplement

^{4.12} "Newly identified strike-slip plate boundary in the northeastern Arabian Sea, Kukowski, N., T Schillhorn, E. R. Flueh, and K. Huhn, *Geology* 28, 355-358 (2000), [\[Abstract/Free Full Text\]](#)[\[CrossRef\]](#)[\[ISI\]](#)[\[GeoRef\]](#)

Pab Fault: This NNW-SSE trending is 135 km in length and is located in the eastern part of the Pab Range and has dislocated vertically the Quaternary alluvial fans. The maximum magnitude of the earthquake associated with this fault is of the order $M \approx 7.0$ on Richter scale.

Hab Fault: The Hab valley is traversed by this fault.

Rann of Kutch Fault: This E-W trending fault has produced earthquake of the order of $M \sim 7.6$ on Richter scale. In 1819 and 1956, this fault was responsible for severe earthquakes in Gujrat, Tharparkar and Indus delta. This fault system also known as Allah Bund Fault passes in the proximity of the Steel Mills and Karachi Nuclear Power plant. It is 225 km in length and is responsible for the production of earthquake of considerably high magnitude of up to 7.6 M on Richter scale and of IX to X intensity on the Modified Mercalli, MM scale on June 16, 1819.

Additionally a complex series of faults generally oriented easterly and slightly concave to the north have been identified through aerial photographs. They are roughly parallel to the inferred zone of rupture for the 1819 earthquake event.

Over the last sixty years, earthquakes of intensity lower than 5 on Richter Scale, including those in 1945 and 1985, have struck the region comprising the macroenvironment and thus far they have been of minor significance. This is mainly because the earthquakes here are not "Inter-Plate" or "Plate Boundary" earthquakes which occur commonly along narrow zones that follow the edges of tectonic plates.

The tectonic fault that produced the 2002-Bhuj earthquake, which registered a massive 7.7 on the Richter scale, was part of a complex system of geologic faults that run northwest in Gujrat through the marshy Rann of Kutch, where it produced a magnitude 7.6 quake in 1819, and also ran into Pakistan. While concealed under the loose sand of the Rajasthan and Thar deserts and sediments of the Indus delta, this system of faults appears to continue to the west, passing through Karachi and while extending into the Arabian Sea, it intersects another system of faults associated with a major tectonic boundary that has produced devastating earthquakes as far north as Quetta in the past. Together these fault systems have produced historically large earthquakes within Kohistan, notably in the Pab Range, Thatta taluka, and Jhimpir areas.

It is the Intra-plate type of earthquakes (Mid-Plate Earthquakes) that occur far away from plate boundaries. The latter type earthquakes are less frequent but are capable of releasing just as much energy in a single event as one of similar intensity along a plate boundary. These arise due to localized systems of forces in the crust sometimes associated with ancient geological structures such as in the Rann of Kutch. Thus while the October 8, 2005 megathrust earthquake was the direct result of the interaction between Indian Plate and the Eurasian plate, the earthquakes of July, August and October 11 in the macroenvironment are intra-plate or Mid-Plate events.

It is interesting to note that no earthquake, including the 1945 Makran and 2001 Bhuj events, as well as the occasional shaking from M 4-5 earthquakes on faults in the Deh Kohistan, has ever produced documented damage anywhere. Although the 1819 earthquake was apparently similar or larger in magnitude than the 2001 Bhuj event, little damage occurred in Thatta and

Hyderabad in 1819 compared to 2001 even though the former event was closer to these towns/cities.^{4.13}

The following Table shows the earthquake occurrences over the last forty years. The Table does not include the numerous events of magnitude less than 4.0 on Richter scale. Earthquakes of recent occurrence were recorded on July 16, 2005, followed by one on August 6, another on August 13, yet another on October 9 and then again on October 11, 2005. They were all of magnitude between 4 and 5.1 on Richter scale. The epicenter of these earthquakes was away from those listed in table. The epicenter of the most recent tremor of January 2, 2009 was 100 kilometers in the coastal region of Thatta district. It had a shallow depth of 10 kilometers and magnitude of 2.2 M on Richter scale.

Table 4.9: Epicenter, Depth, Magnitude & Intensity of Earthquakes Near Jhimpir

Year	Coordinates	Depth	Magnitude Richter Scale	Intensity MM	Location
1962	24°70'N66°00'E	0	4.50	-	Karachi
1965	25° 03N67°76'E	40	4.50	-	Karachi
1966	25° 0N68°00' E	-	5.0	VI-VII	Jhimpir
1968	24° 61N66°42' E	19	4.10	-	Karachi
1970	25° 28N66°65' E	33	4.90	V	Karachi
1971	25° 00N68°00' E	-	4.50	V	Jhimpir
1972	25° 35N66°71' E	33	4.50	V	Karachi
1973	25° 00N68°00' E	-	5.00	VI	Jhimpir
1973	25° 48N66°33' E	57	4.90	V	Karachi
1975	25° 50N66°80' E	-	4.50	V	Gadani
1975	25° 22N66°59' E	33	4.90	V	Karachi
1976	24° 96N70°38' E	14	4.70	V	Karachi
1984	25° 86N66°41' E	33	4.70	VI	Karachi
1985	24° 90N67°39' E	33	5.00	VI	Karachi
1986	25° 34N66°60' E	33	4.50	V	Karachi
1992	25° 25N67°76' E	33	3.60	IV	Karachi
1996	25° 06N66°76' E	33	-	-	Karachi
1998	25° 69N66°46' E	33	4.40	V	Karachi
1998	24° 85N66°35' E	33	4.50	V	Karachi
2009	24° 31N67°18'	10	2.2	IV	Thatta

According to a map created by the Pakistan Meteorological Department, the country is divided into 4 zones based on expected ground acceleration. The areas surrounding Quetta, those along the Makran coast and parts of the NWFP, and also along the Afghan border fall in Zone 4. The rest of the NWFP lies in Zone 3, with the exception of southern parts of this province, which lie in Zone 2. The remaining parts of the Pakistani coastline also lie in Zone 3. The remaining parts of the country lie in Zone 2. According to this classification Deh Kohistan would be placed in Zone 2.

^{4.13} Seismic Hazard in Karachi, Pakistan: Uncertain Past, Uncertain Future, Roger Bilham, Sarosh Lodi, Susan Hough, Saria Bukhary, Abid Murtaza Khan, and S. F. A. Rafeeqi, *Seismological Research Letters*; November 2007; v. 78; no. 6; p. 601-613; DOI: 10.1785/gssrl.78.6.601

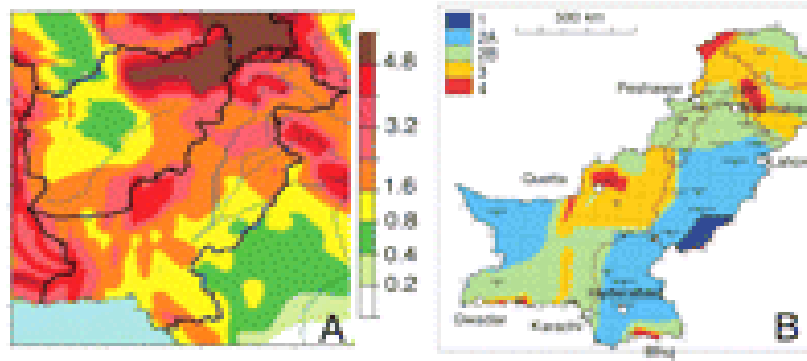


Figure 4.11: GSHAP hazard map of Pakistan^{4.14}; color scale indicates peak ground acceleration (m/s/s) with 10% probability of exceedance in 50 years) compared to (B) a recently revised hazard map following the 2005 earthquake (working group on Pakistan Hazard 2006; zonation 4 is most hazardous, Zone 1 is least hazardous).

In view of the not too distant location of the Project site to Allah Bund Fault line, it is suggested that Deh Kohistan should be placed in Zone 2A i.e. between Zone 2 and Zone 3. Such Seismic Zoning would correspond to Magnitude between 5.0 and 6.5 on Richter Scale and Intensity between VII and IX on Modified Mercallis Scale and hence Ground Force in terms of Assumed Approximate Acceleration equivalent of 0.3 g should be adopted for siting the Wind Farm for constructions and positioning of towers and WTGs, for operational basis earthquakes (OBE) pertaining to damage due to moderate level earthquakes (MM-VII to IX).

The seismic hazard, in view of the historical data, has been estimated for Deh Kohistan 7/1 as "moderate to major". This suggests the "possibility" of earthquakes of intensity V to VII on (MM) scale and "probability" of those above VII. The seismic risk factor of g/20 must therefore be incorporated in the design factor for the construction of Wind Towers and Turbines. Moreover in view of the Rock Quality Designation (RQD) values being lower than 30% and showing poor Rock Quality and low load bearing capacity, the risk of liquefaction during major (> 7 on Richter Scale) earthquakes will have to be taken into account. The appropriate mitigation measures would be to provide bored reinforced concrete piles to minimize the risk to the liquefaction threat during major (> 7 on Richter Scale) earthquake.

4.3.4 Tsunamis

Major damages done by Tsunamis, the impulsively generated seawater waves that are a result of underwater earthquakes, have not been recorded for the coastal area south of Karachi. There are, however, evidences of a 1.2 m tsunami generated by an offshore earthquake of intensity 8 M in 1945, which caused only minor damages in Port Qasim area. This event was followed by another Tidal wave that was recorded in 1953. The Tsunami of December 26, 2004 had no impact on the macroenvironment of the GAWPL Project site.

Tsunami hazards exist on the contiguous coastline. The > 1-hour delay between the main shock and the arrival of the damaging tsunami associated with the 1945 earthquake was very probably caused by submarine slumping offshore rather than direct uplift of the coast. If this were indeed the case, even a modest earthquake in the Rann of Cutch region would be sufficient to trigger a submarine slide that would endanger the shoreline of District Thatta, which however is more than 70 km from the Project site. There is therefore no likelihood of Tsunami threat to the site.

^{4.14} Giardini, D., G. Grunthal, K. Shedlock, and P. Zheng (1999). The GSHAP Global Seismic Hazard Map. *Annali di Geofisica* 42,1,225 – 1,230. [\[GeoRef\]](#)

4.3.5 Storms

The following Table shows the movement of cyclones and storms in the Arabian Sea. The movement is generally in the west-north-westerly direction. The one that moved into the coastal area on May 12, 1999 changed direction and hit the coastal area of Badin while the coastal area southeast of Karachi was in the periphery and only rain showers of moderate intensity were recorded. This coast is otherwise classified outside the zone of cyclone activity for the Arabian Sea. Thunderstorm frequency is also low and is reported to occur at an average rate of 10 thunderstorms/year.

The pattern seems heading towards a change during the last two years. Coastal area of Pakistan has experienced an increase in the frequency of storms in the southern part of Pakistan especially along Balochistan coast. In the month of June 2007 two tropical cyclonic storms namely Gonu and Yemyin hit the Balochistan coast. Under their influence, rain /thunder showers associated with gusty winds and thunderstorms occurred at isolated places of Makran Coast, while the sea conditions were very rough along the coast of Sindh. The high heat content of the Arabian Sea that is adjacent to the heat zone of Pakistan had disturbed the heat balance and water balance of the region. This induced the windstorm in late May, followed by the Tropical Cyclone Gonu in the first week of June, then by Tropical Cyclone 03A from the south of Mumbai, and thereafter by Tropical Cyclone 04B nicknamed Yemyin.

Table 4.10: CYCLONES & STORMS DURING LAST 15 YEARS^{4.15}

Sr. No.	Year	Type/ Location of Cyclone	Wind Speed Range (km/h)
1	November 1993	Tropical Cyclone/ Northeast Arabian Sea	62 – 88
2.	June 1996	Cyclonic Storm /East Central Arabian Sea	62 – 88
3.	October 1996	Tropical Storm /Southeast Arabian Sea	62 – 88
4.	June 1998	Cyclonic Storm /Southeast Arabian Sea	62 – 88
5.	October 1998	Cyclonic Storm /East Central Arabian Sea	62 – 88
6.	May 1999	Very Severe Cyclonic Storm /East Central Arabian Sea	> 118
7.	May 2001	Very Severe Cyclonic Storm /East Central Arabian Sea	> 118
8.	September 2001	Cyclonic Storm /East Central Arabian Sea	62 – 88
9.	May 2002	Tropical Cyclone /West Central Arabian Sea	62 – 88
10.	May 2004	Very Severe Cyclonic Storm /Southeast Arabian Sea	> 118
11.	October 2004	Severe Cyclonic Storm /Northeast Arabian Sea	89 – 117
12.	September 2006	Tropical Cyclone /East Central Adjoining Northeast Arabian Sea	62 – 88
13.	02 June 2007	Tropical Cyclone /East Central Arabian Sea	62 – 88
14.	07 June 2007	Very Severe Cyclonic Storm /Northwesterly of East Central Arabian Sea	> 118
15.	21 June 2007	Tropical Cyclone (Deep Depression) /Northeast Arabian Sea	> 50

4.3.6 Meteorology and Climate

The climate of Kohistan is arid subtropical - monsoonal. The mean minimum and maximum temperatures vary from 10°C- 45°C. High temperatures are experienced in summer.

^{4.15} AEDB website

Temperature

The yearly average temperature varies between minimum 16.4°C and maximum 35.8°C. The monthly average temperature ranges between 8.7°C in January and 39.8 reaching a maximum of 43.8°C in May. The temperatures start falling from October each year to January and dry and hot weather prevails from April to September.

Table 4.11: Meteorological Parameters for Jhimpir Area				
Months	Temperature °C		Rainfall mm	Relative Humidity %
	Maximum	Minimum		
January	25.78	8.73	0.96	50.38
February	28.59	11.60	3.60	48.81
March	34.02	16.80	2.30	48.36
April	38.40	21.80	2.49	48.67
May	39.85	25.47	0.69	53.10
June	38.02	27.46	10.76	60.70
July	35.11	27.04	70.49	69.61
August	33.61	26.06	89.88	72.55
September	34.36	24.87	34.43	68.78
October	35.80	21.70	3.72	58.15
November	31.87	15.86	1.67	53.88
December	26.68	10.10	1.11	52.46
Annual	33.48	19.76	221.64	57.56
<i>Source: Normal for the period 1995-2005, Data Processing Centre, Pakistan Metrological Department</i>				

In Kohistan extreme temperatures of up to 38-45°C in summer and 6-8°C in winter prevail during the two seasons. Due to high temperatures in summer, the plant species with low vigor and shallow root system die away. Maximum temperature is high in these regions, specially in the dry season when there is little cloud or moisture in the atmosphere to absorb solar radiation. Under conditions of high temperatures life and work become difficult. Not only is lack of moisture in the form of rain, the chief factor causing arid conditions, but low air humidity in itself has an adverse effect upon plants and animals, because the rate of evaporation is very high at these temperatures.

Loss of moisture from the ground and from vegetation is an indicator of rate of “evapo-transpiration” which is very high in semi- arid and arid regions of Kohistan. The incidence of high temperature causes heat damage. Maximum temperatures are high in Kohistan especially in dry season when there is little cloud or moisture to absorb solar radiation. Accordingly the rate of evapo-transpiration is very high.

Rainfall

The southwest monsoon brings in humid air from the sea, but the precipitation is generally very low with nearly 80% of the 100 to 200 mm rain falling from June to September. Rainfall, when it does come, it is often torrential causing problems of drainage and erosion of the light and sparsely vegetated land of UA Jhimpir.

The winters are short and mild from late November to early February with the prevailing wind coming from the North East with very little rainfall. The most important characteristics of the prevailing meteorological conditions are the generally high dust conditions as a result of the aridity of the surrounding area; dust storms occur especially before the onset of monsoon. The higher winds during the southwest monsoon tend to carry air-borne dust inland during the summer months, while in winter they tend to be light to moderate in intensity and carry air borne particulate matter seaward.

Monsoon in the arid area of Kohistan is characterized by low and high variable rainfall both in time and space. The rainfall has a specific trend and pattern that is below medium rainfall, which may come once in three years, whereas drought once in 8- 10 years^{4.16}. Annual rainfall increases from less than 100 mm in the north to 350 mm in the southeast. Nearly 14 per cent of the desert receives 350 mm rainfall, 25 per cent gets 250 mm, and 4.5 per cent receives less than 150 mm, and remaining 52.5 percent receives 150- 25 mm rainfall. Almost all the rain is received during monsoon from mid June to mid September, but July and August are the months of heavy rainfall. During remaining period of the year there are drought-like conditions for continuous period of six to nine months. Although, rainfall is in heavy showers yet there is generally little runoff. The rainwater is usually absorbed in the sandy grounds, however the village folks have constructed channels to divert the surface run-off into land area enclosed by dykes for storage in tanks or *bandats*, and also into fields for irrigation.

Removal of vegetation, by overgrazing, or drying up due to continuous drought conditions greatly reduces the effects of rain, because the water runs off the surface of the ground. Within a few minutes, the dry *Nai* (rain fed channel) such as Layari and Harolo become roaring torrents removing any sign of topsoil and eroding deep gullies into the ravaged landscape. The two *nais* are dry except after rain. During some years the persistent wind with high velocity the monsoon winds do not reach the region and no rain occurs during such periods. The desertified area is subject to heavy soil erosion.

During recent years the annual rainfall has ranged between a the minimum 4.6mm in 2002 and 800mm in 2006 with an annual average of 300mm. The rainy season is spread over the June-September period, with maximum rainfall occurring in September, and average rate of evapotranpiration 3218.2mm.

Wind Direction and Speed

The wind direction at the area is predominantly west-northwesterly at 250°, which suggests that it has a direction almost perpendicular to the 11 km long site, which is oriented at the Project site at about 20° above the west-east axis. The wind direction in the area is generally west-northwesterly during the summer monsoon and east-northeasterly during the short winter monsoon season. The wind speed at ground level varies between 0 and 2 m/s during the calm months to 4 and 8m/s during the pre-monsoon season. The normal wind direction during 1961-1990 is given in the following Table.

Table 4.12: Wind Direction in Karachi (1961-1990)

Month	Direction in degrees	Velocity in Knots	Steadiness %
January	36	2.5 to 3.0	31
February	320	3.1 to 3.7	19
March	263	3.9 to 5.0	72

^{4.16} IUCN: Status Paper on Situation of Arid Zones in Sindh, 2000

April	259	5.9 to 6.3	87
May	256	8.2 to 8.6	91
June	249	8.2 to 8.7	84
July	255	7.8 to 9.1	85
August	263	8.3 to 8.6	88
September	265	6.9 to 7.1	82
October	259	3.2 to 4.0	81
November	34	2.7	31
December	47	2.2 to 2.8	38

The following Table shows the monthly average wind velocity recorded for 13 months at two monitoring stations in Malir Valley which is also in the wind corridor in the east of Karachi. The range of variation in wind velocity at 50 m is between a low of 3.7 m in November and a high of 8.3 m in July, while at 30 m it ranges between 3.2 m/sec in November and 7.8 m in July. Thus there are minor differences in velocity between the 30 m and 50 m levels. High velocity winds of 6 to 8 m/sec are, according to the data recorded in the Table dominant from May to August, which are the monsoon months. Monthly average wind velocity decreases from 5.62 m/s at 50 m to 5.12 m/s at 30 m and 4.66 m/s at 20 m level.

Table 4.13: Wind Data at Malir River Valley
NRG WIND DATA

		Anem 1 corrected 50m	Anem 2 50m	Anem 3 30m	Anem 4 20m	Anem 5 20m
S. No.	Month					
1	Mar, 06	4.4	4.3	3.8	3.5	
2	Apr	6.1	6	5.5	4.3	
3	May	8.3	8.2	7.7	7	
4	Jun	7.6	7.5	7.1	6.7	
5	Jul	8.4	8.3	7.8	7.4	
6	Aug	6.4	6.3	5.9	5.5	
7	Sep	4.8	4.7	4.2	3.9	
8	Oct	5	4.8	4.3	3.8	
9	Nov	3.8	3.7	3.2	2.9	
10	Dec	5.1	5	4.3	4	
11	Jan	4.5	4.4	3.8	3.5	
12	Feb	4.8	4.6	4.2	3.9	
13	Mar, 07	4.68	4.57	3.99	3.62	3.4
14	Apr	5.2	5	4.6	4.1	4.2
	Total	74.68	73.07	66.59	60.62	7.6
	Monthly Av	5.74	5.62	5.12	4.66	3.80

The wind velocity recorded at ground level at the Project site on March 9, 2009 was as follows:

Table 4.14: Wind Data at Project Site at Ground Level

	Wind Speed m/s	Direction (Degree)	Air Temperature °C	Humidity %
Average	2.8	104.5	25.3	20.9
Max	8.0	359.0	32.9	37.6
Min	0.0	0.2	15.9	10.1

Detailed analysis of wind data recorded at GAWPL Project site by SUPARCO shows that the wind speed and direction were both erratic. A comparison with wind speed noted at Jherruck

shows that this is typical at the microenvironment for the calm period of mid-February to mid-March. The wind speed noted at Jherruck also situated in the macroenvironment of the GAWPL Project site recorded in April 2008 was as follows:

Table 4.15: Wind Data at Jherruck at Ground Level

Parameter	Unit	Maximum	Minimum	Average
W. Speed	m/s	6.1	0.3	3.3

According to the data recorded at GAWPL Project site, the wind speed at ground level varied between ~1.0 m/s to ~4.0 m/s during the afternoon hours from 1330 Hours to 1800 Hours while the direction varied between 80° and 120°. Occasional gusts were noted at certain points of time when the direction changed, possibly due to whirling. After 1800 Hours the direction remained between 50° and 70° and the speed varied between ~2.0 m/s and ~4.0 m/s. From 1900 Hours to 2000 Hours it was between 80° and 95° with the speed slowing down from ~2.8 m/s to 1.1.5 m/s. The wind direction remained from 50° to 0° and 350° from 2030 to 0730 Hours while the speed remained between ~1.0 m/s and ~3.0 m/s. From 0730 Hours to 0900 Hours the speed slowed down to less than ~1.0 m/s while the direction changed from 100° to 50°. From 0900 Hours to 1600 Hours, the speed varied between 4.0 m/s and 6.0 m/s and occasionally 7.0 m/s while the direction was from 60° to 90°. Each change in direction was followed by increase in speed or else a slow down.

The changes in speed and direction are shown in the Wind Rose and Wind Class Frequency Distribution in Annexure 4.7 and 4.8 respectively.

Wind Direction and Speed at 80 m Height at Project Site

Table 3.6 gives the wind speed and direction recorded at 80 m height at the GAWPL site for 8 months from September 08 to April 09. The mean monthly speed is 7.11 m/s at an average temperature of 26.68°C, while the monthly average wind direction varies from 245° and 260° during the monsoon period; between 275 and 286 during March and April and is erratic during the calm periods of November to February. The average monthly wind speed of 7.29 m/s for the nine months is of the same order as recorded and endorsed by AEDB^{3.1}.

4.3.7 Ambient Air Quality

Services of SUPARCO were hired to conduct ambient air quality and noise level monitoring at GAWPL Project site. SUPARCO Mobile laboratory equipped with online USEPA designated ambient air analyzers for all criteria pollutants was commissioned to monitor ambient air quality with respect to PM₁₀, SO₂, CO, NO_x, and noise level along with meteorological parameters viz. temperature, wind speed, wind direction and humidity. The sampling interval of measurement was 15 minutes and monitoring was carried out continuously for 24 hours at the site. The samples of PM₁₀ were collected on Dust Monitor for 24 hours at selected location of project site.

International protocols of monitoring were followed for site selection, and positioning the analyzer/ sampler above the ground besides type of monitoring techniques during the acquisition of ambient air quality data. Results of Ambient Air Quality Monitoring are shown in Annexure 4.4.

Results of Air Quality Monitoring

It may be seen from Table 4.16 that the average level of each parameter in ambient air is on lower side in comparison with NEQS, USEPA and World Bank Guidelines.

- SO₂ level ranges between 7.0 ppb and 13.6 ppb which is much lower than 38 ppb recommended for the 24-hourly average by the NEQS.
- NO_x level ranges between 8.2 ppb and 16.3 ppb which is much lower than 38 ppb recommended for the 24-hourly average by the NEQS, or World Bank and WHO guidelines, both of which recommend 50 ppb or 53 ppb respectively as its maximum limit.
- CO level ranges between 0.2 ppm and 1.9 ppm which is well within the USEPA and WHO standards i.e. 9 ppm and 8.7 ppm respectively.
- PM₁₀ concentration was between 114.0 µg/m³ and 163 µg/m³ with the average at 140.6 µg/m³ which is below the level suggested by USEPA guidelines (150 µg/m³).

Table 4.16: Ambient Air Quality at Deh Kohistan (GAWPL) Site

	SO ₂ (ppb)	NO _x (ppb)	CO (ppm)	DUST (µg /m ³)	Noise dB(A)
Average	9.7	11.6	1.2	140.6	45.9
Max	13.6	16.3	1.9	163.0	54.0
Min	7.0	8.2	0.2	114.0	41.0

Table 4.17 Standards and Guidelines for Air Quality Parameters

Guideline/ Standards	SO ₂ µg/m ³	NO _x µg/m ³	CO ₂ ppm	CO µg/m ³	O ₃ ppb	Dust / PM10 µg/m ³	Noise dB (A)							
Pakistan NEQS	<200 (70 ppb) 24-hourly	50 (24 ppb) Yearly Average	--	--	--	--	70 *							
World Bank Guidelines	150 (53 ppb) 24-hourly	150 (73 ppb) 24-hourly	--	--	--	150 24-hourly	70							
WHO Standards														
SPM (µg/m ³)				SO ₂ Units: ppm (µg/m3)			NO _x Units: ppm (µg/m3)			CO Units: ppm (µg/m3)			O ₃ ppm (µg/m3)	
1 hr	8 hr	24 Hr	1 yr	1 hr	24 hr	1 yr	1 hr	24 hr	1 yr	1 hr	8 hr	24 hr	1 hr	8 hr
50	-	120	-	(350)	0.048 (125)	0.02 (50)	0.21 (400)	0.08 (150)	0.02 (40)	35 (40,000)	9 (10,000)	-	0.09 (180)	(0.11)

The air quality determined for the Project site is in many respects similar to that noted for Jherruck, except that the Dust level at the latter site is lower than desired by World Bank Guidelines and WHO Standards, while the level at GAWPL Project site is on the higher side of the World Bank Guidelines and exceeds the WHO Standards.

Table 4.18: Ambient Air Quality at Jherruck

	SO ₂ (ppb)	NO _x (ppb)	CO (ppm)	DUST (µg /m ³)	Noise dB(A)
Average	11.4	13.5	0.9	89.4	45
max	14.7	15.9	1.5		56
Min	8.4	11.5	0.75		41

A detailed monitoring report for continuous 24 hours of each parameter along with guideline values is presented at Annexure-4.4.

Modeling for dispersion of PM₁₀, the parameter of concern to a wind farm, from the proposed GAWPL Project site finds that there would be no addition of PM₁₀ or any other pollutant into the air-shed of the wind corridor. This is because operation of the wind turbines itself will not discharge any pollutant. The wind turbines will only modify the wind speed and leave the air quality unaltered. The dispersion of the existing level of PM₁₀ and other pollutants will maintain the status of the airshed of the corridor in the unpolluted category.

NEQS requires that the 24-hour maximum average and annual mean concentration of SO₂ should be less than 50 µg/m³ and 200 µg/m³ for unpolluted category respectively. The dispersion of the small quantities of less than 50 µg/m³ primary pollutants on establishment of proposed Wind Farm in Deh Kohistan 7/1, Jhimpir, *taluka* Thatta would not alter the air quality and maintain the level of primary parameters within limits suggested by NEQS.

4.3.8 Noise

The ambient noise level recorded by SUPARCO and shown in the above Table (Detailed in Annexure) suggests that the Noise level ranged between 41 dB(A) and 54 dB(A) with the average at 45.9 dB(A), which is characteristic of wilderness and well within 70 dB(A) the level suggested by World Bank Guidelines.

Table 4.19 shows the noise level recorded by R&DC at and around the Project site during calm periods at locations not directly exposed to the wind. The highest level was observed at the Super Highway when a heavy vehicle was passing by the observation point, which was at Kohistan Hotel at a distance of 100 m from the edge of the road, as required. At all other locations the level was between 40 dB(A) and 45 dB(A).

Table 4.19: Noise Level At Different Locations Around Proposed Site

S. No.	Site	Noise Level dB(A)		
		Minimum	Maximum	Average
1	Wind Mast B1	42.0	66.5*	45.0
2	Near Mast B2	38.0	46.5	40.0
3	Near Mast B3	40.0	60.0*	45.0
4	Near Sui Gas Pipeline	38.0	45.0	40.0
5	Kohistan Hotel near Super Highway	38.0	65.0**	40.5
6	5 km from Super Highway	40.0	46.0	40.5
7	Goth Haji Walloo	35.0	76.0*	45.5
8	Goth Qasim Burfat	42.5	50.0	47.0
9	Goth Chang	38.5	55.0	45.0
10	Goth Murad Ali	40.0	55.0	45.0
11	Goth Karim Bakhsh	44.0	57.0*	48.5

*Facing Wind, **Exposed to Heavy Traffic

The general observation during the surveys at Project site was that the microenvironment of GAWPL Project site is absolutely calm with noise level ranging between 38 dB(A) and 55 dB(A). No birds were observed nor dogs were found roaming and hence the noise level was not raised due to chirping or barking respectively. The five hamlets listed in Table 4.20 are located about 1500 m to 3000 m from boundary (demarcated by coordinates in Table 3.4). There is no link road that may provide direct access to the site. The few cluster of huts 1500

to 3000 m outside the boundary of the land acquired by GAWPL have an average noise level of 45.0 to 48.5 dB(A). The noise level is raised at the site by the peak noise emission from the hissing and rustling of the wind in particular the gusts and whirl wind. Quite often the rustling of wind induced vibration of the stay wire of the masts which raised the noise level to over 70 dB(A). Noise level recorded for the different positions mentioned in the Table shows that the ambient noise level Noise level recorded for the different positions mentioned in the Table shows that the ambient noise level recorded at some distance away from Super Highway was reduced from an average 65 dB(A) to about 45 dB(A) at distances varying from 0.5 to 1.0 km.

4.3.9 Hydrology

Water Resources

In the province 24 percent of the area is irrigated by canals (95 per cent), wells (4 percent) and tube wells and other means. In Kohistan region, the water sources include wells, tube wells and ponds, and also the Nais. Due to extremely dry conditions the wells have dried up. The Harolo Nai which is close to the GAWPL Project site flows during the rains and some times overflows its banks, as it did in the year 2006. The Nai is able to retain water for some period of time after the rainy season. The soil sustains moisture for longer period to support the dry-land agriculture. When these sources of water dry up, the herders of surrounding hamlets have to walk 10 to 12 kilometers to watering points, and they were found saying during the consultation meetings that they have to migrate to irrigated areas in Jherruck.

Groundwater

In Kohistan arid region ground water quality varies from place to place. At certain places it is brakish or moderately brakish whereas at many sites ground water is sweet, and can be used for drinking. At the GAWPL Project site the wells have dried up and the only tube well in the area is not functional. Harolo Nai has, however, remained a source of sweet water and is being used by the residents of the surrounding for drinking purposes. The *nai* will, however, soon lose its storage capacity as a result of rampant sand and gravel extraction.



Figure 4.12: Water collected from Harolo Nai being delivered to villages

The existing water supply from Nooriabad is also getting limited to extraction of less than 2mgd from underground water sources. During dry spells this supply falls further down. The limited supply of 2mgd is one of the main factors for the investors being uninterested in this Industrial Estate. The drilling of further tube wells is not possible as the lowering of water table has already made few of the wells non-productive.

Wetland

There is no water body designated as wetland except Keenjhar Lake located 15 km from GAWPL wind farm, 19 km north-northeast of Thatta, and 100 km east of Karachi.

4.3.10 Flora and Fauna

Macro-Site Selection Considerations

For siting of wind farms, the Wildlife Act of 1975 makes it necessary to examine the potential of the impact of operation of the wind turbines on the bird and bat migration flyways. Wind farms sited outside these flyways are expected to have the least impact on wildlife. However, even if they are sited peripheral to major flyways, they could have demonstrable impacts on local populations, and threatened and endangered species.

Micro-Site Evaluation

Deh Kohistan 7/1, the microenvironment of GAWPL Project site does not fall within major or minor migration route, and because sufficient work has been done in this region previously^{4.17}, R&DC did not undertake site evaluation studies or multiple seasons and multi year baseline data collection. Site evaluation data collection generally include the following methodologies to measure potential wildlife mortality, displacement and disturbance:

- a. *Mobile Radar*: This technique uses mobile radar and is perhaps the most powerful tool for conducting a risk assessment as it provides data on the abundance, spatial distribution and elevation of birds. This technology is, however very costly. However, it has not been used in Pakistan.
- b. *Sound Recordings*: This low cost technology uses microphones in an array that can provide information on species composition, abundance and altitude.
- c. *Aerial Surveys*: This method is chiefly employed in determining species composition, abundance, behavior and movement patterns in an offshore environment. Aerial surveys can be used to supplement visual observations.
- d. *Visual Observations*: Qualified observers conduct surveys that provide data on abundance and behavior of birds on and around proposed sites.

R&DC employed the visual observation technique for identifying the fauna as well as flora. Local population assisted R&DC experts in a 24-hour watch on the movement and intensity of the wildlife including quadrupeds, reptiles and high flying as well as nesting birds, in addition to locating habitats, if any besides identifying the species in and around the areas where GAWPL has located the wind masts B1, B2 and B3.

Fauna

Wildlife: Wild hare, fox, jackal and honey badger were sighted during surveys by the observers. Only one burrow of a honey badger was found but there were no imprints to show that the same was being actively used by the animal. Four foxes were sighted at dusk, while a jackal was once sighted during the afternoon and was herd once in the night. The number and frequency of visits into the area is reported by the locals to have substantially reduced now. It is inferred from the frequency of visits that those spotted and reported by the locals did not seem to have their habitat in the microenvironment. They appear to have strayed in as casual visitors.

^{4.17} Mohammad Sharif Khan, Annotated Checklist of Amphibians and Reptiles of Pakistan, *Asiatic Herpetological Research*, 2004, Vol. 10, pp. 191-201

Reptiles

Reptiles are also getting rare because of aridity which has in general reduced the biodiversity of the area. The monitor lizard population in the microenvironment of GAWPL Project site is low, while that of spiny-tailed lizard is abundant. Indian Monitor lizard (*Varanus bengalensis*) Wadhi Go/Gioh (reported but not spotted), and Monitor lizard (*Varanus griseus*) were neither reported nor spotted. The spiny-tailed lizard (*Uromastix hardwickii*) Sandho/Sandha is in abundance but is protected by the locals. All sand mounds in the area have their burrows. The species are included in Appendix III of the CITES.

Other reptiles reported here include: Yellow-headed Agama (*Stellio=Agama nupta fusca*) Batth Kirro/Zard Sar Pahari Girgit (spotted during the survey), Indian Garden Lizard (*Calotes versicolor*) Wann Kirro/Rang badal Girgit, Long-tailed Desert Lacerta (*Eremias guttulata watsonana*) Wadhi Puch Kirri/Taweel dum Sandhi (reported but not spotted), Sindh Sand Gecko (*Crossobamon orientalis*) Thari Kirri/Regi Chhupkali (reported but not spotted),

Snakes

The Indian sand boa (*Eryx johani*) Bar Matti/Do Muhi (reported but not spotted); Saw-scaled Viper (*Echis carinatus*) Lundhi Bala/Jalebi Samp (reported to be quite frequent but not spotted), are common in the project area, while the Sindh two-headed snake, Indian common krait, and oxus cobra are rare. All these snakes are front-fanged. The krait, viper, and cobra are deadly but incidence of snake bite is getting low, quite likely because their population is thinning out.

Birds

The most common birds found in the macroenvironment are sparrows, robins and doves. Characteristic bird species that have adapted to the environment and are still to be found in the area, include the Indian grey partridge (*francolinus pondicertanis*), chest-nut-bellied sand grouse (*pterocles exustus*), rock dove (*Columbia livia*), Indian little button quail (*turnix sylvatica*) and Eurasian roller (*coracias garrulous*). Kites, vultures, and falcons the highflying birds were not spotted during the survey and the several visits to the area. They were reported by the locals to be only occasional visitors. Other birds found here include the Houbara bustard (*Clamydotis undulate*) Houbara Bustard (*Tetrax tetrax*) Tiloor (spotted), in IUCN Red List as low risk, near threatened; Grey Partridge (*Francolinus pondiceranus*); Indian Sand grouse (*Pterocles exustes*); Painted Sand grouse (*Pterocles indicus*); Saker Falcon (*Falco biarmicus cherrug*) (Extremely rare); Indian Griffon Vulture (*Gyps fulvus fulvescens*) (not spotted); Partridge (*Ammoperdix griseogularis*) See See Teetar/Sissi Tittar; Common Quail (*Coturnix coturnix*) Butair/Bhunrio; Eurasian Wryneck (*Jynx torquilla*) Gandam Muroor/Nando Kath-Kulho (not spotted); Sindh Woodpecker (*Dendrocopos assimilis*) Sindhi Khat-Khat/Kath Kutho (reported but not spotted); Common Hoopoe (*Upupa epops*) Hud Hud /Hud Hud (spotted); Indian Roller (*Coracias benghalensis*) Neel Kanth/Sat Rango (spotted); Asian Koel (*Eudynamys scolopacea*) Koel/Koel (spotted); Rose-ringed Parakeet (*Psittacula krameri*) Tota, Gulabi Kanth Tota/Mitthu, Chattu (reported but not spotted); Spotted Owlet (*Athene brama*) Chittidar Ullu/Nandho Chibhro (reported but not spotted); Rock Pigeon (*Columba livia*) Jhungi Kabutar (reported but not spotted); Indian Collared Dove (*Streptopelia decaocto*) Bari Fakhta Gero (spotted during survey); Common Crane (*Grus grus*) Koonj (reported but not spotted this year by locals and also not during the survey); Tawny Eagle (*Aquila rapax*) Gandoori Okab, Rigger/Par Mar (not spotted), Common Myna (*Acridotheres tristis*) Myna Ghursal/Kabbri, Myna (spotted during survey); Pale Crag-martin (*Hirundo obsolata*) Peeli Chatani Ababeel/Jabal wari Ababeel also as pithee (spotted); House Sparrow (*Passer domesticus*) Gorrea, Gharelu Chiriya/Jhirki (spotted during survey).

Mammals

Indian Pangolin (Scaly Anteater) (*Manis crassicaudata*) Safna Shikam, (reported but not spotted by locals and also not during survey) in IUCN Red List as low risk, near threatened; Jackal (*Canis aureus*) /Geedarr (spotted during survey), in IUCN Red List as low risk; Ratel (Honey Badger) (*Mellivora capensis*) Gorrrpat/Qabar Ka Bijju (abandoned burrow spotted during survey); Small Indian Mongoose (*Herpestes javanicus*) Chhota-Neula (spotted during survey); Black-naped Hare (*Lepus nigricollis dayanus*) Saho/Khargosh; Grey Spiny Mouse (*Mus saxicola*) Kandan Waro Kuo/Kharpusht Choocha (reported but not spotted).

Livestock

Local inhabitants in the microenvironment maintain stocks of cows, goats and sheep that were found grazing in the area. Livestock and ruminants include: Domestic Goat (*Capra hircus*) Bakri/Bakra; Domestic Sheep (*Ovis aries*) Bhairru/Bhairr; Domestic Cattle (*Bos taurus*) Gaon/Dhaggo, Dhaggi (male, female); Domestic Donkey (*Equus asinus*) Gadduh/Gadah,

Flora

In the case of flora also sufficient work has been reported for the Kohistan^{4.18} region previously. R&DC did, however carry out its own field observations. According to these observations, the vegetation and vegetative growth in Kohistan is constrained by aridity, typography, and relief. The stony waste or the plains of Deh Kohistan 7/1 are getting devoid of whatever natural vegetation as a result of extensive deforestation and land clearance for stone and gravel excavation. The following trees, shrubs and grasses were found during survey of the site:

Trees

Trees found in the Project macroenvironment include *Acacia nilotica* (babul) (spotted during survey, low frequency), *Acacia senegal* (khor) (spotted during survey, low frequency), *Calotropis procera* (spotted, low frequency), *Salvadora oleoides* (khabar) (dominant) and *Prosopis senegal* (kandi) (dominant but with low frequency), *Acacia arabica* (kikar) (dominant but with low frequency), *Capparis aphylla* (reported but not spotted), *Commiphora wrightii* (spotted during survey, low frequency), *Commiphora stocksiana* (spotted during survey, low frequency), *Prosopis cineraria* (spotted during survey, low frequency), *Tamarix gallica* (lai) (dominant), *tamarix aphylla* (low frequency), *Euphorbia cauducifolia*, *Lasiurus indicus* ; willo or bahan (*populus euphratica*), *Rhazya stricta* (spotted during survey, low frequency), karil (*capparis aphylla*), and siris (*acacia lebbek*) (not found during survey), *Prosopis cineraria*, *Eleusine flagellifolia*, *Salsola foetida*; *Baleria acanthoides* (spotted during survey, low frequency), *Lasiurus indicus*, *Aristida sp.* *Ziziphus nummularia* (spotted, low frequency), *Cordia gharaf* (spotted during survey, low frequency), *Grewia villosa*, *Leptodenia pyrotecneca*, *Lyssium depressum* (spotted during survey, getting scarce), *Pterophyllum oliveri* (spotted during survey, low frequency), *Tecoma undulate* (spotted during survey, (spotted during survey, low frequency)),

Grasses

The following grass species have been reported at the site but most of them were found to have succumbed to aridity compounded by overgrazing:

^{4.18} Ethnobotanical Studies Of Mahal Kohistan, Abdul Qadir Panhwar and Hidaytullah Abro, *Pak. J. Bot.*, 39(7): 2301-2315, 2007

Arisdita adscensionis, *A. Mutabilis*, *Cenchrus ciliaris*, *Cenchrus biflorus*, *Cenchrus*, *Cenchrus pennisetformis*, *Cynodon dactylan*, *Cymbopogon jawarancusa*, *Digitaria sp*, *Eleusine flagellifera*, *Lasiarus indicus*, *Saccharum spontaneum*, *Sporobolus marginantus*.

Forbs

Aerva tomentosa, *Cassia holoserica*, *Convolvulus glomeratus*, *Crotolaria bifolia*, *Fagonia cratica*, *Helotropium ophioglossum*, *Indigofera oblongifolia*, *Rynccosia minima*.

Bush

Predominant bush species found in the area include Devi, Chali, Damral and Darathi (local names). No special medicinal value is associated with these bush species by the locals.

Crops

Agricultural activities are constrained by rainfall which has been erratic as well as scant in the microenvironment. Major crops grown on the few fields outside the villages include Indian corn. No crop production was possible during the current season because there was only drizzle which could not even wet the soil.

4.3.11 Wildlife Reserves & Endangered Species

There is no Wildlife Reserve in close vicinity of Project site. Keenjhar Lake Wildlife Sanctuary is located 15 km outside of the macroenvironment. This, the largest freshwater lake in Pakistan, supports extensive reed beds and rich submerged and floating vegetation. This is also a breeding, staging area for wintering water birds. It is estimated to support as many as 140,000 birds, including European Wigeon, Black Coot and Common Pochard. The lake is a major source of drinking water for Karachi and supports an important fishery.

Houbara bustard, although a migratory bird, is one of the endangered species found in the area. Falcons are rarely spotted in the area and were also not spotted during these surveys.

The above list of birds and mammals might give an impression that the area is rich in biodiversity. This is not correct. It has been noted in parenthesis that the animals have been reported by the locals but they were not spotted during the surveys. As such it needs to be stressed that the land has lost or is fast losing its wildlife resources.

The spiny-tailed lizard (*Uromastix hardwickii*) Sandho/Sandha is in abundance in the microenvironment but it is protected by the locals. All sand mounds in the area have the Sandha burrows. The two species: Uromastix and monitor lizard are included in Appendix III of the CITES.

4.4 Socio-economic Aspects

Deh Kohistan 7/1 where the GAWPL Project site is located is in the under developed areas of Thatta, which itself has been shown earlier to be an under developed District of Sindh. The concerned area being dissociated from development activities that may be going on in other parts of the Province, wears the look of impoverishment. It also does not have resources of its own so as to add value and improve the quality of life of its people. The people in the area have resorted to activities detrimental to the ecosystem and thus the process of environmental degradation has been going on unabated.

There is no household or living abode within the area demarcated by the coordinates given in Table 3.6. The surrounding has 5 clusters of settlements (hamlets) all located outside the area sub-leased to GAWPL, in Deh Kohistan 7/1 at 9 km off Super Highway M-9. None of them has safe drinking water, sanitation facilities near home; none of them has been provided electricity or natural gas. They cut trees and sell them to consumers in urban centres and remove the shrubs to use them for fuel. They excavate limestone and rocks and transport the crushed to size stones for construction of roads and houses but they themselves have dirt roads for transportation of firewood and sand/gravel/stone and live in huts.

4.4.1 Population

There are 5 villages in the area surrounding the Project site. There is no living area within the Project area demarcated by the coordinates given in Table 3.6. The villages have been described in Table 4.20 with respect to number of households, population and source of livelihood.

Table 4.20: Villages in Proximity of GAWPL Site

Name of Village	Distance from GAWPL	Households		Population	Source of Income
		Total	Pucca		
Haji Walloo	1.5	10	1	80	Agriculture Livestock, Labor*
Haji Lakhano	1.2	15	1	110	Agriculture Livestock, Labor
Jan Mohammad Jakhra	2.5	6	0	45	Agriculture Livestock, Labor
Murad Ali Chang	1.2	15	5	100	Agriculture Livestock, Labor
Karim Bakhsh Khaskheli	2.5	10	0	95	Agriculture Livestock, Labor

*Labor represents quarrying, stone crushing, sand/gravel collection/transportation, odd jobs

4.4.2 Ethnic Groups

The following ethnic groups/communities live in the villages of the GAWPL Project microenvironment. The Jakhras and Khaskheli form the majority community.

- Jhakro
- Khaskheli
- Brohi

4.4.3 Infrastructure Facilities Available in Villages

The following Table shows that the infrastructure facilities available in the villages are inadequate. One tube well was bored here earlier but the same is closed down and is no longer functional. The primary school buildings are lying vacant waiting for regular appointment of teachers.

Table 4.21: Infrastructure Facilities Available in Villages

Villages	Primary School		Middle School	High School	Dispensary	Water Supply		Electricity
	Boys	Girls				Tanker	Cart	
Haji Walloo =	-	-	-	-	-	√		-

Lakhana	√	-	-	-	-	√	-	-
Jan Mohammad		-	-	-	-	√	-	-
Murad Ali Chang	√	-	-	-	-	√	-	-
Karim Bakhsh Khaskheli =	-	-	-	-	-	√		-
* Water supply is through tanker service to a tank in village or by delivery by donkey cart								

4.4.4 Drinking water

There is an acute shortage of safe drinking water in all the villages. Ground water level is too deep at ~200 ft. One tubewell about 3 km from Kohistan Hotel remains abandoned. The residents get water through tanker service which collects it from Nooriabad and delivers into a tank outside one or two villages from where each household has to purchase his share. Jan Mohammad Jakhra and Karim Bakhsh Khaskheli Goths get their drinking water from the ponds on the Harolo Nai bed while all others around GAWPL depend on the tanker supply from Nooriabad. There is no regular water supply scheme in the villages of the project area.

Water supplied by the tankers is of poor quality and as shown in Annexure 4.5 is not of desired quality for human consumption, while that from Harolo Nai are surprisingly fit for human consumption, as shown by the analytical data in Annexure 4.6.

4.4.5 Transportation

The Super Highway M-9 runs about 9 km from the Project site. A dirt road taking off from Super Highway M-9 at 55 km to Hyderabad provides access to the Project site. The dirt road will be improved to heavy vehicle worthiness so that the large and heavy trucks carrying steel towers, turbines and equipment could be transported to site.

The Superhighway from Karachi to Hyderabad is a four track dual carriageway with asphalt surface. The railway from Karachi to Hyderabad is at 9 kilometers direct distance to Jhimpir Railway Station in the northwest. Indus River does not cater to the needs of transportation.

The villagers often go to Jungshahi, Nooriabad and Kotri, which are 15 km, 10 km and 35 km away. They use the trucks and trailers that transport sand and gravel to reach Super Highway. They take a bus or van from there and pay Rs 50 fare per journey and Rs 100 for return journey to local transportersto reach Kotri. In case of emergency they have to hire a Datsun truck and pay Rs 1000 to reach the nearest clinic.

4.4.6 Power Supply

There is a state power grid at Nooriabad. There is a 132kV regional substation of WAPDA near Jhimpir town. The voltage in the state grid is low and in poor condition, frequently suffering from power restriction or instant power breakdown.

4.4.7 Diseases

Water borne diseases are common in the villages using the tanker supply. Incidence of following diseases is reported from villages in the surrounding of Project site.

- Water borne diseases
- Malaria
- Cough
- Skin Diseases
- Typhoid
- Hepatitis

- Tuberculosis

Two cases of hepatitis have been reported from villages using water supplied by tankers. Only one case of TB has so far been reported from among the area population.

4.4.8 Health Facilities

The healthcare services are simply not available in the villages around the Project area. The people are compelled to go to Jhimpir, Battis Mahal, or Nooriabad at distances of 10 to 15 km for general ailments and to Kotri, Jamshoro or Hyderabad, at a distance of 30-40 kms for treatment of major diseases. Cost of treatment is unbearable to the people particularly because of travel, fee that has to be paid to the doctor, and medicine that has to be purchased. The cost of treatment takes away at least Rs 2500 to 4000 each time a person falls seriously sick. Hiring a Datsun truck for transporting the patient, costs over Rs 1000. This being equivalent to ten days earning of the family, adds to their debt burden. The situation is worse for the females who have to be taken to Mother and Child Health Centre for delivery and child care and that takes away a few thousand for each delivery, and subsequent child care. People pay the high cost by borrowing and that adds to their debt burden.

4.4.9 Literacy Rate and Education Facilities

There are two primary school buildings for boys in the five villages surveyed for this study. However, none of them is functional. It is reported that teachers have been appointed for the non-functional schools but the system being too inadequately organized, the staff did not turn up. The buildings are being used by the village hierarchy as *autaq*. Under the circumstances the school going children remain in Jherruck where the families have their second home.

Male literacy ratio is less than 10% and female literacy is almost nothing. Only few persons can speak Urdu, the National language and very few can read the Holy Quran. Things have started to change with the emergence of new leadership which has started setting up mosques and madressas in the area of influence.

4.4.10 Professional Affiliations

The people in the project area are engaged in low level occupation, with the members of the nuclear family engaged in farming, raising livestock, excavating rocks and crushing, collecting sand and gravel at and from the river bed. Two or three persons from each village assume the management responsibility and assign different roles to different members of the family and to the families in other villages, if necessary. The persons in the management hierarchy are responsible to the Sardar of the area. The following Table gives the weightage rather than percentage of different roles.

Table 4.22: Professional Affiliations of Project Area Population		
S.No.	Profession	Weightage
1	Management	5
2	Farming	50
3	Wood cutting/Quarry Labor (stone cutting), Sand/Gravel collection & Transportation	70
4	Livestock farming	25
5	Industrial Labour	5

Labor Type

The people both males and females are engaged in the following types of labor:

- Quarrying
- Wood collection
- Farming
- Stone excavation, gravel collection
- Water sale by donkey-cart

4.4.11 Source of Livelihood

The project is located in the arid stony waste land which receives no rains. However, occasional torrential rains bring some surface flow which is diverted through channels into dyked ponds called bandat. People grow maize and fodder for livestock. They collect fuel wood for household consumption and sale to the urban clusters in the Province and to the market. People own land varying in size from 2 to 5 acres.

The village folks own livestock. Every village has 35 to 60 animals including goats and cows but not many sheep. When natural vegetation dries up and it is costly to buy green or dry fodder for animals from the town, the people move their livestock and animals to Jherruck where the Kalri-Baghar Feeder provides sufficient moisture for vegetation to grow. The people are used to this type of living since according to their elders (two of them are 90-100) they were homeless migrant herders. They had settled here after the great floods of 1844 caused by 400mm rainfall in 24 hours (Author's archives).

Residents of Deh Kohistan hardly get job in industries located in Nooriabad or Kotri SITE area which are only 10 to 35 kms away mostly because they are not skilled and opportunities for unskilled labour are very few.

The only source of livelihood for the people is keeping livestock which provides them milk every day and brings them their bonus every year just before Eidul Azha. The other source of income is quarrying, stone cutting, gravel and sand collection for use in building construction in Hyderabad city. Male members go early in the morning to the river bed and/or hilly areas near their villages and start excavating stone and collecting gravel. Other family members follow them subsequently to help in collection, piling and loading. The stones are sold on a per truck basis and purchased by the building contractors. Women, married or unmarried and children of working age are all engaged along with the elders in stone cutting and do the same labour as males do. The family labor gets about Rs 1200 per truck in two days which puts the family earning at an average of Rs 600 per day.

Low literacy rate is a major constraint to their employment in government offices or in teaching. Thus the villagers have no worthwhile sources for livelihood that may bring them reasonable income to get reasonable quality of food and other necessities. Self-employment being the way of life, the entire family in the villages around the proposed GAWPL Project site remains in chronic poverty.

Crop & Livestock Production

It is difficult to grow main crops because of aridity and largely sandy soil. Maize is the main crop that suits the rainfed area and the same is used for fodder.

Livestock Rearing

Live stock is an important source of income of the people. About 35% people are involved in rearing livestock. The people mostly own cows, goats, and sheep. Buffalos were not seen during the surveys or visits to the area.

Food & Nutrition

The people mostly eat two times a day. They do not take three meals and often skip lunch. They generally eat bread with lassi (water yogurt), tea, lentils and potato. Being a nuclear family no one starves. Food may not be in plenty but people try to live within their means. This may be the reason that the people of these villages do not look malnourished.

Monthly household income and expenditure

The survey showed that the average monthly household income is Rs. 5,000 to 7000, while the expenditure is Rs. 7,000 to 10,000. The gap between monthly expenditure and income is met by borrowing, and not by reduction in food or stimulant consumption, or less attention to the sick.

Indebtedness

Most of the families are indebted in the range of Rs. 20,000 to Rs. 50,000 yearly. They borrow money for household consumption from *banyas* in Jhimpir and Thano Bola Khan and repay the loan by selling livestock at the time of Eidul Azha.

4.4.12 Land Degradation, Desertification & Poverty Nexus

In and around Deh Kohistan, desertification has caused widespread degradation of the ecosystem to support the quest for urban development and not so much the growing population. Aridity in the ecosystem compounded by deflation by wind as a common natural process in the GAWPL Project macroenvironment has deflated the surface of the soils by several centimeters. The much too common gravel covered surfaces occurring throughout the the stony wastes of Deh Kohistan are evidence of high contemporary rates of wind erosion. The elevated mounds of fine sand that occur around shrubs on the Plains Unit (Fig.) provide evidence that it has been deflated by wind blown sand during the life of the plants and aggravated the process of desertification thus contributing to environmental crises, such as loss of flora, fauna, biodiversity and productivity of the ecosystems. In general, the quest for enhanced productivity in urban centres has intensified exploitation and has carried disturbance by man into less productive and more fragile lands.

Over exploitation of the meager resources has given rise to degradation of soil, water and vegetation. These three elements of the natural ecosystem serve as the natural foundation for human existence. In the fragile ecosystem at Deh Kohistan, the loss of biological productivity through impoverishment of plant, animal, soil and water resources has become irreversible, and has permanently reduced its capacity to support human life.

Impoverishment of resources leading to environmental degradation is both a cause and a consequence of rural poverty. Therefore, impoverishment of resources leads to desertification which in turn leads to poverty, and the vicious circle completes when poverty leads to further desertification.

Poverty

Level of poverty is increasing because of frequent droughts occurring in this arid zone of Sindh. The trend, of uprooting shrubs, cutting trees for fuel wood, over grazing due to over stocking, and sand /gravel removal from the river beds, is increasing. If the current trend

continues, the already exhausted rangelands will not be in a position to support the existing level of livestock population of this arid region. The economic impact of such a situation has had direct effect on the population here and is likely to increase the level of poverty amongst the herders of this area of Deh Kohistan.

Such continuous and uninterrupted degradation of natural resources is pushing the ever growing population for its livelihood to migration to urban centres, which are not prepared to absorb it. The migration of the rural population to the urban areas has amassed the urban areas with social problems by increasing slums around the cities. This situation has created law and order problem in the cities. Because of increasing poverty and lack of basic amenities the most vulnerable sections of population like the children and women are being affected and will be badly affected in the next few years.

Although formal area poverty profile has not been prepared for Lower Sindh including Thatta, secondary data generated by the project preparatory technical assistance (PPTA) showed that 54% are among the “poorest” category and 79% may be characterized as poor. In a 2004 national survey Pakistan’s poorest district was Thatta, and Badin was not far behind.

Family income of Rs 5 to 7 thousand, arrived at by this study, already suggests that almost 90% of the families live below the poverty line. All members of the family have to contribute to sustain their subsistence living. Poverty has mostly been caused by the following factors:

- Scarcity of water
- Recurring drought
- Low return from crop and livestock farming
- Low wages from stone cutting
- Low literacy rate
- Lack of training
- High population growth
- Lack of access to employment in industrial area
- Increasing unemployment
- High cost of healthcare

Unemployment

According to the community members, more than 60% people with age between 15 and 45 years are under-employed if not unemployed due to limited opportunities available to them.

Out-Migration

Non-availability of opportunities and recurring drought has induced the tendency among the youngsters in far flung rural areas to out-migrate to Karachi, Kotri and Hyderabad for employment. Such tendency does not appear to have developed so far in Deh Kohistan since the village elders and leaders are working hard for improvement of quality of life in the area. The latter see the GAWPL Project as an opportunity.

In- Migration

There is no in-migration to the area because of

- Low socio-economic profile of the area
- Intolerant attitude of the society that does not encourage in-migration

4.4.13 Gender Issues

In individual interview and focus group discussions, women identified the following issues:

- Need for a dispensary and Mother and Child Healthcare Centre for Deh Kohistan
- Awareness on education
- Access to vocational training centre for women to earn through working at home
- Establishment of industrial home type of institution for production of hand made goods
- Gender discrimination
- Compulsion to engagement in stone cutting to supplement their family income
- Fetching water from long distances, some times more than once
- Malnourishment.

4.4.14 Community Expectations from GAWPL

All respondents i.e. males as well as females expect the following from the proposed project:

- Safe drinking water**
- Job Opportunity*
- Healthcare centers particularly for women and children**
- Schools*
- Vocational training
- Black top link roads*
- Poverty alleviation schemes*
- Land development for suitable crops
- Protection from drought
- New income generating opportunities like small business, and supply of goods and services to the company and people working for the wind farm

** Highest Priority

*High Priority

The resident population was confident that the proposed wind power project would change their lifestyle and they will enjoy better quality of life and their young and future generation will not live in poverty, if the company is committed to develop the villages and provide them job opportunities.

4.4.15 Archaeological and Historical Record

No archaeological site has been identified / seen within or around the limits demarcated for the GAWPL Project during the site visits and surveys.

4.4.16 Employment Opportunities in Macroenvironment & GAWPL

Macroenvironment of GAWPL Project site has no factory or prominent industrial unit located within 10 Km from the site. Moreover the 5 villages do not have skilled labour of the sort that is needed for industrial units. However, the skilled labourers of the category comprising drivers, mechanics, welders, plumbers and electricians, if available will be offered employment in the forthcoming construction and operation phase of the Wind Power Production Unit. The construction phase of GAWPL Wind Power Generation Complex will generate approximately 600 new jobs during construction/erection and installation phase and about 30 new jobs after coming into operation.

Annexure 4.1

Places of Archeological, Historical & Religious Significance in District Thatta

1. Brick dome to the north-east of tomb of Mubarak Khan (tomb of Fateh Khan's sister) Makli Hill, Thatta.
2. Tomb of Mubarak Khan son of Jam Nizamuddin, Makli Hill Thatta.
3. Tomb and compound wall of yellow stone to the south of Jam Nizamuddin, Makli Hill, Thatta.
4. Tomb and enclosure to the south-west of S. No. 92. Makli Hill, Thatta.
5. Tomb and enclosure to the west of the above tomb S. No. 93, Makli Hill, Thatta.
6. Brick dome to the south of the tomb S. No 94, above Makli Hill, Thatta.
7. Sultan Ibrahim and other tombs also but wrongly known Amir Khalil Khan's tomb, Makli Hill, Thatta.
8. Tomb and compound wall of yellow stone to the south of Mirza Muhammad Baqi Tarkhan tomb (wrongly called Mirza Isa Khan's tomb), Makli Hill, Thatta.
9. Brick enclosure of Mirza Baqi Baig Uzbek's tomb, south of the tomb of Nawab Isa Khan the younger, Makli Hill, Thatta.
10. Dabgir Masjid, Makli Hill, Thatta.
11. Graveyard, Makli Hill, Thatta.
12. Goth Raja Malik graveyard known as Maqam Qadar Shah, Deh Raja Malik, Thatta.
13. Sonda graveyard, village Sonda, Thatta.
14. Jam Nizamuddin's tomb, Makli Hill, Thatta.
15. Baradari, Makli Hill, Thatta.
16. Tomb of Amir Sultan Muhammad son of Amir Hajika, Makli hill, Thatta.
17. Tomb of Nawab Isa Khan, the younger Makli Hill, Thatta.
18. Mirza Tughral Baig's tomb, Makli Hill, Thatta.
19. Tomb of Mirza Jani and Mirza Ghazi Baig, Makli Hill, Thatta.
20. Stone enclosure containing tombs of Nawab Isa Khan, Makli Hill, Thatta.
21. Mirza Muhammad Baqi Tarkhan's tomb (wrongly called Mirza Isa Khan's tomb) Makli Hill, Thatta.
22. Stone tomb with a dome on stone pillars by the side Mirza Jani Baig's tomb, Makli Hill Thatta.
23. Brick masjid and enclosure near Nawab Shurfa Khan's tomb (supposed to be the tomb of Sayyed Amir Khan), Makli Hill, Thatta.
24. Stone tomb with enclosure to the south of tomb of Mirza Muhammad Baqi Tarkhan, Makli Hill, Thatta.
25. Tomb of Mirza Muhammad Isa Turkhan I, Makli Hill, Thatta.
26. Brick tomb near the tomb of Qulia pir, Makli Hill, Thatta.
27. Tomb with superstructure on stone pillars to the north of tomb of Jam Nizamuddin, Makli Hill, Thatta.
28. Brick structure to the north of tomb of Jam Nizamuddin, Makli Hill, Thatta.
29. Two pavilions on stone pillars over the tombs to the southwest of tomb of Jam Nizamuddin. One is the tomb of Jam Sikandar Shah, Makli Hill, Thatta.
30. Kalan Kot, Makli Hill, Thatta.
31. Nawab Amir Khan's mosque, Makli Hill, Thatta.
32. Building with two domes near the Civil Hospital, Thatta, Makli Hill, Thatta.
33. Jama Masjid, Makli Hill, Thatta.
34. Sasian-Jo-Takar (Mirpur Sakro, Thatta.
35. Jama Masjid, Thatta.

World Heritage Monuments on UNESCO List

Makli Hill, Thatta.

Source: Guidelines for Sensitive and Critical Areas. Government of Pakistan. 1997.

Annexure 4.2

LIST OF MAIN SHRINES IN DISTRICT THATTA

Thatta District

- Haji Turabi, Gujjo Village, National Highway
- Mai Makli, Makli
- Abdullah Shah Sahabi, Makli
- Pir Patho Debali, Pir Patho Village
- Shah Jamil Datar Girnari, Pir Patho Village
- Shah Inayat, Miranpur near Pir Patho Village
- Shah Murad Shah Sherazi, Makli
- Makhdoom Mohammad Hashim Thatvi, Makli
- Hazrat Magar Been, Village Jati
- Shah Aqeeq, Taluka Shah Bunder

ANNEXURE 4.3

GOVERNMENT HOSPITALS, DISPENSARIES, RURAL HEALTH CENTRES, T.B CLINICS AND BASIC HEALTH UNITS WITH THEIR BED CAPACITY IN SINDH, 1996 TO 2000					
ITEMS	1996	1997	1998	1999	2000
HOSPITALS					
General & Teaching	7	7	7	7	7
Civil, Specilized, Taluka & Others	78	78	78	79	79
HOSPITAL BED					
General & Teaching	5,018	5,018	5,116	5,128	5,330
Civil, Specialized, Taluka & Others	5,080	5,036	5,059	5,212	5,414
DISPENSARIES					
Numbers	147	157	182	208	221
Beds	12	10	6	6	6
RURAL HEALTH CENTRES					
Numbers	84	89	90	90	92
Beds	1,262	1,304	1,324	1,324	1,364
T.B CLINICS					
Numbers	159	166	167	167	169
BASIC HEALTH UNITS					
Numbers	644	658	672	687	701
Beds	1,341	1,368	1,392	1,422	1,450
Source:- Directorate General of Health Services Hyderabad.					

PATIENTS TREATED IN GOVERNMENT HOSPITALS, DISPENSARIES, RURAL HEALTH CENTRES AND BASIC HEALTH UNITS BY DISTRICT IN SINDH (1999)					
Hospitals			Dispensaries	Rural Health Centres	Basic Health Units
Province/Division/District	Indoor Patients	Outdoor Patients	Total Patients	Total Patients	Total Patients
SINDH	284,520	6,888,831	1,073,382	1,652,340	2,775,944
Thatta	12,965	198,133	31,405	93,421	185,064
Source:- Directorate General of Health Services, Hyderabad.					

Annexure 4.4

Ambient Air Quality and Noise Level at GAWPL Mast B2

DATE	TIME	SO ₂ (ppb)	NO _x (ppb)	CO (ppm)	DUST (µg/m ³)	Noise (dB)
9/3/2009	12:00	12.6	15.3	1.6	142.0	46
9/3/2009	12:15	12.5	15.6	1.2	146.0	42
9/3/2009	12:30	12.3	15.4	1.5	147.0	45
9/3/2009	12:45	12.4	15.0	1.3	145.0	47
9/3/2009	13:00	13.6	15.2	1.4	142.0	45
9/3/2009	13:15	12.5	15.3	1.2	148.0	48
9/3/2009	13:30	12.3	15.4	1.5	145.0	45
9/3/2009	13:45	12.1	15.6	1.6	147.0	47
9/3/2009	14:00	12.3	15.2	1.2	142.0	46
9/3/2009	14:15	12.8	16.3	1.8	145.0	45
9/3/2009	14:30	12.4	15.9	1.3	142.0	42
9/3/2009	14:45	12.3	15.4	1.2	147.0	48
9/3/2009	15:00	12.5	15.3	1.5	145.0	47
9/3/2009	15:15	12.3	15.2	1.4	144.0	45
9/3/2009	15:30	12.4	15.1	1.2	146.0	41
9/3/2009	15:45	12.6	14.9	1.2	114.0	45
9/3/2009	16:00	12.5	14.6	1.3	152.0	45
9/3/2009	16:15	12.3	14.7	1.2	145.0	47
9/3/2009	16:30	12.1	14.5	1.2	145.0	45
9/3/2009	16:45	11.9	14.3	1.3	145.0	48
9/3/2009	17:00	11.3	14.1	1.2	142.0	47
9/3/2009	17:15	11.2	13.9	1.3	163.0	45
9/3/2009	17:30	11.6	13.5	1.2	154.0	41
9/3/2009	17:45	11.4	13.4	1.2	144.0	45
9/3/2009	18:00	11.2	13.6	1.3	125.0	41
9/3/2009	18:15	11.3	13.1	1.2	145.0	45
9/3/2009	18:30	11.1	13.6	1.3	142.0	47
9/3/2009	18:45	10.0	12.9	1.2	136.0	45
9/3/2009	19:00	10.6	12.9	1.3	125.0	47
9/3/2009	19:15	10.2	12.8	1.9	145.0	45
9/3/2009	19:30	10.3	12.6	1.2	152.0	47
9/3/2009	19:45	10.2	12.8	1.1	154.0	45
9/3/2009	20:00	10.3	12.6	1.2	125.0	47
9/3/2009	20:15	10.6	12.5	1.1	141.0	45
9/3/2009	20:30	10.2	12.4	1.2	163.0	47
9/3/2009	20:45	10.3	12.6	1.1	125.0	45
9/3/2009	21:00	10.4	12.6	1.3	144.0	47
9/3/2009	21:15	10.5	12.8	1.2	145.0	45
9/3/2009	21:30	10.3	12.4	1.3	147.0	47
9/3/2009	21:45	10.1	12.3	1.2	145.0	45
9/3/2009	22:00	9.9	12.1	1.2	142.0	48
9/3/2009	22:15	9.7	11.3	1.3	152.0	47
9/3/2009	22:30	9.6	11.6	1.2	158.0	45
9/3/2009	22:45	9.6	11.8	1.1	154.0	47

Initial Environmental Examination Of 50 Mw GAWPL-WPGC At Deh Kohistan Thatta

9/3/2009	23:00	9.3	11.6	1.2	152.0	45
9/3/2009	23:15	9.5	11.4	1.2	154.0	47
9/3/2009	23:30	9.4	11.2	1.3	147.0	45
9/3/2009	23:45	9.3	11.3	1.2	145.0	48
10/3/2009	0:00	9.5	11.2	1.3	142.0	47
10/3/2009	0:15	9.3	11.3	1.2	152.0	45
10/3/2009	0:30	9.4	11.1	1.3	147.0	47
10/3/2009	0:45	9.5	10.9	1.2	145.0	45
10/3/2009	1:00	9.3	10.8	1.3	142.0	47
10/3/2009	1:15	9.5	10.6	1.2	142.0	45
10/3/2009	1:30	9.7	10.5	1.3	155.0	47
10/3/2009	1:45	9.3	10.8	1.2	145.0	48
10/3/2009	2:00	9.2	10.4	1.1	142.0	45
10/3/2009	2:15	9.2	10.3	1.0	145.0	47
10/3/2009	2:30	8.9	10.5	0.9	144.0	45
10/3/2009	2:45	8.5	10.2	0.9	142.0	47
10/3/2009	3:00	8.4	10.6	0.9	145.0	45
10/3/2009	3:15	8.6	10.7	0.9	147.0	47
10/3/2009	3:30	8.6	10.5	0.8	145.0	45
10/3/2009	3:45	8.5	10.2	0.9	142.0	48
10/3/2009	4:00	8.3	10.1	0.8	144.0	47
10/3/2009	4:15	8.2	9.9	0.9	145.0	45
10/3/2009	4:30	8.1	9.8	0.9	143.0	47
10/3/2009	4:45	7.9	9.9	0.8	140.0	45
10/3/2009	5:00	7.8	9.7	0.9	139.0	47
10/3/2009	5:15	7.8	9.8	0.9	135.0	45
10/3/2009	5:30	7.3	9.6	0.8	135.0	48
10/3/2009	5:45	7.3	9.8	0.9	132.0	47
10/3/2009	6:00	7.5	9.5	0.8	136.0	45
10/3/2009	6:15	7.2	9.6	0.9	135.0	47
10/3/2009	6:30	7.1	9.5	0.8	132.0	45
10/3/2009	6:45	7.1	9.1	0.9	135.0	48
10/3/2009	7:00	7.0	9.2	0.8	136.0	47
10/3/2009	7:15	7.3	9.3	0.9	134.0	45
10/3/2009	7:30	7.5	9.2	1.0	132.0	47
10/3/2009	7:45	7.4	9.2	1.2	132.0	45
10/3/2009	8:00	7.3	8.9	1.3	136.0	47
10/3/2009	8:15	7.2	8.9	1.2	135.0	45
10/3/2009	8:30	7.6	8.7	1.6	132.0	45
10/3/2009	8:45	7.2	8.6	1.2	136.0	45
10/3/2009	9:00	7.1	8.5	1.3	134.0	48
10/3/2009	9:15	7.3	8.9	1.2	132.0	47
10/3/2009	9:30	7.2	8.7	0.2	136.0	45
10/3/2009	9:45	7.6	8.6	1.2	135.0	47
10/3/2009	10:00	7.5	8.2	1.2	132.0	45
10/3/2009	10:15	7.3	8.6	1.2	136.0	47
10/3/2009	10:30	7.1	8.5	1.3	134.0	45
10/3/2009	10:45	7.3	8.9	1.2	132.0	47

10/3/2009	11:00	7.3	9.1	1.1	136.0	45
10/3/2009	11:15	7.9	9.3	1.2	135.0	47
10/3/2009	11:30	7.9	9.5	1.2	132.0	45
10/3/2009	11:45	8.6	9.4	1.1	136.0	47
10/3/2009	12:00	8.5	9.6	1.3	139.0	45
10/3/2009	12:15	8.4	9.2	1.2	135.0	47
10/3/2009	12:30	9.3	9.8	1.2	132.0	45
10/3/2009	12:45	9.7	10.6	1.3	136.0	47
10/3/2009	13:00	9.8	10.5	1.2	135.0	45
10/3/2009	13:15	9.7	10.9	1.1	132.0	47
10/3/2009	13:30	10.3	11.2	1.2	136.0	44
10/3/2009	13:45	10.6	11.3	1.3	134.0	44
10/3/2009	14:00	10.2	11.4	1.1	136.0	54
10/3/2009	14:15	10.6	11.3	1.2	132.0	45
10/3/2009	14:30	11.2	11.2	1.3	135.0	47
10/3/2009	14:45	11.3	11.6	1.1	136.0	45
10/3/2009	15:00	11.2	11.1	1.2	138.0	47
10/3/2009	15:15	11.5	11.0	1.1	134.0	45
10/3/2009	15:30	11.2	11.5	1.2	136.0	47
10/3/2009	15:45	11.3	11.9	1.3	132.0	45
10/3/2009	16:00	11.6	11.2	1.2	136.0	47
Average		9.7	11.6	1.2	140.6	45.9
Maximum		13.6	16.3	1.9	163.0	54.0
Minimum		7.0	8.2	0.2	114.0	41.0

Annexure 4. 5

ANALYTICAL TEST REPORT**Sample ID.:** Water SampleSample Description: **NOORIABAD BORING WATER**

Analytes Description: Mentioned below parameters

Sr #	Parameters/ Analytes Description	* WHO Limits	Units	Results
1	pH Value	6.5 - 8.5	SU	7.99
2	Total Dissolved Solids (TDS)	1000.0	mg/L	1074.83
3	Sodium (Na ⁺)	200.0	mg/L	234.39
4	Potassium (K ⁺)	10 - 12	mg/L	18.24
5	Calcium (Ca ⁺²)	200.0	mg/L	53.79
6	Magnesium (Mg ⁺²)	125.0	mg/L	37.83
7	Chloride (Cl ⁻)	250.0	mg/L	396.06
8	Bicarbonates (HCO ₃ ⁻)	150 - 200	mg/L	173.00
9	Sulphate (SO ₄ ⁻²)	250.0	mg/L	138.0
10	Nitrate (NO ₃ ⁻)	50.0	mg/L	13.84
11	Total Plate Count @ 37 °C/ 24 hrs.	< 20 colony/ml	cfu	TNTC
12	Total Plate Count @ 22 °C/ 48 hrs.	< 100 colony/ml	cfu	TNTC
13	Feacal Coliform @ 44 °C/24 hrs.	0 colony/100 ml	cfu	TNTC
14	Total Coliform @ 37 °C/48 hrs.	0 colony/100 ml	cfu	> 350
15	Total Coliform @ 37 °C/48 hrs.	0 colony/100 ml	cfu	> 350
16	Feceal Streptococci @ 35-37 °C for 24 hrs	0/250ml	cfu	>200
17	Escherichia Coli (E. Coli) @35-37 °C for 24 hrs	0/250ml	cfu	TNTC
18	Salmonellae species @35-37 °C for 24 hrs	NA	cfu	+ve
19	Shigella species @35-37 °C for 24 hrs	NA	cfu	+ve

* WHO & EC= World Health Organization Geneva 2004, and European Communities Council Directive 98/83/EC 3rd November 1998.

SU = Standard Unit, cfu = colony forming unit, N.S = Standard not available

Annexure 4. 6

ANALYTICAL TEST REPORT**Sample ID.:** Water SampleSample Description: Harolo Nai (Rodh Nadi) **Subsurface Water**

Analytes Description: Mentioned below parameters

Sr #	Parameters/ Analytes Description	* WHO Limits	Units	Results
1	pH Value	6.5 - 8.5	SU	7.72
2	Total Dissolved Solids (TDS)	1000.0	mg/L	182.37
3	Sodium (Na ⁺)	200.0	mg/L	17.96
4	Potassium (K ⁺)	10 - 12	mg/L	9.07
5	Calcium (Ca ⁺²)	200.0	mg/L	16.82
6	Magnesium (Mg ⁺²)	125.0	mg/L	11.27
7	Chloride (Cl ⁻)	250.0	mg/L	41.83
8	Bicarbonates (HCO ₃ ⁻)	150 - 200	mg/L	48.75
9	Sulphate (SO ₄ ⁻²)	250.0	mg/L	34.0
10	Nitrate (NO ₃ ⁻)	50.0	mg/L	1.60
11	Total Plate Count @ 37 °C/ 24 hrs.	< 20 colony/ml	cfu	- ve
12	Total Plate Count @ 22 °C/ 48 hrs.	< 100 colony/ml	cfu	- ve
13	Feecal Coliform @ 44 °C/24 hrs.	0 colony/100 ml	cfu	- ve
14	Total Coliform @ 37 °C/48 hrs.	0 colony/100 ml	cfu	- ve
15	Total Coliform @ 37 °C/48 hrs.	0 colony/100 ml	cfu	- ve
16	Feceal Streptococci @ 35-37 °C for 24 hrs	0/250ml	cfu	- ve
17	Escherichia Coli (E. Coli) @35-37 °C for 24 hrs	0/250ml	cfu	- ve
18	Salmonellae species @35-37 °C for 24 hrs	NA	cfu	- ve
19	Shigella species @35-37 °C for 24 hrs	NA	cfu	- ve

* WHO & EC= World Health Organization Geneva 2004, and European Communities Council Directive 98/83/EC 3rd November 1998.

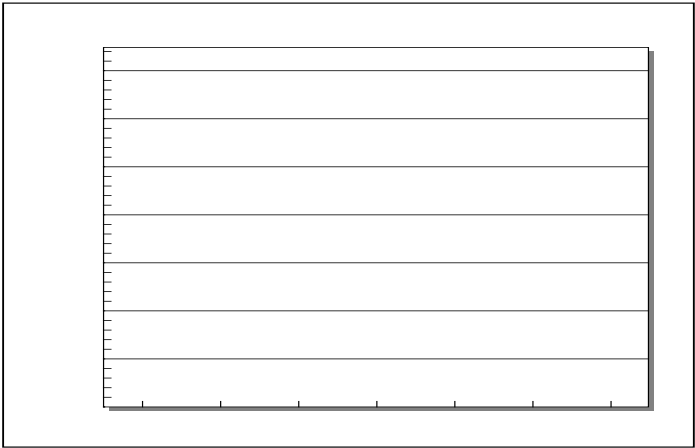
SU = Standard Unit, cfu = colony forming unit, N.S = Standard not available

Annexure 4.7
Wind Rose for GAWPL Site

WIND ROSE PLOT: Nooriabade Met One (B-5)	COMMENTS:
	COMPANY NAME: Research & Development Consultants (R&DC)
	MODELER:
	DATE: 5/2/2009
	PROJECT NO.: 01

WRPLOT View - Lakes Environmental Software

Annexure 4.8
Wind Class Frequency Distribution at GAWPL Site



CHAPTER 5

5.0 SCREENING OF POTENTIAL ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

This Chapter presents the screening of potential environmental and social impacts of different activities of GAWPL Project during its different stages of designing, construction and operation. Using the general guidelines as well as professional judgment it evaluates the positive and negative impact of emissions and waste discharges on the aesthetics, airshed, watershed, fauna, flora and the living environment at Deh Kohistan 7/1. The screening process, besides identifying significant environmental impacts and the existence of residual impact suggests mitigation measures that may have to be adopted in order to reduce, minimize or compensate for the impact.

5.1 SCREENING OF ALTERNATIVES

The GAWPL Project aims at harnessing wind energy the renewable energy source potential in the Jhimpir Wind Corridor in Deh Kohistan as an alternative to the conventional system that depends on fossil fuel, and thus meet the shortfall in the current energy production system. The alternatives available are

1. No Action, continuation with the existing condition
2. No renewable energy alternative; No New system alternative that involves renewable energy but continuation with the use of fossil fuel, and
3. Harnessing Wind Energy Potential of the Jhimpir Wind Corridor at Deh Kohistan

Selection of Preferred Alternative Site

Selection of the preferred alternative system and site for establishment of wind farm needs to be based on:

- (a) Current status of energy production system,
- (b) Strategic needs of energy production, conservation and environmental protection,
- (c) Urgent need to provide better level of service in power production to meet the current and future demand.

No Action Alternative

The “No Action Alternative” does not offer the advantages sought by the Alternative Energy Development Project. It does not respond to:

- The urgent and strategic needs of enhanced power production to meet the demand of industry, agriculture as well as commercial and domestic consumers of the country; nor does it propose better level of service for improvement of quality of life.
- The need to increase the current power production capacity despite the shortfall in energy availability resulting in load shedding of 6 to 8 hours every day.
- The requirement of slowing down on fossil fuel consumption that is adding to global warming on the one hand and on the other hand depleting its resources.

In view of the above shortcomings the “No Action Alternative” cannot be considered.

No New Renewable Energy alternative

Alternative -2 also does not respond to:

- The need to increase the current power production capacity despite the shortfall in energy availability resulting in load shedding of 6 to 8 hours every day.
- The requirement of slowing down on fossil fuel consumption that is adding to global warming on the one hand and on the other hand depleting the resources.

Harnessing Wind Energy Potential of Deh Kohistan

Alternative-3: Harnessing Wind Energy Potential of Deh Kohistan responds to the criteria just mentioned. Moreover it offers the following advantages over the others:

The screening process finds the site of the Project in the Jhimpir Wind Corridor suitable for wind classes 3-4.

The proposed site has been sub-leased by AEDB to GAWPL, the proponent of the project.

It is the only alternative offered to GAWPL for establishment of the WPGC.

It suits to the requirement of accessibility to infrastructure facilities for the establishment of Wind Farm and for providing energy to WAPDA when it goes into operation.

Alternative-3 has, in view of the above findings, been found to be the preferred alternative.

5.2 ENVIRONMENTAL ASPECTS OF SITING WIND FARM

5.2.1 GAWPL-Project activities will involve the following aspects:

- Improvement of Access track and construction of Internal road network linking all wind turbines
- Road transportation of prefabricated steel tower, turbine machinery, and rotor blades of up to 45 m length
- Piling for foundation of towers
- Installation of Wind turbines
- Installation of step-up transformers mounted at the foot of each turbine tower
- Construction of 11 KV underground electrical collection system leading to the project sub-station
 - Construction of operations/maintenance and control facility; substation and grid connection to NTDC 132 KV system
 - Operation of wind farm,
 - Maintenance, and
 - Decommissioning.

5.2.2 Construction activities for wind energy projects will include land clearing for site preparation and access routes; excavation, blasting, piling and filling; transportation of equipment including towers, blades, turbines, supply materials and fuels; construction of foundations involving excavations and placement of concrete; operating cranes for unloading and installation of equipment; and commissioning of new equipment. Decommissioning activities include removal of project infrastructure and site rehabilitation.

Exploitation of wind energy potential at Deh Kohistan 7/1 will require the following environmental constraints to be addressed:

- Land Use
- Visual Effects
- Noise Effect
- EMI Assessment
- Flicker Effects
- Cultural Heritage and Archaeological Issues
- Flora
- Fauna (Wildlife, Birds)
- Wind Farm Development Advantages (positive effects)
- Recreational and Tourism Issues
- Impact during Construction phase
- Impact during Operational phase

5.2.2.1 Land Use

The wind farm site lies in the Deh Kohistan 7/1 near Jhimpir. The 647-acre land comprising the microenvironment is arid stony wasteland with rock, sand and gravel removal besides tree/dead wood/shrubs removal activities leading to impoverishment of resources and further degradation. There are 5 hamlets (small villages) with 10 to 15 households each in the surrounding with Haji Walloo Goth at 1.6 km, Haji Lakhano at 1.2 km, Jan Mohammad Jakhra at 2.5 km, Murad Ali Chang at 1.2 km, and Karim Bakhsh Khaskheli at 2.5 km from the boundary of the Project site.

The site map in Figure 3.8 shows the land features. The wind turbine generators (WTGs) would be located along the 11 km x 0.2 km strip of land maintaining designed spaces apart and in direction perpendicular to the prevailing wind. The single row of WTGs would be housed on land measuring 647 acre allotted to GAWPL at Deh Kohistan 7/1 in Jhimpir Wind Corridor. Changes, if any, would be adopted as per micro-siting requirements at the time of final design.

Mitigation Measures

No mitigation measures are needed with respect to existing land use and land tenure since:

- 647 acres land has been sub-leased officially by AEDB to GAWPL.
- Unsurveyed land, including the villages, lies outside the sub-leased area. Haji Walloo village is 1.6 km; Haji Lakhano 1.2 km; Jan Mohammad Jakhra 2.5 km; Murad Ali Chang 1.2 km, and Karim Bakhsh Khaskheli 2.5 km outside the boundary demarcated by the coordinates mentioned in lease deed.

Likewise there are no issues on loss of land, or loss of business. No involuntary resettlement is consequently required and no business can be considered lost on the acquired land.

The detailed design will give due consideration to location of the WTG close to the living area at Haji Walloo village, Haji Lakhano village and Murad Ali Chang village and site the WTGs to maintain a distance of about 1.6 km. The wind turbines would be suitably landscaped so as to make them visually attractive and also matt-finished to make the rotors less glossy.

The site is not located under the flyway of commercial aircrafts. The wind turbines would be at the hub height of 80 m, which would necessitate adequate provision of warning lights and signals necessary for elevated structures. This would require obtaining clearance from the Civil Aviation Authority and Telecommunication Authority, which has since been obtained.

5.2.2.2 ***Geology and Land Form***

Typical analysis of borehole data generated for the GAWPL Project site show that the water table is deep down and much below 20m. It is assumed that the strata in the vicinity of water table are dried up. Different strata of the soil comprise an initial 1 to 3 m of mostly soft materials like fine to coarse silty sand, followed by reddish brown hard claystone/siltstone fractured to 10 m, siltstone/claystone/limestone fractured in the following 15 to 20 m.

The borehole data for the site in conjunction with Rock Quality Designation (RQD) values indicate that the soil at borehole site has RQD values lower than 30% which shows poor Rock Quality and low load bearing capacity.

Mitigation Measures

This would require appropriate mitigation measures in providing bored reinforced concrete piles to the depth of hard rocks with RQD values greater than 50%. It is therefore suggested that piles of the foundations of the towers should be laid at depth of sandstone/hard rock which are hard and pose minimum risk to the liquefaction threat during major (> 7 on Richter Scale) earthquake.

Seismic Hazard

The seismic hazard, in view of the historical data as well as proximity to Jhimpir fault has been estimated for Deh Kohistan 7/1 as "moderate to major". This suggests the "possibility" of earthquakes of intensity V to VII on (MM) scale and "probability" of those above VII. The GAWPL site should be placed between Zone 2 and Zone 3 i.e. Zone 2A. Such Seismic Zoning would correspond to Magnitude between 5.0 and 6.5 on Richter Scale and Intensity between VII and IX on Modified Mercallis Scale. This suggests that Ground Force in terms of Assumed Approximate Acceleration equivalent of 0.3 g should be adopted for the site.

A seismic risk factor of 0.3 g is recommended for the design for constructions and installations at the site in view of the installations involving large towers with hub heights reaching 80 metres, for operational basis earthquakes (OBE) pertaining to damage due to moderate level earthquakes (MM scale VII to IX).

Moreover in view of the Rock Quality Designation (RQD) values being lower than 30% and showing poor Rock Quality and low load bearing capacity, the risk of liquefaction during major (> 7 on Richter Scale) earthquakes will have to be taken into account.

Mitigation Measures

- Seismic risk factor of 0.3 g should be incorporated in the design factor for the construction of Wind Towers and Turbines.
- Bored reinforced concrete piles shall be provided to minimize the risk of liquefaction threat during major (> 7 on Richter Scale) earthquake.

5.2.2.3 Visual Effects

Visual impact depends on the visual contrast between turbine structures and visual character against the skyline and landscape, both of which result from color, form and scale. Visual effects are so far a non-issue in the construction of large structures. They have so far not appeared as a major constraint to development of high-rise apartments, towers, minarets and chimneys. There are also no regulations for visual effects while siting wind turbines.

The proposed wind farm at GAWPL site will have Haji Walloo goth, Haji Lakhano goth and Murad Ali Chang goth on the southwest at distances of 1.2 to 1.6 km respectively from the Project site. The population resident in these villages will be the only one to view the wind turbines. Visual impact will not be of concern to the areas in the north or south since they have been allotted to Lucky Energy and Metro Power Company respectively. It will also not be of concern to the residences and structures in Jan Mohammad Jakhra village and Karim Bakhsh Khaskheli goth both of which are 2.5 km outside the GAWPL sub-leased area. The wind farm will hardly be visible from Super Highway M-9 on the west and National highway on the east.

Mitigation Measures

The GAWPL Wind Farm will be so designed at the final design stage that the nearest WTG is sited at a distance of about 1.6 km from Haji Walloo village, Haji Lakhano village and Murad Ali Chang village.

Reflected light can be distressing to the eye of persons in living environment in close proximity. The rotor blades will have dull finish so as to retard reflection.

The wind farm being established in Deh Kohistan would be viewed as a curiosity as is being reported by the residents of Qasim Burfat Goth in the neighbourhood. The cluster of WTG all lined up along the 11 km strip of land in the wilderness will create a point of interest in the distantly located rural landscape. This point of interest could be cashed by suitable landscaping and creating a public viewing area to demonstrate the performance of this clean, renewable form of energy generation.

5.2.2.4 Noise Impact

Noise created by the wind turbines would range between 90 and 105 dB(A) at a height of about 70 m. This level would attenuate at the ground level to perceptible range of 55 to 65 dB(A), which is almost the same as noted when the surface wind is blowing. With the rotation of blades by class 3-4 winds at 12 to 15 rotations, the noise emission would be at the lower level of 55 to 60 dB(A). At a distance of over 1.5 km, where the three villages are located, the noise emission would be just perceptible. The average background noise level recorded at site during the reconnaissance survey was 38.0 to 46.5 dB(A), while it ranged between 41 and 54 dB(A) during 24-hour monitoring at the site. The noise level as a result of exposure to wind was 65.0 to 76.0 dB(A).

Performance of WTGs at a recently installed wind farm in the Jhimpir Wind Corridor has been observed by the residents of Qasim Burfat Goth. The blades were found rotating at 12 to 15 rounds per minute and were not causing sound disturbance or roaring effect. The residents were of the opinion that the wind was at times noisier than the WTGs all put together.

Mitigation Measures

In case the wind turbines are noisier than just stated, the impact will be largely on the operators working at the wind farm or the security personnel resident in the accommodation provided to them. It will be mandatory for the workers and officials to wear ear muffers or earplugs while in the operations area and for the management to adopt mitigation measures during construction to minimize the environmental impact of the wind farm. Regulations/standards relevant to wind farm have not been framed.

National Environmental Quality Standards have only been stated for transport vehicles which suggests that the level should not exceed 85 dB(A) when measured at a distance of 7.5 m from the edge of the road. World Bank Guidelines have set the following standards:

Maximum allowable log equivalent (hourly measurements) in dB(A)	Day Receptor (07:00–22:00)	Night Receptor (22:00 - 07:00)
Residential, institutional, educational	55	45
Industrial, commercial	70	70

The standards will be applied if the level exceeds the limits for Industrial and commercial sites set at 70 dB(A) at the boundary of the wind farm. Simulation studies indicate that this level would be achieved at the ground level of the wind farm. These studies also show that the noise level would be reduced at Haji Walloo, Haji Lakhano and Murad Ali Chang villages at a distance of over 1.2 km to acceptable levels of 55 dB(A) during the day and 45 dB(A) during the night, as required by the World Bank Guidelines.

The detailed design shall nevertheless take the noise aspect into consideration and site the WTG nearest to the village at a distance exceeding 1.6 km.

5.2.2.5 EMI Impact

Electro-magnetic Interference (EMI) caused by the development of wind farm is not expected to be significant. Electro-magnetic Interference produced from either WTG placement in the direct line of sight of point-to-point communications, or too close to omni- (all) directional communications or radar equipment, is the main point of interest for communications and radar operators.

Mitigation Measures

Contact with the Pakistan Telecommunication Authority will be made to establish licensed communications operators in the area. Although no major impact is anticipated, communications operators may need to be contacted, during the initial stages of development. In some cases before and after surveys of signal strength and interference may be required. Typically the following types of owners/operators are contacted.

- Television (Some interference to Television signals close to and within the wind farm is possible, however this would probably be possible by rectification with relatively inexpensive aerials or repeaters.)
- Radar Systems – (Considered an issue on Super Highway for security reasons.)

- Public Communications Systems (Pakistan Telecommunication Authority)
- Private Communications Systems: Mobile phone coverage is presently being extended to Jhimpir near the Project site.

5.2.2.6 Flicker Shadow Effect

Turbines that are east or west of houses can impose fluctuating shadow effects at morning or evening hours when the sun is behind the rotor blades and the alternating shadow flicker is cause for annoyance to residents within one km. The WTGs would be located in a row along the 11 km x 0.2 km strip of land, with the nearest WTG on the southwest at a distance of 1.6 km from the three hamlets Haji Walloo, Haji Lakhano and Murad Ali Chang comprising clusters of 10 to 15 temporary structures/huts. The Goths will thus be outside the corridor of impact of rotor induced shadow during morning or evening hours. The setback distance of 750 m to 1000 m will for most areas exclude the possibility of significant shadow effects at residences beyond 1 km.

Mitigation Measures

This issue will be analysed in more detail at the designing and siting stage for the final layout.

5.2.2.7 Cultural Heritage and Archaeological Issues

There is no prominent cultural or archeological feature in or around the GAWPL Project site. The nearest graveyard is beyond Harolo Nai on the south and the same does not have marks of antiquity. Places of archeological, historical and religious significance in District Thatta, listed in Annexure 4.1 are located in Thatta and are 50 to 60 km from the Project site.

Mitigation Measures

The recommended procedure will be followed during site excavation for construction at the site, which requires that if artifacts of significance are found, the finding will be immediately reported to the Department of Archaeology, Sindh.

5.2.2.8 Flora

Trees and shrubs (Indigenous Germplasm)

One of the main causes of depletion of rangeland and desertification of the land in the microenvironment is the practice of cutting and uprooting trees and shrubs for use as fuel by the rural population because wood is the principal source of available energy, and the dead wood resulting from continuous drought, is also cash crop. It has been shown in the following Table that the following indigenous tree/shrub species are still present but would soon be lost since tree cutting and the resulting topsoil removal is going on unabated.

Mitigation Measures

The trees named hereunder are a valuable resource and are essential for sustaining the biodiversity of this fast degrading land. The Project will promote the program for protection of the following indigenous plants and replant them where necessary.

Local Name	English Name	Botanical Name	Family
Babul	Acacia	Acacia nilotica	Leguminosae/Mimosoideae
Kunbhat	Gum Arabic	Acacia Senegal	Leguminosae/ Mimosaceae
Bavri	----	Acacia Jacquemontii	Leguminosae/Mimosoideae
Phulai	Amartasar gum	Acacia modesta	Leguminosae/ Mimosoideae
Nim	Neem	Azadiradita indica	Meliaceae
Gugur	Indian Bdeium	Commiphora mukul	Burseraceae
Phog	Calligonum	Calligonum polygonoides	Polygonaceae
Lyar	Narrow leaf sepistan	Cordia latifolia	Ethretiaceae
Kirir	Caper berry	Capparis deciduas	Capparidaceae
Kandi	Prosopis	Prosopis cineraria	Leguminosae/ Mimosoideae
Devi	Mesquite	Prosopis juliflora	Leguminosae/ Mimosoideae
Jaar	Tooth brush Tree	Salvadora persica	Salvadoraceae
Mithi Jaar	Tooth brush Tree	Salvadora oleoides	Salvadoraceae
Rohiro	Tecoma	Tecoma undulata	Bignoniaceae
Lai/Lao	Tamarix	Tamarix aphylla	Coniferae
Ber	Jujube	Ziziphus mauritiana	Rhamnaceae
Jaanguri ber	Desert Jujube	Ziziphus nummularia	Rhamnaceae

5.2.2.9. **Fauna**

There is no Wildlife Reserve in close proximity of Project site. Keenjhar Lake Wildlife Sanctuary is located 15 km outside of the macroenvironment.

Low frequency of visits of a small number of mammals, birds, and reptiles leads to the conclusion that biodiversity of the area has been substantially reduced. Indian Monitor lizard (*Varanus bengalensis*) Wadhi Go/Gioh (reported but not spotted), and Monitor lizard (*Varanus griseus*) were neither reported nor spotted during the surveys for this study. The spiny-tailed lizard (*Uromastix hardwickii*) Sandha is in abundance. All sand mounds in the area have burrows of the sandhas. With extensive wood cutting the mounds are also getting flattened and despite their being protected by the locals they are getting endangered. The species are included in Appendix III of the CITES.

Mitigation Measures

The GAWPL Project will require land clearance for siting the WTGs. The Project site itself is stony wasteland and has only few mounds along the 11 km strip of the site that hosts the sandhas. Contractors will be required to commit to protect them and not to disturb the mounds but if necessary, the lizards will not be trapped but scared away. They usually find an alternative hole in the surrounding when scared. Commitment to protection of the lizards and other reptiles will be the mitigation measure employed to save the animals during construction.

The sandhas will soon find other holes and get rehabilitated. These reptile species are scared by movement of mechanical systems or men and animals. Wind turbines and movement of rotors will be at hub height of ~80 m, while movement of personnel would be around the WTGs that would be sited apart suitably. Thus it is less likely that the sandas will be disturbed if they continue to remain in the microenvironment of the WTGs.

Birds

Studies undertaken throughout the world have shown that WTGs on landbased wind farms do not pose any substantial threat to birds and other wildlife. Risks of birds colliding with WTGs are much lower than with communication towers, high tension wires, vehicles, and are the highest with buildings and windows

The GAWPL Project site does not have habitat of the concerned high flying birds including kites, vultures, and falcons or the Houbara bustard (Tiloor), which is in the IUCN Red List as *low risk, near threatened*.

Mitigation Measures

GAWPL Project site is stony wasteland degraded further by removal of trees, sand, gravel and stone. As such the area offers no attraction to the falcons or other high flying birds for habitation, nor to the migratory birds which do not find an aquatic environment to land. The falcon or other high flying birds found in the microenvironment are those that stray in. The Environmental Management Plan will include monitoring the number of such birds flying in during the pre-construction period and also their mortality in case they fly in.

The possibility of the noise-sensitive falcons flying into the wind turbine structures will be substantially lowered by the siting of seven wind farms in a row in Deh Kohistan. The cumulative effect of such siting would inhibit the high flying birds from flying into or landing in the Jhimpir Wind Corridor. The wind corridor is not on the fly way of the wintering birds and also not a habitat for the falcon or Houbara bustard. GAWPL Project site being the sixth on the corridor, will not contribute to birds being inhibited in flying in or landing in the wind corridor.

The noise level of about 95 to 105 dB(A) is even otherwise sufficient to scare the high flying birds. The movement of the rotors at 12 to 15 rounds per minute is not so brisk as to entangle a bird easily. Despite these observations, services of sharp shooters will be acquired to carefully stupefy the high-flying stray birds before they reach the turbines and subsequently rehabilitate them in safe environment. The EMP will include monitoring the incidence of such birds straying in and the number of birds killed or injured.

5.2.2.10 Recreational Value & Tourism

At present the GAWPL wind farm site does not have any tourism value. However, establishment of the wind farm and its operation in the stony wasteland only 9 km from the Super Highway M-9 may induce curiosity and encourage tourism. However, the resident population is highly traditional and does not encourage visits of non-locals.

5.3 SCREENING OF POTENTIAL ENVIRONMENTAL IMPACTS DUE TO LOCATION OF WIND FARM

- The microenvironment i.e. the 647 acre land area in Deh Kohistan 7/1 is currently stony wasteland being further degraded by indiscriminate removal of sand, gravel, stone and vegetation. The living area is more than 1.5 km outside the Project site and being at least 15 km from industrial activity center at Nooriabad and at a distance of 9 km from Super Highway M-9, does not fall in the corridor of their impact. Current land-use in the distantly located villages is limited to subsistence farming, and cashing on the dead wood dried up vegetation and sand/gravel/stone.
- The resident population outside Deh Kohistan is engaged in low level labour in stone digging, crushing, wood cutting and sand/gravel/stone collection as well as wood cutting.
- The land has been subleased by AEDB to GAWPL, and does not entail involuntary resettlement.
- The GAWPL Wind Farm site has no protected areas such as wildlife, game reserves or national park, or any archaeological, historical or cultural heritage in its neighbourhood, as such it would have no visual impact on them.
- Removal of vegetation will be needed at 33 locations on the 11 km long strip of land for piling for siting the wind turbines.

Mitigation Measures: Contractors will be committed to minimizing the removal of vegetation, and replanting trees that may have to be removed.

- Soil erosion is likely to be caused by the vehicular traffic on unpaved roads and dirt tracks, land clearing for construction camps and wind turbine towers, construction of roads and excavation for tower foundations.
- Soil may be contaminated as a result of fuel/oils/chemicals spillage and leakage, and inappropriate waste (solid as well as liquid) disposal.

Mitigation Measures: Contractors will be committed to strictly follow the EMP as well as IFC's EHS Guidelines on minimizing the soil erosion and contamination

- GAWPL Wind Farm would have its share of water from the Kalri-Baghar Feeder that will soon start feeding the Nooriabad Industrial Area and would thus have no significant impact on the current beneficial water uses in the area.
- The airshed of the GAWPL Wind Farm is, according to the assessment of ambient air quality, unpolluted. The dust fall in the microenvironment as estimated from the ambient air quality measurements at site is high as a result of high aridity in the airshed of the macroenvironment as well as that of the site itself.

Mitigation Measures: Deposition of dust on the rotor blades of the WTG may have significant impact on operation of the WTGs. The WTG supplier will take this aspect into account, while Environmental monitoring and management plan as well as maintenance staff will address this issue in particular.

- The wasteland at Deh Kohistan has remained an isolated component of ecosystem of Lower Sindh for a long time; location of GAWPL Wind Farm will comprise value addition to the wasteland and will have no significant impact on its degraded ecology.

5.4 SCREENING OF POTENTIAL ENVIRONMENTAL IMPACTS AT CONSTRUCTION STAGE

Construction activities at Deh Kohistan for the establishment of GAWPL Wind Farm will include the following main elements:

- Location of campsite and field construction office
- Construction of access road, site roads, turn-around areas and crane pads at each wind turbine location;
- Construction of the turbine tower foundations and transformer pads;
- Installation of electrical collection system – underground and some overhead lines;
- Assembly and erection of the wind turbines;
- Construction and installation of the substation;
- Plant commissioning and energizing, and
- Decommissioning.

The above activities will entail the following construction related issues that may have impact on the environment and will require mitigation measures to be adopted during the implementation phase:

- Heavy weight and/or long trucks haulage
- Surface sealing (foundations, roads)
- Topsoil removal
- Compressing of topsoil
- Protection of (natural) drainage of agricultural lands
- Fuel storage
- Concrete production
- Ground water levels and watercourses, erosion minimization
- Waste disposal
- Dust emission and control
- Construction related noise
- General conditions of construction site (visual)
- Disturbance of fauna
- Impact on flora
- Emergency response
- Site rehabilitation.

5.4.1 Impact Assessment

- Construction at the proposed site of Wind Farm would not involve extensive land preparation since the stony wasteland at GAWPL WPGC is almost flat. The impact of land preparation on the microenvironment i.e. Deh Kohistan with no value addition to its land use, and the living area 1.5 km outside the allotted area, will be minor and not significant.
- Site preparation activities would include clearing, excavation, earth and fill movement, and transportation of wind turbine sets and associated equipment to the site. The said activities will not lead to extensive soil erosion resulting from removal of topsoil at the site, but to improvement of its quality.

Mitigation Measures: The fugitive dust emission would be controlled by spraying water to keep the soil moist. Dust emission due to other materials

of construction will be controlled through appropriate measures to reduce the level of impact to be of minor significance.

- Temporary disturbance to the landscape that will occur during construction of site roads, turn-around areas and crane pads at each wind turbine location; construction of the turbine tower foundations and transformer pads; installation of the electrical collection system, including underground and some overhead lines; assembly and erection of the wind turbines, and construction and installation of the substation, will be limited to the microenvironment.

Mitigation Measures: Environmental Management Plan (EMP) and IFC' HSE Guidelines will be effectively implemented to keep the interventions in the ecosystem well within prescribed limits and contractors will be mandated to adopt the EMP in letter and spirit.

- Vehicles and construction equipment will not be repaired in the field. If unavoidable, impervious sheathing will be used to avoid soil and water contamination.
 - For the domestic sewage from the construction camps, appropriate treatment and disposal system, such as septic tanks and soaking pits, will be constructed having adequate capacity, and after determining the soil percolation capacity. The contractor(s) will submit to the GAWPL the plans for the camp layout and waste disposal system, and obtain approval.
 - Waste oils will be collected in drums and sold to the recycling contractors.
 - The inert recyclable waste from the site (such as card board, drums, broken/used parts, etc.) will be sold to recycling/disposal contractors. The hazardous waste will be kept separate and handled according to the nature of the waste.
 - Domestic solid waste from the construction camp will be disposed in a manner that does not cause soil contamination. The waste disposal plan submitted by the contractor(s) will also address the solid waste.
 - The construction camp will not be established close to the storm water channels and the living areas in particular the villages.
- Formation of internal access tracks, foundation excavations, electrical trenching and other site works will not be visible to the public commuting on Super Highway M-9 at a distance of over 5 km, nor will there be a shadow effect on the villages that are located on the southwest of the site at a distance of 1.5 km. Estimates available from other sites in Jhimpir wind corridor show that 7 - 10% of the project area is temporarily disturbed for road and crane pad construction. At completion of the project, the turbines, access tracks and associated equipment occupying about 1% of the site area, will meaningfully add value to the wasteland at Deh Kohistan.
 - **Blocked Access**
There are no settlements at or in the immediate vicinity of the proposed site. Hence the construction activities at the site will not cause any inconvenience to the nearby population by blocking their access routes. The movement of extra heavy plant equipment along the roads leading to the site may require temporary

adjustment and would not block the insignificant local traffic even for short periods of time.

Mitigation Measures

- The IFC's EHS Guidelines, as described in the Annexure, will be strictly followed
- Movement of extra heavy loads will be carefully planned, in consultation with the communities in the surrounding and relevant authorities.
- Co-habitation issues with existing wind farm operations will not require negotiations with the community who are settled in the villages on unsurveyed land outside the sub-leased area.
- Diesel and other petroleum products used for the operation of construction machinery and transportation equipment would cause air pollution besides causing soil pollution through oil spills. The impact from such activity would be of minor significance and would be controlled by good housekeeping practices.
- 40,000 liters water required daily for numerous construction activities would be transported in tanker trucks from Nooriabad Industrial area and will not have significant impact on other beneficial water uses or its reduced availability for the functions of the villages in Deh Kohistan. Conservation practices would nevertheless be adopted during the entire course of construction.
- Noise and visual impact will be limited to the microenvironment comprising Deh Kohistan. No major operational impact is envisaged at the construction stage from the GAWPL wind farm.
- **Air Quality Deterioration**
Construction machinery, diesel generators and project vehicles will release exhaust emissions, containing carbon monoxide (CO), sulfur dioxide (SO₂), oxides of nitrogen (NO_x), and particulate matter (PM), which can deteriorate the ambient air quality in the immediate vicinity of the project site and along the road leading to it. Furthermore, construction activities such as excavation, leveling, filling and vehicular movement on unpaved tracks may cause fugitive dust emissions.

The deteriorated air quality at the project site is unlikely to impact the communities, since the nearest community/settled area is 1.2 to 2.5 kilometers away. However the construction crew and other site staff can be impacted by this air quality deterioration. In addition, the exhaust and dust emissions caused by project related vehicular traffic may impact the communities living along the dirt track leading to the site.

Emissions and Discharges during Construction Phase:

The daily fuel requirement will be about 6500 liters. This quantity of fuel will be responsible for daily emission of approximately 260 kg CO, 14 kg SO₂, 65 kg NO_x, and 14 kg Particulate matter, besides 16 tons CO₂. These emissions will be dispersed into the unpolluted environment at Deh Kohistan. Their dispersal will not degrade the quality of airshed of the Project site.

Mitigation Measures

- Environmental Management Plan (EMP) will be effectively implemented to keep the interventions in the ecosystem well within prescribed limits while IFC's HSE Guidelines will be strictly followed and contractors will be mandated to adopt the EMP in letter and spirit.

- Emissions from the generators will be monitored to ensure that the engines are properly tuned and maintained, and generators are so located that emissions are dispersed away from the camp and work areas.
 - Noise emission from the vehicles and equipments will exceed 85 dB(A) but the same would be reduced to less than 85 dB(A) at 7.5 m from the source. Workers will be provided ear plugs and other safety equipment as safeguard against the hazards in the 'high noise zones', which will be clearly defined.
 - The liquid effluents generated during the construction phase will include domestic sewage and grey water from the camp operation.
 - The sewage will be treated in septic tanks and soaking pits.
 - The grey water from kitchens and washing areas will be directed to separate soaking pits.
 - The storm water will be collected in ponds and either disposed of after appropriate treatment, or diverted to fields for vegetation, and rejuvenation of local flora.
- **Gender and Social Issues**
- The construction site and construction camp will be located well outside the community, thus eliminating any impact on the women of the area. The vehicular traffic on the local roads can potentially pose low level of adverse impact on the women of the area.
- Mitigation Measures**
- Construction crew will avoid entering villages and settlements.
 - Local norms will be respected
 - Communities will be informed and consulted before commencing the site works.
 - Strict adherence to EMP and IFC's EHS Guidelines as well as code of conduct will be maintained by the construction crew.
 - Environmental monitoring during the project execution will ensure compliance with the above mitigation measures and their adequacy, as well as significance of any residual impacts.
- **Child Labor**
- Although the use of child labor is not prevalent in the construction works such as those involved in the proposed project, yet the provisions of the Child Labor Act will be made part of the construction contracts, in order to ensure that no child labor is employed at the project sites or campsites.

5.5 SCREENING OF POTENTIAL ENVIRONMENTAL IMPACTS AT OPERATION STAGE

Operation of Wind Farm at the proposed site would start as soon as the wind turbines and switchyard are in place, and the system starts to produce power. Environmental problems identified at the Operations stage relate to the following aspects:

- Air quality and noise level changes due to operation of fleet of trucks, container trucks and operation of mechanical equipment.
- Visual Effects
- Noise Effect
- EMI Effects
- Flicker Effects
- Cultural Heritage and Archaeological Issues

- Flora
 - Fauna (Wildlife, Birds)
 - Recreational and Tourism Issues
-
- Operation of Wind Farm would not release air pollutants into the airshed, and wastewater will be discharged into soak pits after treatment.
 - Diesel and other petroleum products used for the operation of mechanical equipment and transportation vehicles would cause air pollution besides causing soil pollution through oil spills. The impact from such activity would be of minor significance and would be controlled by good housekeeping practices.
 - Visual effect, Noise effect, EMI effect, Flicker effect induced by operation of the wind turbines will have no significant impact on the living area, since the detailed design would locate the nearest turbine beyond 1.5 km on the outside of GAWPL Project site in Deh Kohistan.

Mitigation Measures

The induced impact on operation of the appropriately sited wind turbines on the microenvironment will be monitored through Environmental Management Plan (EMP) and IFC's HSE Guidelines on Wind Energy 2007, and mitigated, if necessary by adoption of suitable measures to minimise the impact of Visual effect, Noise effect and Flicker effect on the microenvironment as well as macroenvironment.

- **Noise Effect**

The rotor blades of the wind turbines are the main source of noise during the operation phase of the wind power plants.

- The study of noise data for a power plant of similar size and using the same turbines in the same microenvironment shows that the noise levels generated by the wind farm drop down to 35-40 dB(A) range within a distance of about one kilometer from the power plant. This noise level is much lower than the background noise that exists in the living environment i.e. the villages which will be at a distance of over 1.5 km from the nearest turbine.
- The emergency generator, if installed at the site, will also generate some noise. However, much like the noise generated by the wind farm, its impact on the communities will be negligible, in view of the large distance.

Mitigation Measure

- No mitigation measure is necessary. The power plant staff will be provided with the personnel protective equipment (PPE)
- **Shadow Flicker and Blade Glint**
Shadow flicker occurs when the sun passes behind the wind turbine and casts a shadow on the immediate neighbourhood. As the rotor blades rotate, shadows pass over the same point causing an effect termed shadow flicker. Shadow flicker may become a problem when residences are located near, or have a specific orientation to, the wind farm. Similar to shadow flicker, blade or tower glint occurs when the sun strikes a rotor blade or the tower at a particular orientation. This can impact a community, as the reflection of sunlight off the rotor blade may be angled toward nearby residences. Blade glint is not a concern for new turbines as matt finish paint is now being used which does not produce the glint effect. However, the nearest WTG will be sited in the detailed design at about 1.5 km away from the living area in the hamlets. Hence the flicker or glint from the proposed power plant will not cause any significant adverse impact.

Mitigation Measure

- No mitigation measure is necessary. The power plant staff will be provided with the personnel protective equipment (PPE)
- Daily water requirement at the site during operation and wastewater discharges would not be of such order as to result in any significant impact on other beneficial water uses or its reduced availability for the functions in the three villages that are outside the operations area of GAWPL Wind Farm. Conservation practices would nevertheless be adopted during the entire course of construction.
- Generation of solid and hazardous waste will be of small order and good housekeeping practices will be adopted to reduce their impact, which is expected to be of small order.
- During the operation phase a small quantity of oil/oily water will be produced during the maintenance of the pumping stations. This will be treated in oil/water separators.
- There are no cultural heritage, recognized archaeological sites, endangered species of flora, wildlife reserve, or potential tourism sites that may need protection and hence no mitigation measures need to be taken during the operation of the wind farm.
- **Wildlife:** The project site and its immediate vicinity do not provide habitat to any terrestrial or avian faunal species, nor is it located along or under the route of migratory birds. The endangered Houbara bustard found in the macroenvironment, and the highflying falcons are only few in number. The number of the few that visit the site and also their mortality will be recorded during the pre-construction period. High noise levels scare these noise sensitive bird species and the falcons, eagles and high flying birds would be scared off by the scores of WTGs lined up in the Jhimpir Wind Corridor.

Mitigation measures

- Environmental Management Plan (EMP) will be effectively implemented to keep the interventions in the ecosystem well within prescribed limits. Contractors will be mandated to adopt the EMP in letter and spirit and strictly follow IFC's HSE Guidelines.
- Mitigation measures such as positioning of sharp shooters will be in place not to kill but stupefy the high-flying stray birds before they reach the turbines. Such birds would be rehabilitated subsequently into safe environment.
- A record of bird casualties will be maintained and reviewed at the end of every month.
- The endangered spiny-tailed lizard (*Uromastix hardwickii*) Sandha that is abundant in the microenvironment is included in Appendix III of the CITES.

Mitigation measures

- The species will be protected by mandating the contractors to commit to protect them by scaring off, instead of trapping them or disturbing the mounds and their habitat.
- The sandhas usually find an alternative hole in the surrounding when scared. They will get rehabilitated by the time the wind farms go into production.
- These reptile species are scared by movement of mechanical systems or men and animals.
- Wind turbines and movement of rotors will be at hub height of ~80 m, while movement of personnel would be around the WTGs that would be sited apart suitably. Thus it is less likely that the sandas will be disturbed if they continue to remain in the microenvironment of the WTGs.
- The environmental monitoring and strictly following IFC's EHS Guidelines during the project execution will further ensure compliance with the above mitigation measures and their adequacy in dealing with significant residual impacts.

■ Habitat Modification

The establishment and operation of a series of wind power plants will potentially modify the natural habitat of the ecosystem of Deh Kohistan 7/1. However the macroenvironment of these wind farms is not located in an area which is known for high bird concentration, or bird migration route. Such a route is at least 15 to 20 km from this site. The aridity of the land and removal of topsoil has rendered the land unproductive and unattractive for the birds and wildlife to move in. The series of wind turbines would be a deterrent for the high flying migratory bird to make a landing in this barren land. As a result of the GAWPL- WPGC's O&M activities on the seven wind farms in a row, the site will not remain available to the wild birds as landing area and not the least as feeding ground.

GAWPL site is at lower heights compared with the other five farms in the south in Deh Kohistan. It will be less likely to initiate modification of the habitat, if there is any. Hence the loss of the site as the feeding ground for the birds is unlikely to be significant.

5.6 CHECKLIST OF ACTIONS AFFECTING ENVIRONMENT & SIGNIFICANCE OF THEIR IMPACT

Actions Affecting Environment Resources & Values	Damage To Environment	Recommended Mitigation Measures	Significance of Impact			
A. Environmental Problems due to Siting/ Location of Project			None	Small	Medium	Major
1. Changes in hydrology affecting existing land values	1. Damages to land by erosion and/or accretion	1. Careful design and planning to minimize/offset problem	√			
2. Changes in drainage pattern	2. Damages due to change in flooding, accretion, erosion hazards	2. Careful design to minimize/offset problem	√			
2a. Obstruction in Water Flow	2a Conflicts with other beneficial water uses	2a. Appropriate sharing of water with Nooriabad Industrial Area	√			
3. Changes in land uses	3. Possible loss in overall regional welfare	3. Careful planning & Implementation of IFC's HSE Guidelines		√		
4. Encroachment into precious ecological zones	4. Loss of precious ecology	4. Careful planning & Implementation of IFC's HSE Guidelines		√		
5. Resettlement	5. Displacement of local population	5. Adequate attention to local problems	√			
6. Historical/monuments/cultural values	6. Loss of precious values	6. Careful planning to minimize/offset problem	√			
7. Environmental aesthetics	7. Loss of environmental aesthetics	7. Careful planning		√		

Actions Affecting Environment Resources & Values	Damage To Environment	Recommended Mitigation Measures	Significance of Impact			
B. Environmental Problems due to Inadequate Design			No ne	Small	Medium	Major
1. Unrealistic assumptions on available O & M skills	1. Unnecessary damages because O&M requirements too high	1. Realistic O & M assumptions & Implementation of IFC’s HSE Guidelines	√			
2. Pollution Control Equipment Selection	2. Assumed pollution removals not realized	2. Appropriate equipment selection	√			
3. Environmental pollution control operations	3. Possible loss in overall regional welfare	3. Careful planning/desgning/ monitoring and use of appropriate standards	√			
3a. Surface water	3a. Impairment of downstream beneficial water uses	3a. Careful Management of Resources	√			
3b. Groundwater .	3b Impairment of beneficial water uses	3b. Careful Management of Resources	√			
3c. Air	3c. .Impairment of air quality	3c. Careful Management & monitoring	√			
3d. Noise	3d. Environmental Degradation & Health hazard	3d. Careful planning & monitoring		√		
4. Impacts on adjacent land economic users including recreation/tourism	4. Impairment of land uses	4. Careful planning/O&M		√		
5. Occupational health & Safety hazards	5. Hazards to workers health & safety	5. Effective implementation of EMP & IFC’s HSE Guidelines to offset problem		√		
6. Hazards due to Spills/fires/explosions	6. Hazards to workers health & safety	6. Effective implementation of EMP & IFC’s HSE Guidelines		√		
7. Area sanitation	7.Sanitation/disease hazards	7. Careful planning/design	√			
8. Hauling routes in/out areas	8. Traffic congestion and nuisances along routes	8. Effective implementation of EMP		√		
C. Environmental Problems During Construction Stage	C. Poor Construction Practices cause Degradation Problems	C. Careful Construction Planning and Implementation of IFC’s HSE Guidelines				
1. Problems due to uncontrolled construction practices	1. Problems of Environmental Degradation	1. Careful Planning and Implementation of EMP & IFC’s HSE Guidelines		√		
a) runoff erosion	(a) Problems of Environmental Degradation	a) Careful Planning and Implementation of EMP		√		
b) worker accidents	b) Problems of Environmental Degradation	b) Careful Planning and Implementation of EMP		√		
c) sanitation disease hazards	c) Problems of Environmental Degradation	c) Careful Planning and Implementation of EMP		√		
d) insect vector disease hazards	(d) Problems of Environmental Degradation	d) Careful Planning and Implementation of EMP & IFC’s HSE Guidelines		√		
e) hazardous material handling	(e) Problems of Environmental Degradation	e) Careful Planning and Implementation of EMP& IFC’s HSE Guidelines		√		
f) dust/odors/fume	(f) Problems of Environmental Degradation	f) Careful Planning and Implementation of EMP & IFC’s			√	

		HSE Guidelines				
g) explosion/fire hazards/hazardous materials spills	(g) Problems of Environmental Degradation	g) Careful Planning and Implementation of EMP & IFC's HSE Guidelines		√		
h) noise/vibration hazards	(h) Problems of Environmental Degradation	h) Careful Planning and Implementation of EMP& IFC's HSE Guidelines		√		
i) traffic congestion	(j) Problems of Environmental Degradation	j) Careful Planning and Implementation of EMP & IFC's HSE Guidelines		√		
k) water pollution hazards	(k) Problems of Environmental Degradation	k) Careful Planning and Implementation of EMP & IFC's HSE Guidelines				
l) blockage of wildlife/birds passageways	(l) Problems of Environmental Degradation	l) Careful Planning and Implementation of EMP & IFC's HSE Guidelines			√	
2. Uncovered cut & fill areas	2. Soil erosion & consequent damage to properties & environment	2. Careful Planning and Implementation of EMP & IFC's HSE Guidelines		√		
2. Inadequate construction monitoring	2. Encourages poor construction practices	2. Adequate monitoring during construction and Implementation of EMP & IFC's HSE Guidelines		√		
D. Environmental Hazards Relating to Operations (assuming proper design assumptions on O&M)	D. Unnecessary Environmental Damages	D. Adequate monitoring during Operation and Implementation of EMP& IFC's HSE Guidelines				
1. Inadequate O & M	1. Variety of environmental degradation similar to items B.1 to 8	Adequate monitoring during Operation and Implementation of EMP & IFC's HSE Guidelines		√		
2. Inadequate operations phase/environmental monitoring	2. Opportunity loss for feedback connections to project design and O&M	Adequate monitoring during Operation and Implementation of EMP & IFC's HSE Guidelines		√		
3. Occupational Health & Safety Programmes including accidents	3. Hazards to workers health & safety	Adequate monitoring during Operation and Implementation of EMP & IFC's HSE Guidelines		√		
4. Nuisance from handling & Transportation of fuels on access roads	4. oil drips, spills, dust & noise hazards	Adequate monitoring during Operation & Implementation of EMP		√		
5. Surface run off from plant yard	5. leakage of fuel on ground & oil drips	Adequate monitoring during Operation & Implementation of EMP		√		
E. Critical Environmental Review Criteria	E. Unnecessary Environmental Damages from Poor Planning	E. Careful Siting/ Design/O&M Monitoring		√		
1. Loss of irreplaceable resources	1. Long-term national environmental and economic losses	1. Planning should be consistent with high-level government policies		√		
2. Accelerated use of resources for short term gain	2. Long-term national environmental and economic losses	2. Planning to be consistent with policies		√		
3. Endangering of species	3. Long-term environmental losses	3. Planning to be consistent with		√		

		polices 3a. Effective implementation of EMP & IFC's HSE Guidelines				
4. Promoting undesirable rural-urban migration	4. Intensification of urban socioeconomic problems	4. Planning to be consistent with polices	√			
5. Increase in affluence/poor income gap	5. Intensification of national socioeconomic imbalances	5. Planning to be consistent with polices		√		
F. Potential Environmental Problems During Operation	F. Problems Normally Handled at Operation Stage	F. Carefully Implemented Environmental Management Plan, EMP & IFC's HSE Guidelines		√		
1. Removal or damage to vegetative growth	1. Problem at preparation of site & during operation	1. Careful implementation of EMP & IFC's HSE Guidelines		√		
2. Land Use Changes	2. Problem at preparation of site & during operation	2. Careful implementation of EMP& IFC's HSE Guidelines		√		
3. Micro level changes in the human settlements	3. Problem at siting & Operation stage	3. Careful implementation of EMP & IFC's HSE Guidelines		√		
4. Industrial & Transportation Activities	4. Problem at Operation Stage	4. Not envisaged Careful implementation of EMP including Traffic Management & IFC's HSE Guidelines	√			
5. Emergence of Slums & Wayside Commercial Activity	5. Problem at Construction & Operation Stage	5. Not envisaged Careful implementation of EMP	√			
G. Impacts from power Transmission facilities	G. Unnecessary Environmental Damages	G. Careful planning & Adequate O&M	√			
1 Environmental health hazard due to electromagnetic radiation	1. Unnecessary exposure of workers to environmental hazards.	Careful planning, training of workers		√		
2. Depreciation of environmental aesthetics	2. Loss of values	2. Careful planning & implementation of EMP& IFC's HSE Guidelines		√		
3. Encroachment on ecosystem	2. Loss of precious ecology	2. Careful implementation of EMP& IFC's HSE Guidelines		√		

Overall Significance of Impact:

Not Significant

CHAPTER 6

PUBLIC CONSULTATION & INFORMATION DISCLOSURE

FINDINGS, RECOMMENDATIONS & CONCLUSIONS

6.0 PUBLIC CONSULTATION & INFORMATION DISCLOSURE

This Chapter provides the details of the consultation meetings held with the stakeholders as part of the environmental and social soundness assessment process requiring information disclosure and sharing. For this purpose consultation meetings were held at the outset for the scoping process of IEE study, followed by a series of meetings at the grassroots level.

6.1 Objectives

The objectives of these meetings were to:

- Inform the public about the importance of GAWPL Project
- Investigate significant environmental impacts on village structures and the microenvironment of the Project site and measures to be adopted to minimize the severity of impact;
- Assess of the level of awareness on the proposed project, and
- Determine the impact of future development plans in the project area.

6.2 Consultation Framework

The consultation being a continuous process needs to be maintained throughout the project^{6.1}. The consultation framework adopted for the pre-construction, construction and subsequent phases of the GAWPL Project is elaborated in the following Table:

Consultation Framework

Project Phase	Proposed Tool	Stakeholders Consulted/to be Consulted	Responsibility
Pre-Construction	Formal and informal meetings, focus group discussions	Institutional stakeholders; Grass root stakeholders, including communities in neighbourhood likely to be Involved during the Project Implementation Stage	R&D Consultants GAWPL Official
Construction	i. Formal and informal contact and liaison with the community and other relevant stakeholders (e.g. Sindh EPA)	i. Institutional stakeholders ii. Grass root stakeholders, including communities in neighbourhood involved during Project Implementation Stage	GAWPL Official
	ii. Grievance Redress iii. Consultations with communities during environmental compliance & Impacts monitoring iv. during external monitoring v. during site visits by IFC/ Equator Principles Financial Institutions (EPFIs) Monitoring Mission	Communities in neighbourhood involved during Project Implementation Stage	
Operation	Liaison with communities in neighbourhood	Communities in neighbourhood Involved during the Project Operation Stage	GAWPL Official

^{6.1} Social Analysis Sourcebook: Incorporating Social Dimensions into Bank-Supported Projects, The World Bank, December 2003

6.3 Consultation Process

The stakeholders were briefed during scoping sessions about the objectives of the wind power project in Jhimpir Wind Corridor, the GAWPL-WPG Project, and the necessity of introducing the IEE process. Observations of the participants have been incorporated into the text of the IEE. At the last public consultation, stakeholders and village representatives were informed that the Wind Power Project will, in the detailed design site the wind turbine generators (WTGs) that may be nearest to the village at least 1.5 km outside the corridor of impact of visibility, flicker and shadow effect, noise, and air emissions. Power Project shall be designed as to site the wind turbine generators (WTGs) nearest to the village taking clear account of typical impact of visibility, flicker and shadow effect, noise, and air emissions clearly outside the neighbouring village. They were also briefed on the process of monitoring through the Environmental Management Plan as the tool to monitor the environmental performance throughout the lifecycle of the Project. The stakeholders and village representatives consulted in this connection have assured of unhindered support towards completion of the Project.

Scoping meetings were conducted with Institutional stakeholders and grassroots stakeholders, including communities in neighbourhood while conducting the present IEE. Institutional stakeholders included the following:

- Sindh Environmental Protection Agency
- Ministry of Environment and Alternative Energy Government of Sindh
- SUPARCO
- IUCN – Pakistan
- WWF – Pakistan
- Sindh Wildlife Department
- Ministry of Local Government & Rural Development
- Department of Archaeology, Government of Pakistan
- Meteorology Department

The grassroots stakeholders included the inhabitants of the goths in the neighbourhood of GAWPL Project site. A list of stakeholders contacted appears as Annexure 6.1 and 6.2.

6.4 Formal Consultation Meetings with Institutional Stakeholders

The Institutional stakeholders contacted during the scoping sessions had a positive view on the project. Although they thought that there would be very little direct benefit of the project for the local community, the area may in the long run gain in terms of increased business activity, expanded infrastructure and improved quality of life. The formal consultation meetings with different officials had the following observations/suggestions:

- i. The environmental issues at the Project site are not acute and should be manageable. The wind traveling inland from the sea has a tendency to descend into the open land on the east of Kirthar Range. The wind here should be dust raising.
- ii. Wildlife to be accounted for include the high flying birds and the reptiles in particular the spiny-tailed lizard (*Uromastix hardwickii*) Sandha. The mitigation measures may include just protection by scaring; they are so shy that they will immediately find another hole. They agreed that places near Super Highway M-9 being away from Keenjhar Lake are not on the flyway of the winter migrating birds.
- iii. Officials and public representatives agreed with the need of the wind power project as one which would make the country less dependent on fossil fuel. They however, desired its early implementation and completion. According to the officials and energy

- consumers the crisis has aggravated due to sidelining the alternative energy sources and not realizing their full potential.
- iv. The majority (70%) of the beneficiary communities were found aware of the Project but were desperate to know as to when power would be produced and made available to consumers.
 - v. Almost all participants suggested that instead of looking for fossil fuel the easier options like the wind energy potential should be exploited as early as possible.
 - vi. Some of them were of the opinion that small wind mills are working successfully and they should be encouraged instead of waiting for investment on import of large wind turbines. They quoted the example of Denmark in this connection.
 - vii. They believe that setting up wind farms based on indigenous technology would allow our high level manpower to play their part in the socioeconomic development of the country.
 - viii. Project impacts and resettlement were not of much concern to the stakeholders both because the Project site is highly degraded land while the small clusters of settlements were outside the boundary of the project area sub-leased by AEDB.
 - ix. Encroachment on precious ecology was not an issue because aridity and scarcity of sweet water had dried up the vegetation and driven whatever wildlife was native to the area. Whatever form may still be there would be barely surviving in the extremely impoverished environment.
 - x. The officials of the local administration welcomed the establishment of the proposed wind power plant on the area sub-leased by AEDB and bounded by the coordinates mentioned in Table 4.5. They considered it a positive step towards the development of the area in general. They were of the view that this project would provide much-needed employment opportunities to the poor people of area, which would improve the economic condition of the area.

6.5 Consultation Meetings with Communities

At the scoping sessions with communities around the proposed site, groups and individuals were first provided the salient information about the proposed project. Some of the resident communities already knew about the project, but did not know the specific details, particularly about the environmental issues involved. The communities generally welcomed the plans to establish the proposed power project in the area. Since the project would not directly affect them, the villagers generally did not have any apprehension or reservation about the project. They nevertheless viewed the project as one that would create employment opportunities and small business/trade opportunities for the local population.

Participatory and consultative approach was employed for information dissemination and data collection. The summary of consultations, major opinions and concerns of the stakeholders identified during scoping meetings is provided below:

- i. Stakeholders in the villages were not much concerned about loss of land or loss of business during construction of access road and at the site, since they knew that their goths were on unsurveyed land.
- ii. In separate meetings held by R&DC with the stakeholders at the villages the participants agreed that the Project would be first of its kind to address development of their area. The village representatives gave firm assurance that there would be no hindrance to completion of the project from any such stakeholder provided they are treated with respect and given whatever is their due. They would be happy if

employment was offered to their youngsters and petty contract to local potential resident.

- iii. The village representatives were convinced that designing the project will spare them with all negative aspects of the Project and see to it that their rights and assets are provided due safeguard.
- iv. Most of the communities were found aware that the project would not affect them.
- v. The local labour force should be engaged as much as possible.

6.6 Proceedings of Consultation Meetings

The consultation meetings did not show concerns about establishment of the project or about installation of large turbines in an otherwise quiet neighbourhood or about loss of business, community owned assets and trees, increase in dust and noise emission, congestion in construction areas, disruption of communication during improvement of roads, loss of land due to road improvement, inconvenience during construction, and potential increase of hunting wildlife. The stakeholders were informed that such concerns have been addressed through project design as well as environmental management and monitoring plan, besides IFC's HSE Guidelines (2007).

6.7 Expectations of Consultation Meetings

The consultation meeting had the following expectations:

- Drinking water supply should be made available to the villages in Deh Kohistan on top priority basis.
- Schools should be provided with all the infrastructure and teachers
- Native species of bushes/trees should be planted in case there are plans to replace felled trees;
- Contractors must adopt standard procedures in all their works and it should be mandatory on them to follow the Environmental Management and Monitoring Plan as well as IFC's HSE Guidelines on employment of local labor and child labor;
- Sites used for labor camps and quarrying of construction materials should be rehabilitated and/or leveled;
- Spoiled dumps should be leveled so that adjacent community/farmers may use them for crops/tree planting;
- Dust and noise pollution should be minimized during construction work;
- Labor camps should not be established too close to local villages; and
- Leftover construction materials must be disposed off before leaving.

Information Disclosure and Enquiries at GAWPL Site	Observations/Response of the Communities
Participants were informed at the outset about the objectives of the wind farm project and about the prevailing environmental condition at the site. People were informed that according to initial observation at the site, the area was highly underdeveloped. There was no	Participants were appreciative of the initiative taken by AEDB in identifying the potential of wind energy in Deh Kohistan, which has remained an underdeveloped area since ages. They appreciated the initiative at bringing the environmental issues to the forefront, and also incorporating mitigation measures and provision of facilities such as water supply for construction, and

water, no electricity while dust and firewood was for free. There was room for upgradation of the general condition. The wind power project could be one step towards achieving the upgradation, but like all other development projects, it has limitations of its own. Those limitations are imposed by environmental aspects. These limits are identified by environmental impact assessment. The purpose of our visit, the participants were explained, was to share information on the environmental baseline and impact that the different activities will have on the physical and social environment. The impact of activities involved in bringing the machinery and equipment to site, their installation, and operation will be assessed and finally the environmental performance will be evaluated. The participants were informed about the different environmental aspects and their impact on the physical and living environment and how the severity of impact will be reduced. They were informed that evaluation of social soundness of the project was just as important as physical and biological soundness. For this purpose it is important to have information on Living conditions at Project site and in the surrounding villages, name of villages, number of households, distance from Project site; distance from important towns, mode of transport; Availability of water and safe drinking water; Pattern of disease and common ailments in the area; Availability of healthcare facilities, and their performance, schools and their performance; General living conditions, occupation, professional affiliation, type of family, Size of family, Indigenous communities in the area, ethnicity, Treatment of disadvantaged communities. The people of the area nominated Mir Mohammad Burfat to provide all information since very few among them could interact in Urdu.	provision of safe drinking water, besides handing over the water supply and wastewater disposal system to the village residents at the end of construction period. There were observations on impoverishment of the environment resulting from inattention to improve the general condition of the area and maintaining it. Poverty was the main issue confronting the stakeholders in particular the residents of villages at great distances from the site. There were observations that ecological resources were being depleted at a rapid rate while subsistence farming was unable to meet the day-to-day needs of the local population. Others observed that poverty level in the district was almost the same, if not lower than the average in the rural areas of Sindh and the household income of at least 50% population was less than Rs 6000 per month/household. Employment opportunities were low and the younger generation was not prepared to remain in poverty; leading to considerable migration to Karachi in search of jobs. Poverty has mostly been caused by the following factors: • Scarcity of water • Recurring drought • Low return from crop and livestock farming • Low wages from stone cutting • Low literacy rate • Lack of training • High population growth • Lack of access to employment in industrial area • Increasing unemployment • High cost of healthcare In individual interview and focus group discussions, women identified the following issues: • Need for a dispensary and Mother and Child Healthcare Centre for Deh Kohistan • Awareness on education • Access to vocational training centre for women to earn through working at home • Establishment of industrial home type of institution for production of hand made goods • Gender discrimination • Compulsion to engagement in stone cutting to supplement their family income • Fetching water from long distances, some times more than once • Malnourishment. Community Expectations from GAWPL: All respondents i.e. males as well as females expect the following from the proposed project: • Safe drinking water** • Job Opportunity* • Healthcare centers particularly for women and children** • Schools*
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	• Vocational training • Black top link roads* • Poverty alleviation schemes* • Land development for suitable crops • Protection from drought • New income generating opportunities like small business, and supply of goods and services to the company and people working for the wind farm ** Highest Priority *High Priority The resident population was found expecting that the proposed wind power project would change their lifestyle and they will enjoy better quality of life while their young and future generation will not live in poverty.
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Annexure 6.1**LIST OF OFFICIALS OF INSTITUTIONAL STAKEHOLDERS**

S. #	Name	Designation
1	Naeem Ahmed Mughal	Director Sindh EPA
2	Mr. Hashmi	Director General Sindh EPA
3	Mr. Mir Hussain Ali	Secretary Ministry of Environment and Alternate Energy
4	Fehmida Firdaus	Sindh Wildlife Department
5	Mr. Hussain Bux Bhaagat	Conservator Wildlife GoS
6	Mr. Mohammad Aaqib	National Development Coordinator Clean Energy IUCN
7	Rafiul Haq	Coordinator Natural Resource Management
8	Tahir Qureshi	Head Forestry and Natural Resource Management
9.	Shakir Ali	Deputy Director, Department of Archaeology Government of Pakistan

Annexure 6.2**LIST OF STAKEHOLDERS RESIDENT IN SURROUNDING VILLAGES**

S.NO	NAME OF GOTH	NAME OF RESIDENT	REMARKS
1	Haji Wallo	Haji Wallo	The village is 1.5 km from the boundary. Residents appreciate the project and look forward to employment of their young men, getting safe drinking water supply, healthcare facility and school teachers.
2	Haji Wallo	Mohammad Bakhsh	
3	Haji Wallo	Khuda Bakhsh	
4	Haji Wallo	Allah Bakhsh	
5	Haji Wallo	Mohammad Ahsan	
6	Haji Wallo	Judial	
7	Haji Wallo	Majnoo	
1	Murad Ali Chang	Murad Ali Chang	The village is 1.2 km from the boundary. The nearest wind turbine will be sited to maintain a distance of 1.6 km. Residents appreciate the project and look forward to employment of their young men, getting safe drinking water supply, healthcare facility and school teachers.
2	Murad Ali Chang	Mohib Chang	
3	Murad Ali Chang	Mir Mohammad	
4	Murad Ali Chang	Dad Mohammad	
5	Murad Ali Chang	Dost Mohammad	
6	Murad Ali Chang	Rawal	
7	Murad Ali Chang	Umar	

1	Haji Lakhano	Haji Lakhano Jakhro	The village is 1.2 km from the boundary. The nearest wind turbine will be sited to maintain a distance of 1.6 km. Residents appreciate the project and look forward to employment of their young men, getting safe drinking water supply, healthcare facility and school teachers.
2	Haji Lakhano	Ali Hasan Jakhro	
3	Haji Lakhano	Ali Nawaz Jakhro	
4	Haji Lakhano	Gul Hasan Jakhro	
5	Haji Lakhano	Noor Hasan Jakhro	
6	Haji Lakhano	Ali Ahmed Jakhro	
1	Jan Mohammad Jakhro	Jan Mohammad Jakhro	The village is 2.5 km from the boundary. Residents appreciate the project and look forward to employment of their young men, getting safe drinking water supply, healthcare facility and school teachers.
2	Jan Mohammad Jakhro	Khudan Jakhro	
1	Karim Bakhsh Khaskheli	Karim Bakhsh Khaskheli	The village is 2.5 km from the boundary. Residents appreciate the project and look forward to employment of their young men, getting safe drinking water supply, healthcare facility and school teachers.
2	Karim Bakhsh Khaskheli	Usman Khaskheli	

6.8 FINDINGS AND RECOMMENDATIONS

Overall assessment of the environmental aspects and screening of potential impacts of the proposed activities pertaining to establishment of GAWPL-WPGC at Union Administration Jhimpir Taluka and District Thatta finds that:

- Site of the Project in the Jhimpir Wind Corridor is the preferred alternative for establishment of the GAWPL WPGC. It is suitable for wind classes 3-4.
- An appropriate number of wind turbines will be sited along the 11 km x 0.2 km strip of land, with each WTG spaced at optimum distances apart following the annual maximum wind direction.
- There are no issues on land acquisition, loss of land, or loss of business, and no involuntary resettlement will be required
- Noise emissions from the wind turbines at GAWPL WPGC site will have a high level at the top and will attenuate with distance. The noise level at the living areas at more than 1.5 km or three times the safe distance of seven rotor diameter equivalents will be within acceptable limits of the World Bank Guidelines and the limits recently proposed by Federal EPA.
- Visual effect, Noise effect, EMI effect, Flicker effect induced by operation of the wind turbines will have no significant impact on the living area, located 1.5 km or in excess of one rotor diameter equivalents outside the sub-leased land in Deh Kohistan 7/1.
- Detailed design will give due consideration to location of the WTG close to the clusters of settlements at Haji Wallo Goth, Murad Ali Chang Goth and Haji Lakhano Goth and site them to maintain a distance of about 1.6 km. At this distance, the noise from the wind turbine attenuates to acceptable levels, while the visibility, shadow flicker and shadow effects are viewed as curiosity and not annoyance.
- The induced impact on operation of the wind turbines on the microenvironment will be monitored through environmental management plan, environmental monitoring plan and the IFC's HSE Guidelines, and mitigated, if necessary by adoption of suitable measures at the site.
- Piles for the foundations of WTG towers would be laid, if required at depth of bedrock which are hard and pose minimum risk to the liquefaction threat during major (> 7 on Richter Scale) earthquake.
- Precious ecology of the microenvironment of GAWPL-WPGC will be protected. The land being stony wasteland has no worthwhile vegetation. A few patches of dead wood and dried up shrubs may have to be removed towards land clearance but the same will have only minor impact on the environment.
- There are no cultural heritage, recognized archaeological sites, endangered species of flora, wildlife reserve, or potential tourism sites that may need protection and hence no mitigation measures need to be taken. Mitigation measures have been proposed for the protection of the spiny-tailed lizard (*Uromastix hardwickii*) Sandha and the straying high flying birds. The number of the few Houbara bustard and high flying eagles and falcons still around will be recorded during the pre-construction period. Mitigation measures such as hiring the services of sharp shooters will be in place to stupefy the high-flying stray birds and later on release them to safe environment.
- Due vigilance will be kept for protecting the wildlife that may still be there.

- Adoption of mitigation measures identified for different stages of the project will be keenly monitored to further enhance the environmental performance of the GAWPL-WPGC.

Assessment of impact of activities during construction processes at the GAWPL site in Deh Kohistan shows that the impacts will be of temporary nature and small order. They are not expected to have any significant adverse impacts on the microenvironment and macroenvironment of the Project. The minor impacts resulting from said activities or operation of facilities would be mitigated.

6.9 RECOMMENDATIONS

IEE of the GAWPL has identified the key environmental aspects that need to be attended to. Mitigation measures for the likely impact have been suggested. General specification/details have been worked out in respect of type of structures, grade of concrete, and all other materials of construction for the Construction Phase of GAWPL WPGC.

It is recommended that:

- a. The structures and materials conform to recommended standards and follow standard practice of civil works.
- b. Environmentally sound materials and goods are selected, with priority being accorded to products meeting national and international standards.
- c. Traditionally well-tried materials are chosen for provision of utilities services in the Project.
- d. Temporary inconveniences due to construction works are minimized through planning and coordination with local population and organizations in the neighbourhood.
- e. The foundations of the wind turbine towers are of concrete on bearing soil. Bearing capacity, settlement, static and dynamic loading conditions are determined while seismic conditions pertain to placement of the site in zone 2A (Moderate to High hazards) and taken into account in the working designs that have been submitted for approval.
- f. The stability of soil is verified before laying the foundations of the wind turbines.
- g. No resettlement of population or relocation of structures will be involved since the wind farm to be designed shall have living area of the villages clearly outside the corridor of impact of the location of wind turbines along the 11 km x 0.2 km strip of land sub-leased by AEDB. The stakeholders have been consulted in this connection and the village representatives have assured of unhindered completion of the Project.
- h. Environmental Performance Monitoring will be an integral part of the Project to ensure environmental safeguards.

6.10 CONCLUSIONS

Review of Guidelines for classification of polluted and unpolluted sites with respect to their airshed, watershed, soil, sensitivity of ecosystem including fauna, flora, wildlife, aquatic life, historical and archaeological sites and their values, along with assessment of impact by using the “Checklist of actions affecting environment and significance of their impact” has been used in this IEE Study for assessment of impact of different activities for establishment of GAWPL Wind Power Generation Complex (WPGC). The review process finds that:

- The impacts from Wind Farm Project during construction, and installation of machinery and the resulting emission of noise and gaseous effluent, and wastewater discharges during siting, construction and operation of the Wind Farm Project would be of small order and would be of little significance at the site or microenvironment and none in the macroenvironment.
- Estimates on net saving in terms of air pollutants clearly suggest that operation of the GAWPL Wind Power Project would be economically viable and environment friendly.
- No untreated wastewater would be discharged from the GAWPL Wind Farm. Initiatives will be taken to harvest rainwater by channelizing it into dyked ponds for subsequent use in plantation.
- Noise emissions from the wind turbines at GAWPL WPGC site will have a high level at the top and will attenuate with distance. The noise level at the living areas at more than 1.5 km or three times the safe distance of seven rotor diameter equivalents will be within acceptable limits of the World Bank Guidelines and the limits recently proposed by Federal EPA.
- The level of emissions and discharges suggests that Wind Farm operations will have no significant impact either on its microenvironment that includes the proposed site for Wind Farm, or on its macroenvironment that includes small clusters of settlements.

Screening of potential environmental impacts at the different stages viz. siting, construction, installation of machinery and equipment and finally operation, leads to the conclusion that:

- The wasteland at Deh Kohistan has remained an isolated component of the ecosystem of Lower Sindh for a long time. Location of GAWPL WPGC will comprise value - addition to the wasteland, besides having no significant impact on the micro and macroenvironment, will not degrade the ecology of the stony wasteland of Deh Kohistan.
- Visual effect, Noise effect, EMI effect, Flicker effect induced by operation of the wind turbines will have no significant impact on the living area, located 1.5 km or three times the safe distance of seven rotor diameter equivalents outside the sub-leased land in Deh Kohistan 7/1. The induced impact on operation of the wind turbines on the microenvironment will be monitored through environmental management plan, environmental monitoring plan and the IFC’s HSE Guidelines, and mitigated, if necessary by adoption of suitable measures at the site.
- There are no cultural heritage, recognized archaeological sites, endangered species of flora, wildlife reserve, or potential tourism sites that may need protection and hence no mitigation measures need to be taken. Mitigation measures have been proposed for the

protection of the spiny-tailed lizard (*Uromastix hardwickii*) Sandha and the straying high flying birds. The number of the few Houbara bustard and high flying eagles and falcons still around will be recorded during the pre-construction period. Mitigation measures such as hiring the services of sharp shooters will be in place to stupefy the high-flying stray birds and later on release them to safe environment.

- Finding of archaeological artifacts during the construction phase will be immediately reported to the Department of Archaeology, Sindh.
- The proposed GAWPL Wind Farm, when commissioned, would add value to the otherwise wasteland of Deh Kohistan and become an integral part of the macroenvironment of Union Administration Jhimpir.

Based on the findings of the environmental assessment, it is reasonable to suggest that the environmental impacts of establishment of GAWPL-WPGC are minor and can easily be mitigated by implementing the Environmental Management Plan (EMP), Environmental Performance Monitoring Plan and IFC's HSE Guidelines as well as Equator Principles all of which form an integral part of the IEE

The value-addition characteristics of GAWPL WPGC as well as the largely insignificant impact of its operations on the microenvironment and macroenvironment does not demand further detailed Environmental Assessment.

6.11 ECONOMIC ASSESSMENT OF ENVIRONMENTAL IMPACTS

A. Environmental Benefits Of Wind Farm Development

Significant environmental benefits will be gained by installing the GAWPL WPGC. Developing the renewable energy resource would, besides proportionately lessening the need to use fossil fuels such as imported fuel oil, or gas, complement the GoP efforts in increasing the power production capacity. Substantial reduction in gaseous emissions from fuel-fired generation will be achieved, although the amount would depend on the wind farm installed capacity.

B. Saving on Emissions

Utilizing wind power is among the cheapest methods of reducing CO₂ emissions in electricity production. According to a Danish study, a 100 MW offshore wind farm will reduce CO₂ emissions by almost 0.3 million tons per year, when substituting power from conventional coal-fired power plants. The costs will be approximately US\$ 5 per ton of CO₂ for offshore wind farms situated near the coast.

CO₂ emission is not the only gas of concern in terms of global warming. Others including NO_x, VOCs and humidity also contribute to retaining the thermal component of solar energy. The following indicative figures are based on the estimates that a 100 MW installed capacity power plant using fossil fuel produces 1 kg of CO₂ for generation of each 1 kWh of electricity. Accordingly the 50 MW capacity power plant based on fossil fuel would produce:

- CO₂ (a major contributor to the “greenhouse effect”): 155,000 tonnes/year
- SO₂ (Sulphur Dioxide a constituent of acid rain): 2,375 tonnes/year
- NO_x (Nitrous Oxides a constituent of acid rain): 1,150 tonnes/year

Thus GAWPL Wind Power Generation Complex will

- Prevent emission of an amount equivalent to 155,000 tonnes CO₂, 2,375 tonnes SO₂, and 1150 tonnes NO_x annually
- Add as much value as the saving on CO₂ to the wind whose potential has so far remained neglected in the country.
- Help the government environmental initiatives in:
 - o Augmenting the power production capacity in the country, and
 - o Lowering the emission of greenhouse gases.

CHAPTER 7

ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

7.0 This Chapter presents an environmental management plan (EMP) as the implementation mechanism to manage environmental and social issues and mitigation measures identified in Chapter 5 on screening potential environmental impacts and mitigation measures

7.1 Objectives of Environmental Management Plan

The EMP will help GAWPL, the Proponent in addressing the adverse environmental impact of the project, enhance project benefits, and introduce standards of good environmental practice. The primary objectives of the EMP are to:

- Facilitate Owner/project sponsors corporate policy on environment
- Define the responsibilities of project coordinators, contractors and other role players and effectively communicate environmental issues among them.
- Facilitate the implementation of mitigation measures identified in the IEE by providing the technical details of each project impact, and providing an implementation schedule.
- Define a monitoring mechanism and identify monitoring parameters to ensure that all mitigation measures are completely and effectively implemented.
- Ensure that after completion of Project, restoration of site and rehabilitation work will be carried out
- Required equipment and human resources for environmental monitoring and meeting contingency plan objectives are in place and personnel are trained to meet accidents and emergencies

7.2 Scope of EMP

This Environmental Management Plan has provided detailed strategy to be implemented for achieving improved environmental performance in the following areas:

1. Environmental Management
2. Water Usages and Disposal
3. Recycling and Waste Management
4. Storm Water Management
5. Pollution Prevention/Environmental Risk Assessment
6. Bio-Diversity
7. Energy Management
8. Transport
9. Community Awareness

7.3 Components of EMP

The EMP consists of the following components:

1. Legislation and Guidelines
2. Organizational Structure and Responsibilities
3. Mitigation Plan

4. Environmental Monitoring Plan
5. Emergency Response and Contingency Plan
6. Communication and Documentation
7. Change Management

7.3.1 Legislation and Guidelines

The IEE for Wind Power Generation has discussed national and international legislation and guidelines that are relevant to the project. GAWPL will ensure that the key project management officials and staff and all its assigned consultants and contractors are aware of these legislations and guidelines prior to the start of the project activities.

Legislation and Guidelines

EIA Regulation: The project will be conducted in conformance with EIA regulation and relevant international conventions and that guidance is sought from national and international guidelines. An independent monitoring consultant will be appointed for the project.

NEQS Requirements: The NEQS for industrial gaseous emissions, Motor Vehicle Emissions and Noise levels, and Industrial and Municipal effluents will be followed throughout the project activities and operation.

World Bank Guidelines: The World Bank guidelines will be followed in all such cases where National guidelines have not been proposed. The project designers need to know applicable bank requirements and the environmental implications of their design choices.

Protection of Wildlife & Endangered Species: The Wind Corridor in Deh Kohistan is wasteland having few trees on its area and hence offers no attraction for habitation to the falcons or other highflying birds of concern to the project. As such they are only occasional visitors to Deh Kohistan. It will be necessary to monitor the number and type of visiting bird species including the falcons during the pre-construction and subsequent stages of the project. Mitigation measures for protection of the spiny-tailed lizard (*Uromastix hardwickii*) Sandha have been proposed and the same will be adopted.

7.3.2 Organizational Roles and Responsibilities

GAWPL shall have its own Environmental Management System GAWPL EMS to ensure the implementation of EMP and Health and Safety Issues during construction and maintenance.

- The environmental management responsibilities will be assumed by its Project Manager and his team members during construction and operations phase to:
- Coordinate with relevant government departments
- Identify and report changes in activities and services that may create new environmental aspects
- Collect and coordinate information regarding environmental aspects, and maintain records related to environmental aspects and their impacts
- Ensure construction work is carried out in an environmentally sound manner by the Contractor by incorporating environmental compliance by appropriate provision in the construction contract

- Contractor will ensure compliance with the environmental management plan by way of training of construction crews in all aspects of implementation of EMP.

7.4 Environmentally Sound & Safe Working Procedures

7.4.1 Contractors, sub-contractors and contract workers will be made aware of environmental aspects and Emergency Response Plan prior to commencing the work. Prior to leaving the site contractors, sub-contractors and contract workers will ensure that their work area is in safe position. On emergency call they will report in assembly area.

7.4.2 Written procedures or standards will be prepared for all activities, where the absence of such procedures and standards could result in not following HSE policy, the law or the contract.

7.4.3 Safe Working Procedures will be based on the following four aspects of job safety:

Safe Place: Work site will be designed and controls set up to ensure that working environment provides no significant risk to personnel, property and the environment.

Safe Equipment: All equipment for any job, including tools, machinery and protective equipment will be specified and/or designed to ensure that it poses no significant risk to personnel, property or the environment. All equipment will comply with legislative standards for conformity and test.

Safe Procedure: Procedures will be designed for all aspects of the job to facilitate safe use of equipment at the work site to complete tasks with no significant risk to personnel, property or the environment. Design of procedure will be based on step-by-step analysis of the tasks involved (Job Safety Analysis), identification of associated hazards and elimination of control of those hazards. Procedures should allow for work in ideal conditions as well as under aggravating conditions e.g. adverse weather.

Trained Personnel: Suitable job-specific, safety skills and supervision training will be provided to personnel involved in construction and operation activities so that they are able to use the procedure and equipment at the worksite with no significant risk to personnel, property and environment.

Safe Working Procedures will be available to contractors and sub-contractors, who will adopt the relevant labour laws of the country.

7.4.4 Identification of Environmentally Safe Aspects

GAWPL-EMS will:

Identify Environmental aspects at the initiation of activities at the site with regard to:

- Emissions of fugitive dust and gaseous pollutants from vehicles and equipment,
- Discharges of liquid effluent including oily waste and seepage to land, and water
- Disposal of excavated material and solid waste to land, water and air
- Noise

- Consumption of natural resources and energy
- Emergency releases
- Fauna and Flora.

7.4.5 Environmental Assessment of Safe Procedures

After identifying the environmental aspects, the related impacts will be assessed and the significance of each aspect will be evaluated. Following factors will be considered for evaluating the impacts:

- Parts of microenvironment impacted
- Parts of macroenvironment impacted
- Whether the impact is beneficial or damaging
- Severity of impact
- Frequency or likelihood of impact
- Existing mitigation measures
- Adequacy of mitigation measures
- Concerns of stakeholders/interested parties
- Regulatory requirements and their compliance

7.4.6 Impact rating

Impact rating will be assessed for each identified aspect to determine the significance as small, medium and high intensity or non-significant.

7.5 Environmental Aspects of Construction Activity

Construction activities at Deh Kohistan 7/1, Jhimpir for establishment of GAWPL WPGC Wind Farm would likely include the following main elements:

- Location of campsite and field construction office
- Construction of site roads, turn-around areas and crane pads at each wind turbine location;
- Construction of turbine tower foundations and transformer pads;
- Installation of electrical collection system – underground and some overhead lines;
- Assembly and erection of wind turbines;
- Construction and installation of substation;
- Plant commissioning and energizing.

The above activities would likely entail the following issues that may have impact on the environment and require adoption of mitigation measures during the implementation phase:

- Heavy weight and/or long trucks haulage
- Surface sealing (WTG foundations)
- Topsoil removal
- Compressing of topsoil
- Fuel storage
- Concrete production
- Waste disposal
- Dust
- Construction related noise

- General conditions of construction site (visual)
- Disturbance of fauna
- Impact on flora
- Emergency response
- Site rehabilitation.

7.5.1 Potential Impact of Construction Activity & Mitigation Measures

Construction at the proposed site of Wind Farm would not involve extensive land preparation and the likely impact will be minor and not significant on the microenvironment i.e. Deh Kohistan 7/1 Jhimpir that has currently insignificant land use, while the few hamlets are outside the Project site,.

Site preparation activities would include clearing, excavation, earth and fill movement; transportation of towers, rotors, wind turbine sets and associated equipment to the site. The said activities will lead to soil erosion resulting from removal of topsoil at the site, but to improvement of its quality. The fugitive dust emission would be extensive because of aridity of the soil. Dust emission due to other materials of construction will be controlled through appropriate measures to reduce the level of impact to be of minor significance.

Temporary disturbance to the landscape will be limited to the microenvironment during construction at site, turn-around areas and crane pads at each wind turbine location; construction of turbine tower foundations and transformer pads; installation of electrical collection system, including underground and overhead lines; assembly and erection of wind turbines, and construction and installation of substations.

Formation of internal access tracks, foundation excavations, electrical trenching and other site works will hardly be perceptible to the residents of villages in the neighbourhood at distances of over 1.5 km from the site. Estimates available from other sites show that 7 - 10% of the project area is temporarily disturbed for road and crane pad construction. At completion of the project, the turbines, access tracks and associated equipment occupying about 1% of the site area, will meaningfully add value to the wasteland at Deh Kohistan 7/1, Jhimpir.

Co-habitation issues with existing wind farm operations will not require assessment and negotiation with landowners.

Diesel and other petroleum products used for the operation of construction machinery and transportation equipment would cause air pollution besides causing soil pollution through oil spills. The impact from such activity would be of minor significance and would be controlled by good housekeeping practices.

Water required for numerous construction activities would not be of such order as to result in any significant impact on other beneficial water uses or its reduced availability for functions of villages outside sub-leased area in Deh Kohistan 7/1 Jhimpir. Conservation practices would nevertheless be adopted during the entire course of construction.

Noise, visual impact, flicker shadow and shadow impact will be limited to the microenvironment comprising the allotted land.

No major operational impact is envisaged at the construction stage from the GAWPL WPGC wind farm.

7.5.2 Potential Impacts At Operation Stage & Mitigation Measures

Environmental problems identified at the Operations stage of GAWPL WPGC Wind Farm relate to:

Air quality and noise level changes due to operation of fleet of long vehicles, container trucks and operation of mechanical equipment.

Visual Effects

Noise Effect

EMI Assessment

Flicker Effects

Cultural Heritage and Archaeological Issues

Flora

Fauna (Wildlife, Birds)

Recreational and Tourism Issues

Operation of Wind Farm would not release air pollutants into the airshed, and wastewater will be discharged into the soak pits after treatment.

Diesel and other petroleum products used for operation of mechanical equipment and transportation vehicles may cause air pollution and also soil pollution through oil spills. The impact from such activity would be of minor significance and would be controlled by good housekeeping practices.

Noise emissions from the wind turbines at GAWPL WPGC site will have a high level at the top but the same would attenuate with distance. The noise level at the living areas at more than 1.5 km or 20 times the hub height will be within acceptable limits of the World Bank Guidelines and the limits recently proposed by Federal EPA.

Visual effect, Noise effect, EMI effect, Flicker effect induced by operation of the wind turbines will have no significant impact on the living area, located 1.5 km or 20 times the hub height outside the sub-leased land in Deh Kohistan 7/1.

Daily water requirement at the site during operation and wastewater discharges would not be of such magnitude as to result in any significant impact on other beneficial water uses or its reduced availability for the functions in the villages that are even otherwise outside the operations area of GAWPL WPGC site. Conservation practices would nevertheless be adopted during the entire course of construction.

Generation of solid and hazardous waste will be of small order and good housekeeping practices will be adopted to reduce their impact.

There are no cultural heritage, recognized archaeological sites, endangered species of flora, wildlife reserve, or potential tourism sites that may need protection and hence no mitigation measures need to be taken. Mitigation measures have been proposed for the protection of the spiny-tailed lizard (*Uromastix hardwickii*) Sandha and the straying high flying birds. The number of the few Houbara bustard and high flying eagles and falcons still around will be recorded during the pre-construction period. Mitigation measures such as hiring the services of sharp shooters will be in place to stupefy the high-flying stray birds and later on release them to safe environment.

7.5.3 Mitigation Plan

Mitigation plan as a key component of GAWPL-EMS lists all the potential impacts of project activities and associated mitigation measures identified in the IEE. Mitigation measures for different activities during different phases of the Project are as follows:

Pre-Construction Phase

Following are likely to be the main activities at pre-construction phase:

- Photographs of the project area will be taken for recording current status of environment to compare with alterations introduced by the Project

- Monitoring disturbance or alterations in the natural drainage of Deh Kohistan 7/1, Jhimpir, and soil erosion, if any
- Number of approach routes to different facilities over the Wind farm and the powerhouse will be minimized
- Use of horns will be avoided
- Soaking pits for waste water from campsites will be constructed and hazardous waste from these pits will be treated during rehabilitation and restoration phase
- Leakages and drips from operating vehicles and equipment will be attended to immediately; vehicles with leaks will be restrained from operation at the site. All vehicles will carry fire extinguishers

7.6 Environmental Management Programme

The following environmental aspects would require planned intervention by GAWPL-EMS for the WPGC at Deh Kohistan 7/1, Jhimpir:

7.6.1 Design Phase: Location/Siting of GAWPL WPGC			
Project Activity	Potential Hazards & Environmental Impacts	Proposed Mitigation Measures and Residual impact	Institutional Responsibilities & Actions Taken
Site Selection	Land Lease in Jhimpir Wind Corridor Land use, Resettlement of Population Relocation of assets	647 acres land in Deh Kohistan 7/1 Jhimpir has been sub-leased to GAWPL WPGC by AEDB. There are no issues relating to existing land use and land tenure or on loss of land, or loss of business. No involuntary resettlement is consequently required and no business is to be considered lost on the land. There is no vegetation on wasteland of Deh Kohistan 7/1. There are no sensitive assets of concern on the GAWPL WPGC-Deh Kohistan site.	<i>Design Consultant</i> Accounted for in the Land Lease and Agrrement to Sub-Lease
	Seismic Activity Changes in sub-soil structure resulting from Location of campsite and field construction office Construction of internal roads at site, turn-around areas and crane pads at each wind turbine location; Construction of turbine tower foundations and transformer pads; Installation of electrical collection system – underground and some overhead lines; Assembly and erection of wind turbines; Construction and installation of substation	IFC's EHS Guidelines will be strictly followed Allowable bearing capacity to be adopted for Seismic Zone 2A. Temporary disturbance to the landscape that will occur during construction of site roads, turn-around areas and crane pads at each wind turbine location; construction of the turbine tower foundations and transformer pads; installation of the electrical collection system, including underground and some overhead lines; assembly and erection of the wind turbines, and construction and installation of the substation, will be limited to the microenvironment. Formation of internal access tracks, foundation excavations, electrical trenching and other site works will not be visible to the residents of villages in the neighbourhood at a distance of over 1.5 km or 20 time hub height from site. Estimates from other sites show temporarily disturbance over 7 - 10% of project area for road and crane pad construction. On completion of project, the turbines, access tracks and associated equipment occupying about 1% of the site area, will meaningfully add value to the wasteland at Deh Kohistan. Co-habitation issues with existing wind farm operations will not require assessment and negotiation with landowners. Diesel and other petroleum products used for operation of construction machinery and transportation equipment would cause air pollution besides causing soil pollution through oil spills. The impact from such activity would be of minor significance and would be controlled by good housekeeping practices. Water required for numerous construction activities would not result in any significant impact on other beneficial water uses or reduce its availability for functions of hamlets outside Project area. Conservation practices would nevertheless be adopted during the entire course of construction. Noise, visual impact, flicker shadow and shadow impact will be limited to the microenvironment comprising the allotted land. No major operational impact is envisaged at the construction stage from the GAWPL WPGC wind farm.	<i>Design Consultant</i> Will be accounted for in the Detailed Design
	Construction activity induced Changes in Ecology	Land use changes in ecology and Loss of vegetation will be non-issue on the wasteland of Deh Kohistan 7/1, Jhimpir where WPGC will be sited. IFC's EHS Guidelines will be strictly followed to minimize changes if any	<i>Environmental Consultant</i>
	Construction Activity induced Land Use Changes	Restoration of land after use	<i>Environmental Consultant</i>

7.6.2 Design Phase: Location of Utilities at GAWPL WPGC Wind Farm			
Project Activity	Potential Hazards & Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibilities & Actions Taken
	Safety on Access Road, Construction of site roads, turn-around areas and crane pads at each wind turbine location; Construction of the turbine tower foundations and transformer pads; Installation of the electrical collection system – underground and some overhead lines; Assembly and erection of the wind turbines; Construction and installation of the substation	IFC's EHS Guidelines will be strictly followed Incorporation of Safety provisions The impacts from Wind Farm Project during construction, and installation of machinery and the resulting emission of noise and gaseous effluent, and wastewater discharges during siting, construction and operation of the Wind Farm Project would be of small order and would be of little significance at Project site or its microenvironment and none in its macroenvironment.	Environment Specialist/Design Consultant Design to include the on-site facility in GAWPL WPGC CoI
	Water Supply & Drinking Water	IFC's EHS Guidelines will be strictly followed GAWPL Wind Farm would have its share of water from the Kalri-Baghar Feeder that will soon start feeding the Nooriabad Industrial Area and would thus have no significant impact on the current beneficial water uses in the area.	Environment Specialist/Design Consultant Detailed Designs to include water supply and sewerage system and standard septic tanks at construction sites.
	Slope Protection	IFC's EHS Guidelines will be strictly followed Intersecting natural flow will be diverted to protect foundations/piles towards bandats for use in vegetation	Environment Specialist/Design Consultant Designs will provide for directing surface flow away from WTG foundation and into bandats/temporary reservoirs for subsequent use in plantation.
	Wastewater	IFC's EHS Guidelines will be strictly followed Sewerage system for conveyance of wastewater from construction sites to septic tanks and separate arrangement for sludge disposal to be provided at campsite and residential area of workers and officials at GAWPL WPGC Wind Farm. Provision of Gravel/Sand Bed for passing Workshop/Yard wastes containing oil & grease	Environment Specialist/Design Consultant Septic tanks will clarify the wastewater by sludge settlements and reduce BOD with increased residence time. Overflow from the septic tank will flow into standard soak pits.
	Solid waste Construction Waste	IFC's EHS Guidelines will be strictly followed Solid waste at camp & construction sites will not be mixed with hazardous waste and will not be disposed of into the HaroloNai. Segregation at source and provision of containers for conveyance to burn-pit at construction sites. Construction waste will be disposed of in designated areas at borrow pits.	Environment Specialist/ Design Consultant Positioning of containers and burn pits will be provided for in the furnishings.
	Air Quality	IFC's EHS Guidelines will be strictly followed The airshed of the GAWPL Wind Farm is unpolluted. The dust fall in the microenvironment is high as a result of high aridity in the airshed of the macroenvironment as well as that of the site itself.	Design Consultant Detailed Designs to account for impact of high dust fall
	Air Pollution	IFC's EHS Guidelines will be strictly followed Air and noise pollution and other forms of nuisance in the microenvironment and macroenvironment of site will be mitigated by monitoring the level of particulate matter and noise. Air pollution due to fugitive dust emission and operation of equipment during construction will be controlled by good housekeeping practices e.g. sprinkling water.	Environment Specialist/Supervision Consultant Implementation of EMP and Monitoring Plan will ensure mitigation of impact of air pollution.
	Noise Pollution	IFC's EHS Guidelines will be strictly followed Noise from Wind turbines does not generally exceed background noise levels at a distance 7 rotor blade diameter from the turbines (5 - 7 rotor diameters is the conventional separation from older versions of turbines; noise footprint of newer turbines is smaller). No mitigation measures would be necessary on siting the 50 MW GAWPL WPGC Wind Turbines at 1.5 Km from any living/activity area. Provision of ear plugs to personnel working in areas with noise level above 85 dB(A).	Environment Specialist/Design Consultant Implementation of EMP and Monitoring Plan will ensure mitigation of impact of noise pollution.

7.6.3 Location & Management of GAWPL WPGC Wind Farm Facilities			
Environmental Issue	Requirement	Mitigation Measures	Institutional Responsibilities & Actions Taken
Topsoil Conservation	Management of Project facilities and Conservation of soil	IFC's EHS Guidelines will be strictly followed Identification & inclusion of siting in the overall design of different activity centers such as camp site, borrow pits, WTG foundation sites.	Environment Specialist/Design Consultant Design to include the on-site facilities at GAWPL WPGC Deh Kohistan 7/1, Jhimpir.
Location & Management of Project Facilities	Management of Project facilities	IFC's EHS Guidelines will be strictly followed The Design would ensure that Campsite is at 500 m distance from living area/village Campsite does not hinder movement of villagers Construction wastes are removed & disposed of in designated borrow pits in environmentally sustainable manner Excavation of 50 cm soil for borrow area Fugitive dust emission is kept to the minimum Site for storage of construction waste is duly restored after use Borrow pits for waste disposal at natural depressions are provided with impervious layer Hazardous waste including concrete waste, if any is segregated & disposed of into borrow pits with impervious layer and liner Oil containers are in place for temporary storage of lubricants Soil contamination is avoided Walls are constructed and suitably landscaped near sensitive locations such as schools, mosques and graveyards for providing sanctity to the structure and protection against noise pollution.	Environment Specialist/Design Consultant/Contractor Design to include the on-site facility at GAWPL WPGC Wind Farm and Contractor to implement the mitigation measures duly supervised by Supervision Consultant and Environment Specialist by implementation of the EMP and Monitoring Plan.

7.6.4 Pre-Construction Phase: Management of Land Use			
Project Activity	Potential Hazards & Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibilities
Mobilization of contractor(s) and pertinent equipment and machinery	Awareness on Environmental Aspects related to use of equipment and associated environmental and occupational health hazards	IFC's EHS Guidelines will be strictly followed Creation of awareness on procedures of - o safety - o health - o environment Provision of protective devices for safety Provision of protective measures for workers	Contractor
Mobilization of project equipment and materials	Awareness on Aspects related to use of equipment and associated environmental and occupational health hazards	IFC's EHS Guidelines will be strictly followed Provision of protective devices for safety Provision of protective measures for workers	Contractor
Establishment and operation of construction camps	Awareness on Aspects of environmental, occupational health & safety	IFC's EHS Guidelines will be strictly followed Provision of jobs for locals Provision of protective devices for safety Provision of protective measures for workers	Contractor
<i>Pre-Construction Phase: Land Preparation</i>			
Initiation of activities at site	Stony Wasteland, scanty vegetation	IFC's EHS Guidelines will be strictly followed Take cognizance of stony wasteland.	<i>Contractor/supervised by HSE Manager</i>
Construction activities at site	Operation of heavy equipment, Noise, Fugitive dust emission, Gaseous emission from construction equipment, Accidents	IFC's EHS Guidelines will be strictly followed Safe Working Procedures; Environmentally Sound Standard Operating Procedures Emergency Response Plan	<i>Contractor/supervised by HSE Manager</i>
Topsoil Conservation	Stony wasteland Topsoil sandy	IFC's EHS Guidelines will be strictly followed Implement good house keeping and environmentally sound standard management practices	<i>Contractor/supervised by HSE Manager</i>
Environmental Enhancement Re-vegetation and Plantation	Damages done to arid ecosystem by natural and man-made activities including sand/ & gravel excavation/ stone crushing /wood cutting & transportation	IFC's EHS Guidelines will be strictly followed Rainwater harvesting and using the water accumulation for revegetation and Establishment of Biodiversity Park specific to arid zone environment.	<i>Contractor/supervised by HSE Manager</i>
Management of Drainage System	Damages done by construction activity to drainage system, and structures, and likely impact during construction	IFC's EHS Guidelines will be strictly followed Take cognizance of arid/stony wasteland that is sandy Avoid location of Camps and access tracks/internal roads on land sloping towards the Harolo Nai Campsite will not be established in the vicinity of Harolo Nai that is the source of water supply to village in the surrounding of GAWPL WPGC Wind Farm. Maintenance of vehicles and other equipment will be allowed only in designated areas underlain with concrete slabs and a system to catch runoff. Washing of vehicles will be restricted.	<i>Contractor/supervised by HSE Manager</i>
Protection of Cultural & Community Owned assets	Adverse impact of siting campsites	IFC's EHS Guidelines will be strictly followed Camps, access tracks, and other project sites will avoid cultural and community owned assets. No campsite will be established in the vicinity of cultural sites and community owned assets. Land acquisition from Revenue Department Government of Sindh by AEDB and sub-leasing the same will not require resettlement of population or relocation of structures.	<i>Contractor/supervised by HSE Manager</i>

7.6.5 GAWPL WPGC Project Environmental Management Programme

GAWPL WPGC Environmental Management Programme			
Project Activity	Potential Hazards & Environmental Impacts	Proposed Mitigation Measures	Institutional Responsibilities
Emergency Medical Aid Services	Emergency Management	IFC's EHS Guidelines will be strictly followed Establishment of emergency First Aid system Provision of speedy transportation system staffed by trained Medical Technicians Adoption and implementation of fire/emergency/contingency plans	Ambulance to be provided at the Construction site <i>HSE Manager</i> to implement Emergency Management Plan and Disaster Management Plan
Environmental Awareness	Creation of awareness on procedures of safety health environment	IFC's EHS Guidelines will be strictly followed Provision of protective devices for safety Provision of protective measures for workers	<i>HSE Manager</i>
Environmental Management Services	Availability of campsite environmental management services	IFC's EHS Guidelines will be strictly followed Adoption and implementation of environmental services plans, including: Best Management of Road construction Environment Best Ground & Housekeeping Management Practices Professional on-site management and support resources Assurance of access to emergency services at GAWPL WPGC Units	<i>HSE Manager</i>
Emergency Management	Availability of emergency services	IFC's EHS Guidelines will be strictly followed Establishment of emergency systems Adoption and implementation of fire/emergency/contingency plans	<i>HSE Manager</i>
Disaster Management	Keeping prepared for disaster	IFC's EHS Guidelines will be strictly followed Establishment of Contingency Plan for WPGC Preparedness for Disaster & Implementation of fire/emergency/contingency plans	<i>HSE Manager</i>

7.7 Emergency Response Plan

GAWPL-EMS would implement its own Emergency Response Plan during the pre-construction and construction stages. During the operations stage the plan will be implemented in conjunction with other wind farms in Jhimpir Wind Corridor and Nooriabad Industrial Estate. The Emergency Response Plan during the construction period will be managed and monitored by the GAWPL-EMS Emergency Response Team. The Response team will ensure that the operations are carried out in minimal

time avoiding any fire, safety and security hazard and affecting the environment. The team will be in readiness to adopt the following procedure:

- Evaluation of the situation to identify the most important steps, which must be taken first and can have an important bearing on the overall action to be taken.
- Deployment of required manpower and equipment.
- Organizing required logistical support so that there are no bottlenecks hampering the operation.
- See to it that injured persons are cared for.
- Respond to calls for ambulances for shifting the injured persons to neighbourhood hospitals/healthcare units and if necessary to DHQ Hospital Thatta.
- Isolate all sources of ignition and environmental hazard.
- Evacuation of people who are in immediate or imminent danger. Response Team and/or in-charge of the Campsite will exert positive leadership and give instructions calmly, firmly, explicitly, and courteously and obtain help of law enforcement agencies, if necessary.
- Block approach roads if necessary for safety of operations.
- Arrange for emergency notifications of water shed areas, public utilities, and the like to safeguard the public and property.
- Surveillance and monitoring operations.
- Retrieval and disposal of earth/debris and resources affected by the hazard at appropriate site.
- Termination of clean-up operation.

7.7.1 Training and Exercises

To ensure effective implementation of the Emergency Response plan, training programs for Disaster response personnel will be organized regularly in collaboration with wind farms in the neighbourhood. The training program will aim at:

- Maintaining the plan and working document to be fully operational.
- Inform the Response Team members and other relevant personnel of their respective duties and procedures to be followed.
- Familiarize all relevant personnel with the use of equipments.

The training program will be structured according to the level of responsibility of the participants:

- Classroom instructions as well as field demonstration will be conducted.
- Regular operational exercise/drills will be conducted to ensure that the response organization and other components detailed in the plan function effectively and
- Response Team members and other relevant personnel assigned specific responsibilities become fully familiar.

7.8 Environmental Monitoring Program

Monitoring: of different activities will be required to assess the impacts of activities during construction and operation on the environment. For this purpose GAWPL-EMS will establish its own unit to

- Coordinate with other units
- Follow the monitoring frequency of selected parameters as per the monitoring plan given in the following Table.

- Record all non-conformities observed and report them along with actions to Project Manager for further action.
- Report any impact anticipated along with recommendations for further action.

Contractor shall take note of the recommendations relating to issues arising during monitoring of construction activities.

7.9 The following Tables show the checklist of actions for monitoring different environmental Aspect during the Construction and Operations Phases of the Project:

Annexure 7.1

Checklist of Actions for Monitoring Environmental Aspects

Stage	Monitoring areas	Location of monitoring	Parameters to monitor	Documentation & Monitoring Frequency
Construction & Operation	Ecological Conditions	Access Road to Wind Mast B1, Haji Walloo & Haji Lakhano Goths, and Access Rd from Wind Farm to Powerhouse	Visual analysis and observations on flora and fauna for loss of biodiversity, recording number of trees lost, animals hunted/killed and number of visiting birds, hunted, killed, stupefied & saved	Quarterly
Construction	Water	Sampling points at campsite, powerhouse; Harolo Nai and Jhimpir water supply	Water analysis for following parameters: pH Dissolved Oxygen Total suspended solids Common ions Oil & grease Coliform count	Quarterly
Construction	Wastewater	Outlet of the wastewater treatment system	Wastewater analysis for the following parameters: pH Total suspended solids DO BOD Oil & grease	Quarterly
Construction	Solid Waste (Kitchen)	Collection, handling and disposal to designated areas/borrow pits	Observations on solid waste type, quantity and disposal arrangement	Quarterly
	Solid Waste			Quarterly
Construction	Air quality	15 meters distance from activity area	Parameters to monitor include: CO SPM SO ₂ NO _x	i. Before beginning of construction ii. Monthly during construction iii. Quarterly during operations

Stage	Monitoring areas	Location of monitoring	Parameters and techniques to monitor	Documentation & Monitoring Frequency
End of Construction	Restoration of sites	All excavation sites & Borrow pits	Visual Observations	Status Report for Completion of Construction
Operations	Accidental risk at site	GAWPL WPGC Deh Kohistan 7/1, Jhimpir	Visual Observations Recording accidents during operation of WTG & equipment	Quarterly
Operations	Noise	▪ Activity areas ▪ Wind Farm ▪ Powerhouse ▪ Haji Walloo & Lakhano goths ▪ Access Road	Noise intensity measurement	Quarterly
Construction & Operations	Occupational Safety	Installation of Machinery and equipment Operations areas	Visual observations and Recording hazard/accident	Quarterly

ACRONYMS

AEDB	Alternative Energy Development Board
Amsl	Above Mean Sea Level
BHU	Basic Health Unit
BOD	Biological Oxygen Demand
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species
COD	Chemical Oxygen Demand
Cusecs	Cubic feet per second
DCO	District Coordination Officer
DO	Dissolved Oxygen
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
ERoI	Energy Return on Investment
FAO	Food and Agriculture Organization
GAEL	Gul Ahmed Energy Limited
GATML	Gul Ahmed Textile Mills Limited
GDP	Gross Domestic Product
GoP	Government of Pakistan
GWh	Giga watt hour
Ha	Hectare
HESCO	Hyderabad Electric Supply Company
HSE /EHS	Health, Safety and Environment
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IPP	Independent Power Producer
IUCN	International Union for Conservation of Nature
km	Kilometer
KWh	Kilo watt hour
LAA	Land Acquisition Act (of 1894)
LNG	Liquefied Natural Gas
LoI	Letter of Intent
LPG	Liquefied Petroleum Gas
MAF	Million Acre Feet
GAWPCL	Metro Power Company Limited
MoU	Memorandum of Understanding
MSDS	Material Safety Data Sheet
MW	Mega Watts
NEPRA	National Electric Power Regulatory Authority
NEQS	National Environmental Quality Standards
NGO	Non Governmental Organization
NO_x	Oxides of Nitrogen
NTDC	National Transmission and Dispatch Company
O&M	Operation and Maintenance
PEPC	Pakistan Environmental Protection Council
PEPA	Pakistan Environmental Protection Act of 1997
PMD	Pakistan Meteorological Department
PPE	Personal Protective Equipment
PS	Performance Standard
RE	Renewable Energy
RH	Relative Humidity
RHC	Rural Health Center

TDS	Total Dissolved Solids
TMA	Tehsil Municipal Administration
TW	Tera Watts
UA	Union Administration
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
USEPA	United States Environmental Protection Agency
WB	World Bank
WHO	World Health Organization
WPGC	Wind Power Generation Complex
WTG	Wind Turbine Generator
WWF	World Wide Fund for Nature