



Environmental Impact Assessment (EIA)

Oil & Gas Exploration
Activities in

**ZINDAN-II BLOCK
(EL 3271-9)**

PUNJAB PROVINCE



**EMC Pakistan
Private Limited**



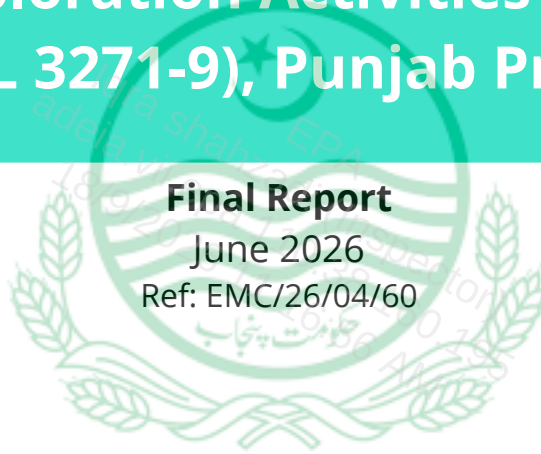
Environmental Impact Assessment (EIA)

Oil & Gas Exploration Activities in Zindan-II Block (EL 3271-9), Punjab Province

Final Report

June 2026

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EXECUTIVE SUMMARY

This document presents the findings of an Environmental Impact Assessment (EIA) carried out by EMC Pakistan (Pvt.) Limited for the project "Oil & Gas Exploration Activities in Zindan-II Block (EL 3271-9), Punjab Province" proposed by Oil & Gas Development Company Limited (OGDC). The total area of the block is approximately 951 km², of which approximately 534 km² falls within the administrative jurisdiction of Tehsil Piplan, District Mianwali, and approximately 417 km² falls within Tehsil Kalur Kot, District Bhakkar.

The proposed project involves 2D seismic activities in Zindan-II Block, spanning Districts Bhakkar and Mianwali, Punjab. Approximately 400-line km of seismic surveys will be carried out by the proponent for the exploration of oil and gas resources within the block.

The seismic survey activities are intended to acquire subsurface geological and geophysical data required for the exploration of oil and gas resources within the designated exploration block located in these districts. The exploration block has been awarded by the Government of Pakistan to Oil and Gas Development Company (OGDC) for carrying out oil and gas exploration and production activities.

It is important to note that the extent and layout of seismic coverage may be adjusted during the course of the project in response to technical, geological, or operational requirements. This Environmental Impact Assessment (EIA) Report has been prepared in compliance with Section 12 of the Punjab Environmental Protection Act, 1997, as amended in 2012 and 2017, to evaluate the potential environmental impacts of the proposed seismic activities and to recommend appropriate mitigation measures.

Tentative location coordinates for proposed 2D seismic lines are given below in **Table-ES-1** while project location map of Zindan-II Block, Punjab Province is given as **Figure ES.1.1**.

Table ES1.1: Tentative Location Coordinates of Seismic Activities

Seismic Line	Description	GPS Coordinates (X, Y)		Length L (km)
ZND-01	Start	32° 8'59.73"N	71°14'57.42"E	45.13
	End	32°20'4.30"N	71°25'24.12"E	
ZND-02	Start	32° 5'35.73"N	71°14'54.36"E	56.54
	End	32°21'52.04"N	71°30'14.64"E	
ZND-03	Start	32° 5'32.58"N	71°18'2.49"E	57.09
	End	32°19'54.34"N	71°31'39.50"E	
ZND-04	Start	31°56'57.74"N	71°13'52.82"E	79.86
	End	32°19'59.11"N	71°34'52.14"E	
ZND-05	Start	32° 5'23.21"N	71°24'49.43"E	49.36
	End	32°16'31.62"N	71°35'13.72"E	
ZND-06	Start	32°14'51.04"N	71°37'6.34"E	58.61
	End	32° 5'17.15"N	71°28'8.33"E	
ZND-07	Start	32° 4'51.35"N	71°31'24.61"E	53.41
	End	32°14'21.52"N	71°40'15.89"E	
ZND-08	Start	32°18'57.01"N	71°18'51.29"E	49.50
	End	32° 5'55.76"N	71°37'9.30"E	
Total Line Km				400

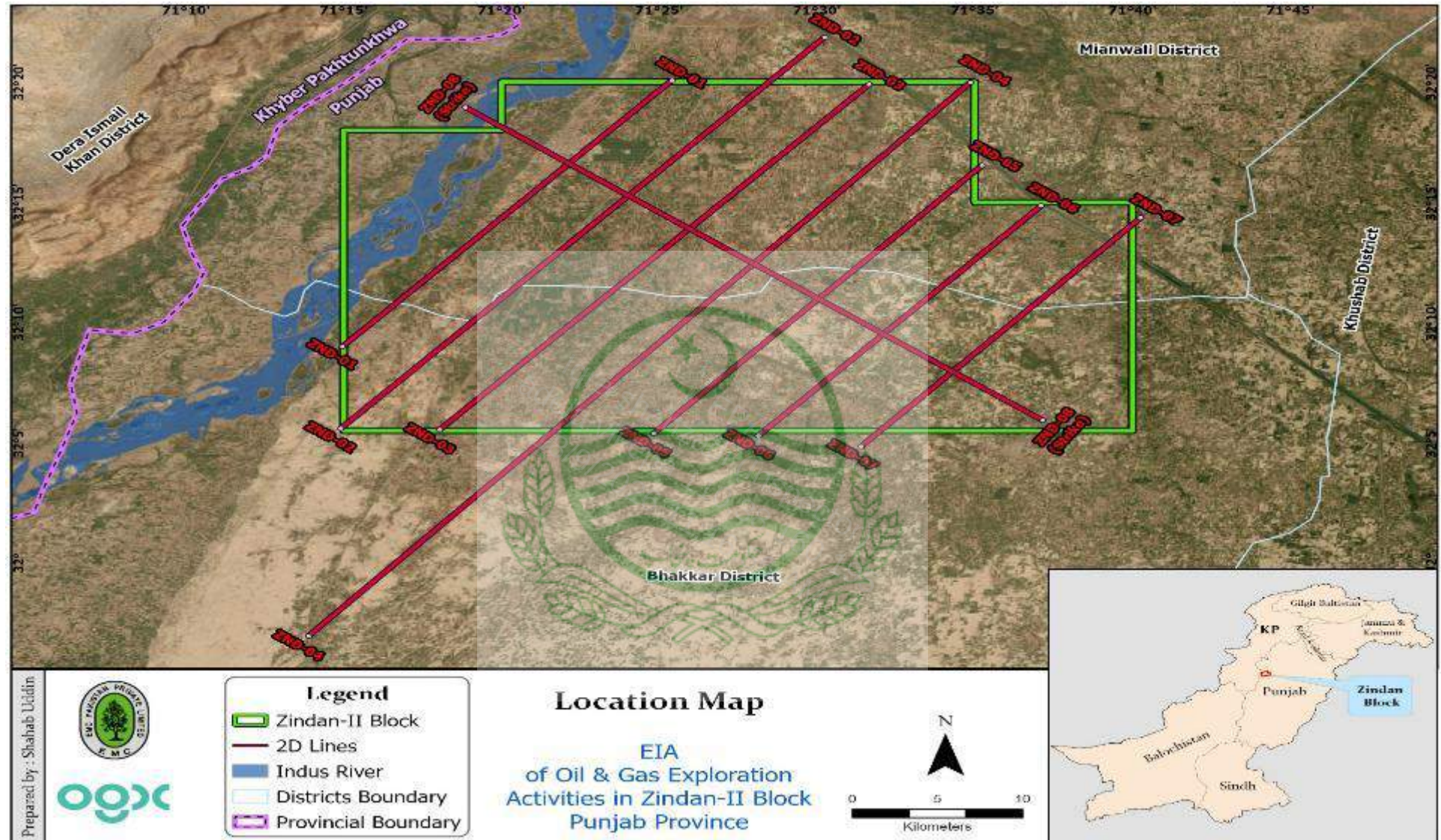


Figure ES 1.1: Location of proposed 2D Seismic Lines in Zindan-II Block

The schedule of exploration activities is given below. The tentative duration of key activities will be approximately of about 10 months:

- | | |
|--|-----------|
| ➤ Mobilization (if base camp is established) | 01 Month |
| ➤ Seismic Survey | 5-6 Month |
| ➤ Site restoration | 01 Month |
| ➤ Demobilization | 02 Month |

Potential Impacts and Mitigation Measures

The potential environmental and socioeconomic impacts related to the proposed project have been identified through literature review, scrutinizing baseline data (both primary and secondary), professional opinions, experience, understanding of the proposed project activities, field observations and site surveys.

Screening and assessment of potential environmental impacts for the project finds that:

The project area comprises a combination of plain, desert, and undulating terrain within Districts Bhakkar and Mianwali, characterized by sparsely populated rural settlements. The proposed exploration activities will be conducted in open agricultural fields, rangelands, desert scrub areas, and riverine plains, and no activities will be undertaken within or in close proximity to permanent settlements. All exploration activities will be carried out at a minimum distance of 500 m from inhabited areas, in order to avoid disturbance to local communities and ensure compliance with applicable environmental and social safeguards.

- Subsistence agriculture has been carried out within block at some places. Compensation will be paid for the land acquired and crop damaged.
- The proposed activities may have adverse impacts which can be mitigated by adopting best industrial practices and restoration of the area after activity.
- Fuel or oil leakage or spill during the project activities can result in contamination of soil and water and can be categorized as minor, moderate or major.
- Proper implementation of plan for hazardous waste management will reduce the soil and water contamination.
- Impacts on air quality during project activities would include emissions and dust from earth-moving equipment, and vehicles. By minimizing the disturbance and areas cleared of vegetation, using dust control techniques, following restoration and using well maintained machinery and vehicles can effectively reduce the impact on air quality.
- The primary impacts due to noise pollution generated by project activities would be localized disturbance to wildlife and inhabitants.
- Operation of different equipment during various phases causes varying degree of vibration depending on the type of equipment and operations. Protecting workers from the effects of vibration is essential otherwise it may lead to an increased risk of hand-arm vibration syndrome (HAVS).
- Screening of potential environmental and socio-economic impacts resulting from various activities associated with the project reveals that majority of the impacts will occur on temporary basis and will be reduced with adaptation of good industrial practices, mindful planning, design and control of operations in each phase.

The risks identified have been addressed by recommendations of various mitigation measures to reduce the severity of each impact. Assessment of the identified impacts was validated using the information obtained through site surveys. The experts engaged for the EIA study visited the project area to gather information on the environmental and social characteristics of the project area. The proponent shall oversee the entire activities with an objective to ensure environmental protection. The mitigation matrix for the proposed activities is included in the Section 8.0 of this report.

During the project, environmental monitoring of following parameters has been suggested:

- Exhaust and Emissions Monitoring
- Waste water
- Noise
- Solid Waste
- Occupational Safety

The EMP has been prepared in accordance to national and provincial guidelines. Several actions have been identified in the EMP to prevent or mitigate the environmental impacts of proposed project.

All activities associated with the proposed project have been reviewed and their possible impacts methodically analyzed. A comprehensive Environmental Management Plan has been put together and provided in the report for adherence which will ensure the evasion of environmental degradation or contamination. Screening of potential impacts from the project activities finds that:

- The project's impacts on the ambient environment will be short term and mostly localized.
- The project location (location of seismic lines) is safely away from key sensitive receptors e.g. settlements and infrastructure.
- Vegetation density of the site and surroundings is low and mature trees are less common.
- The predominant vegetation type of the area includes shrubs and grasses. Project activities will not significantly affect the vegetation density of the area.
- Animal density in the project area is very low due to current land use pattern. Wild animals are limited to small mammals and reptiles while domestic animals are found in the nearby villages.
- Impact from project related transportation activities can occur in areas falling close to communities. Adoption of safe driving practices and careful scheduling of activities will be required near these areas.
- The project is not water intensive, the impact on area's water availability is not expected from project's water consumption. However, water conservation measures will still be adopted to prevent any unanticipated impact.
- Socioeconomic impacts on micro-scale would be insignificant if any. Social issues like removal of existing business, property and resettlement are not anticipated from any project activity.

Based on the risk assessment carried out for the project, it is recommended that:

- The impact on animal life can be prevented by careful clearance, excavation works and adopting a "No Hunting, No trapping" Policy.

- Temporary inconveniences due to construction works are minimized through planning and coordination with local population and organizations in the neighborhood.
- Environmental Performance Monitoring is made an integral part of the Project to ensure environmental safeguards.
- Water conservation practices may be adopted at all stages of project.

A series of mitigation and monitoring measures have been included to address the concerns for these measures. Assuming effective implementation of the mitigation measures and monitoring requirements as outlined in the Environmental Management Plan, the adverse environmental and social impacts of the proposed project activities are likely to remain within the acceptable limits.

The project is not expected to have long-term significant or irreversible negative environmental impacts at any of the phases. It is thus recommended that the EIA for the proposed project be approved with the condition that all corrective and mitigation measures proposed in this report will be implemented with diligence. The provided EMP in the report will provide guidelines and measures to ensure sustainable and eco-responsible execution of the project activities. The environmental Monitoring plan has been devised and provided in **Table ES 1.2**.

Table ES 1.2: Environmental Monitoring Plan for Seismic Activities

S. No.	Monitoring Aspects	Monitoring locations	Parameters	Frequency	Responsibility
1	Exhaust Emissions	Vehicles, and Generators	As per PEQS	Annually	OGDC/SC
2	Wastewater	Campsite	As per PEQS	Quarterly (if wastewater discharged into any nullah)	OGDC/SC
3	Noise	Boundaries of the camp sites	Noise level (dBA)	Quarterly	OGDC/SC
4	Solid Waste	Project site	Solid waste collection, storage, transportation and disposal	Daily	OGDC/SC
5	Occupational Safety	Campsite, project roads	HSE Records, Incidents and injuries	Daily	OGDC/SC

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1. INTRODUCTION

1.1. Purpose of Report

This report presents the findings of an Environmental Impact Assessment (EIA) study conducted by EMC Pakistan Pvt. Ltd. for the Exploration Activities in Zindan-II Block, Districts Bhakkar and Mianwali, Punjab. The EIA study of the proposed project has been carried out in accordance with Section 12 of Punjab Environmental Protection Act, 1997 (amended 2012 and 2017) and rules and regulations framed thereunder.

1.2. Identification of Project and Proponent

Project: EIA Oil & Gas Exploration Activities in Zindan-II Block (EL 3271-9), Punjab Province
Proponent: Oil & Gas Development Company limited (OGDC)
Contact: Mr. Babar Iftikhar - General Manager (HSEQ)
Email: babar_iftikhar@ogdcl.com; info@ogdcl.com
Phone: 051-92002-3638 | 051-9209811-8
Fax: 051-2623041 | 051-2623113-117
Address: OGDC HQ, Jinnah Avenue, Blue Area, Islamabad (44000) Pakistan.
Website: www.ogdcl.com

1.3. EIA Consultant - Contact Details

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1.4. Brief Description of the Nature, Size and Location of Project

This document presents the findings of an Environmental Impact Assessment (EIA) carried out by EMC Pakistan (Pvt.) Limited for the project "Oil & Gas Exploration Activities in Zindan-II Block (EL 3271-9), Punjab Province" proposed by Oil & Gas Development Company Limited (OGDC). The proposed project includes 2D Seismic Survey to acquire seismic data for the exploration of hydrocarbon in Zindan-II Block over an area of 400 L. km approx. The proposed 2D seismic survey will be carried out in districts Bhakkar and Mianwali of Punjab.

The objective of proposed project is to collect stratigraphic information of subsurface structures which can be analyzed to identify potential oil & gas reservoirs and to enhance the production of fossil-fuels in order to reduce energy deficiencies of the Pakistan.

The project involves various activities associated with 2D seismic survey; scope of the project involves:

- Temporary land acquisition (on rent)

- Construction of access road
- Development of camp-sites (base-camp and fly-camp if required)
- Mobilization of seismic crew
- Seismic Data Acquisition
- Restoration and rehabilitation of disturbed land

Tentative location coordinates for proposed 2D Seismic lines are given below in **Table 1.1** while project location map of Zindan-II Block is given as **Figure 1.1**.

Seismic Line	Description	GPS Coordinates (X, Y)		Length L (km)
ZND-01	Start	32° 8'59.73"N	71°14'57.42"E	45.13
	End	32°20'4.30"N	71°25'24.12"E	
ZND-02	Start	32° 5'35.73"N	71°14'54.36"E	56.54
	End	32°21'52.04"N	71°30'14.64"E	
ZND-03	Start	32° 5'32.58"N	71°18'2.49"E	57.09
	End	32°19'54.34"N	71°31'39.50"E	
ZND-04	Start	31°56'57.74"N	71°13'52.82"E	79.86
	End	32°19'59.11"N	71°34'52.14"E	
ZND-05	Start	32° 5'23.21"N	71°24'49.43"E	49.36
	End	32°16'31.62"N	71°35'13.72"E	
ZND-06	Start	32°14'51.04"N	71°37'6.34"E	58.61
	End	32° 5'17.15"N	71°28'8.33"E	
ZND-07	Start	32° 4'51.35"N	71°31'24.61"E	53.41
	End	32°14'21.52"N	71°40'15.89"E	
ZND-08 (strike)	Start	32°18'57.01"N	71°18'51.29"E	49.50
	End	32° 5'55.76"N	71°37'9.30"E	
Total Line Km				400

It is noteworthy to highlight that the positioning of the seismic lines mentioned above may undergo deviations of 500 – 1000 m at the time of the execution of the project activities. This may be needed to address a particular requirement e.g. protection of settlement, water body and/or others sensitive environmental features or based on a technical requirement.

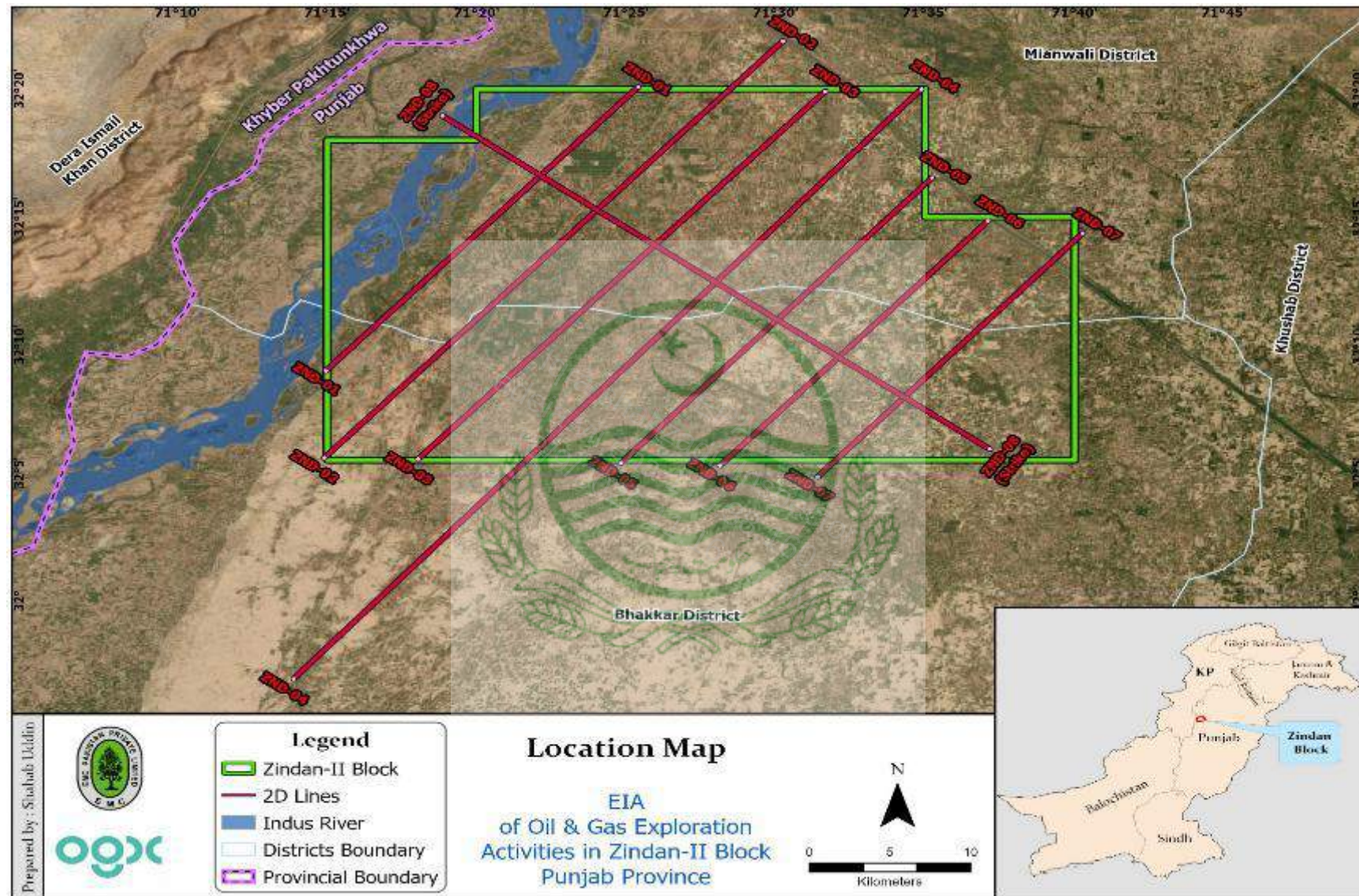


Figure 1.1: Location Map of Proposed Project Showing Zindan-II Block

1.5. Project Proponent – OGDC

OGDC, Pakistan's leading national Exploration & Production Company, maintains a balanced portfolio of exploratory assets across both mature and frontier areas. Guided by an exploration-led growth strategy, the company utilizes state-of-the-art in-house technology and a highly skilled professional workforce to identify and develop hydrocarbon resources with minimized risk. OGDC operates multiple advanced 2D and 3D seismic acquisition crews supported by a modern seismic data processing and interpretation facility, enabling high-quality subsurface imaging across diverse terrains. With dedicated teams specializing in prospect generation, quantitative interpretation, rock physics, and unconventional resource evaluation, OGDC continues to actively pursue conventional and shale/tight gas opportunities. As a State-Owned Enterprise (SOE), the company also seeks strategic domestic and international partnerships, farm-in/farm-out opportunities, and concession acquisitions, while sustaining an aggressive exploration and drilling program to enhance reserves, increase production, and contribute to Pakistan's economic growth.

1.5.1. OGDC Health, Safety and Environment Management

OGDC is firmly committed to the highest standards of health, safety, environment and quality (HSEQ) across all its operations, reflecting the company's belief that safety is everyone's responsibility and a core element of its business success. The Company has developed and implemented a comprehensive HSE Management System in alignment with international standards such as ISO 45001, ISO 14001, and ISO 9001 to identify, control and monitor safety-critical activities in exploration, drilling, production, engineering and other field operations. OGDC promotes a positive safety culture by integrating HSE principles into every stage of work, ensuring compliance with relevant laws and industry best practices, eliminating hazards, and protecting both its workforce and the environment. Safety training, emergency response planning, contractor HSE engagement, are key pillars of the Company's efforts to prevent accidents, reduce risk, and continuously improve performance.

1.6. Screening

Environmental Impact Assessment (EIA) of the project has been carried out in compliance with the mandatory requirement of Section 12 of Punjab Environmental Protection Act, 1997 (amended 2012 & 2017) which requires that: *"No proponent of a project shall commence construction or operation unless he has filed with the Provincial Agency an initial environmental examination or where the project is likely to cause an adverse environmental effect, an environmental impact assessment, and has obtained from the Provincial Agency approval in respect thereof."* In compliance with the above cited regulations, an EIA study has been prepared and its report is being filed with the Punjab Environmental Protection Agency for approval.

Based on categorization given in Schedules I and II of the Punjab Environmental Protection Agency (Review of IEE and EIA) Regulations, 2022, the proposed project falls in Schedule II Category A5 (Energy): Oil & gas extraction projects including exploration, production, gathering systems, separation and storage.

1.7. Scoping

Scoping is an early step during the environmental assessment study to identify the important issues to be considered and eliminate those that are not important. Scoping helps identify the boundaries of the project and TORs for later stages of baseline collection and impact identification and evaluation and help to save extra efforts and resources.

Scoping for the project was conducted to identify the key issues that need to be covered in the EIA and determine the scale and magnitude of same for further planning and management. The proposed project comprises exploration activities for the identification of hydrocarbon resources in Zindan-II Block, Districts Bhakkar and Mianwali, Punjab.

1.7.1. Spatial and Temporal Boundaries of Environmental Assessment

The project activities have been assessed w.r.t project's impacts on micro and macro-environment. The project area considered as microenvironment comprises the project site and its immediate surroundings in 1000 meters radius. The macro-environment has been studied with respect to the project area located within Districts Bhakkar and Mianwali. The EIA study has focused on the assessment of potential impacts on the physical and ecological environment, including land, soil, water, air quality, and biological resources. Given the predominantly rural setting, dispersed settlements, and temporary nature of the proposed project activities, the anticipated social impacts are expected to be limited in extent and localized in nature.

Exploration activities can have potential impacts on the environment if proper mitigation measures are not taken into consideration. Inadequate management of project activities can lead to potential impacts which may include soil contamination, disturbances to local communities, loss to the wildlife, damage to or destruction of habitats or living sanctuaries, pollutions and erosion etc. With the thorough identification of control measures for the potential impacts, the scale and magnitude of environmental and social impacts can be greatly reduced, thereby rendering the project environmentally and socially conducive.

The EIA study aims to provide complete environmental assessment of the Seismic Activities in Zindan-II Block, Districts Bhakkar and Mianwali, Punjab. The assessment covered the project's anticipated impacts on the surrounding biological, physical and socio-economic environment. Overall scope of the EIA study included:

- Description of project activities
- Overview of legal framework for the project
- Environmental and social surveys of project area to develop baseline environmental and social profile of project area
- Conducting consultation with project area communities and other stakeholders
- Analysis of project alternatives
- Risk assessment of project activities followed by identification of suitable mitigation measures to offset or otherwise reduce the scale and magnitude of impact
- Preparation of Environmental Management Plan (EMP) for the project
- Submission of EIA report to EPD for approval
- Follow up with EPD for issuance of environmental approval

1.7.2. Important issues and concerns raised during consultation

Details of the consultations with stakeholders is provided in Section 6.0 of the report. Important issues highlighted during consultation are listed below:

- Land clearing should be done at minimum.
- The hazardous waste should be disposed of via EPA approved waste contractor.

The residents shared no grievances regarding this project. However, they expect uplift of the area's social profile through investment in its infrastructure and providing basic needs of day to day living e.g. clean water and health facilities

1.7.3. Significant impacts and factors to be considered

Important issues and factors during different phases of the project that need to be considered include but not limited to;

- Project area's physical environment
- Waste generation
- Project's resilience towards natural disasters (floods)
- Safety Hazards

Detailed risk assessment is provided in Section 7.0.

1.8. Methodology for Environmental Impact Assessment (EIA)

Various steps were undertaken to conduct, prepare and present this EIA report. Brief details of those steps are given below while their description is documented in the subsequent sections of this report.

1.8.1. Understanding of the Proposed Project

This step required collection of information from proponent for the proposed project and understanding the activities to identify potential impacts.

1.8.2. Review of National Legislations and Guidelines

National legislation, international agreements, environmental guidelines and best industry practices were reviewed to set environmental standards.

1.8.3. Collection of Secondary Data

Available published and unpublished information pertaining to physical, biological and socio-economic micro & macro environment was obtained and reviewed. It includes previous environmental studies and baselines conducted for seismic activities in Punjab.

1.8.4. Collection of Field Data

This study is based on the findings from site visits conducted by the EMC Team. In April 2026, the team carried out a baseline survey of the project area to collect primary data on environmental (both physical and biological) and social aspects. The team also consulted with residents to gather area-specific information, including their views and concerns regarding the proposed project's activities. Both primary and secondary sources of information were used to develop the baseline for the area.

1.8.5. Baseline Environmental Profile of Project Area

The environmental profile of the project area was established through secondary data as well as primary data (field surveys). The information was collected and compiled on environmentally important areas (Ambient Air Quality, Surface and Groundwater Resources, community setup, Existing and Proposed Roads, Livelihood, Agriculture, Health, Public Services, and Sites of Archeological or Cultural Importance).

1.8.6. Stakeholder Consultation

Stakeholder consultations were held to involve the public in the decision-making process and to have a fair interaction with all community groups and assuring them that every attempt would be made to reduce the negative impacts of the project, and that adequate remedial measures would be taken to recompense the loss of the affected persons, if any.

1.8.7. Impact Identification and Evaluation

Potential impacts which may arise from project related activities were identified. These include effects on physical, biological, socio-economic, archaeological and cultural environment. Impacts were identified and assessed based on field data, secondary data, expert opinions and monitoring results of previous oil and gas exploration projects in Pakistan.

1.8.8. Recommendations to Mitigate Impacts

Keeping in view the baseline data collected and impacts identified; mitigation measures have been recommended to eliminate, minimize or compensate for the potential environmental and social impacts on the zone of influence of the project. Mitigation measures recommended here are based on experience, best industrial practices, legislative requirements and professional judgments.

1.8.9. Environmental Management Plan (EMP)

Environmental Management Plan (EMP) is formulated for an effective and efficient implementation of the endorsed mitigation measures. EMP includes controls to lessen the identified impacts, and monitoring programs of residual impacts, if found any, during the operations. The EMP has been laid down with the procedures to be followed during the seismic activities and has catered all the identified roles and responsibilities for all concerned personnel.

1.8.10. Report Compilation and Review

This is the final stage of EIA study where all EIA activities and findings are documents, compiled and reviewed. At the end of the study, the report is reviewed and shared.

1.9. Structure of the EIA Report

The EIA report has been designed on the standardized format. The Report has been divided in the following sections:

Section 1: Delivers an introduction and overview of the Project and EIA process.

Section 2: Describes the proposed project i.e., the overall description of the project and its associated activities in detail.

Section 3: Describes the alternatives analyzed for the project

Section 4: Summarizes the national & international policies and legislation along with guidelines relevant to the project.

Section 5: Provides description of the microenvironment and macro-environment of the project area explaining its biological, physical environment along with the socio-economic conditions

Section 6: Provides details of the consultations and feedbacks received from the stakeholders.

Section 7: It includes screening of potential environmental and socioeconomic impacts arising from the proposed project activities and incorporates mitigation measures. General and project specific guidelines are used to assess the potential environmental impacts at various phases of the project.

Section 8: Presents a comprehensive Environmental Management Plan (EMP) and Monitoring Program for the project.

Section 9: Summarizes the report and presents its conclusions and deliverables.

The main text of the report is supported by a series of Appendices and Annexures which provide added information.



2. DESCRIPTION OF PROJECT

2.1. Project Objectives and Overview

This document presents the findings of an Environmental Impact Assessment (EIA) carried out by EMC Pakistan (Pvt.) Limited for the project "Oil & Gas Exploration Activities in Zindan-II Block (EL 3271-9), Punjab Province" proposed by Oil & Gas Development Company Limited (OGDC). The proposed project includes 2D Seismic Survey to acquire seismic data for the exploration of hydrocarbon in Zindan-II Block over an area of 400 L. km approx. The proposed 2D seismic survey will be carried out in districts Bhakkar and Mianwali of Punjab.

OGDC aims to explore new hydrocarbon reserves through seismic surveys on the basis of promising geological features and to enhance the production of fossil fuels in order to reduce energy deficiencies of the Pakistan. This survey will help increase the prospects of finding new hydrocarbon resources in the Punjab.

2.2. Project Location

The proposed project involves 2D seismic activities to be conducted in the Zindan-II Block, spanning Districts Bhakkar and Mianwali, Punjab. The total area of the block is 951 km², of which 534 km² falls within the administrative jurisdiction of Tehsil Piplan, District Mianwali, and 417 km² falls within Tehsil Kalur Kot, District Bhakkar. Approximately 400-line km of seismic surveys will be carried out by OGDC for the identification and exploration of oil and gas resources within the block.

Tentative coordinates for proposed 2D seismic lines are given below in **Table 2.1** while project location map of Zindan-II Block, districts Bhakkar and Mianwali, Punjab is given as **Figure 2.1**.

Table 2.1: Tentative Location Coordinates of Seismic Activities

Seismic Line	Description	GPS Coordinates		Length L (km)
ZND-01	Start	32° 8'59.73"N	71°14'57.42"E	45.13
	End	32°20'4.30"N	71°25'24.12"E	
ZND-02	Start	32° 5'35.73"N	71°14'54.36"E	56.54
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	End	32°14'21.52"N	71°40'15.89"E	
ZND-08 (strike)	Start	32°18'57.01"N	71°18'51.29"E	49.50
	End	32° 5'55.76"N	71°37'9.30"E	
Total Line Km				400

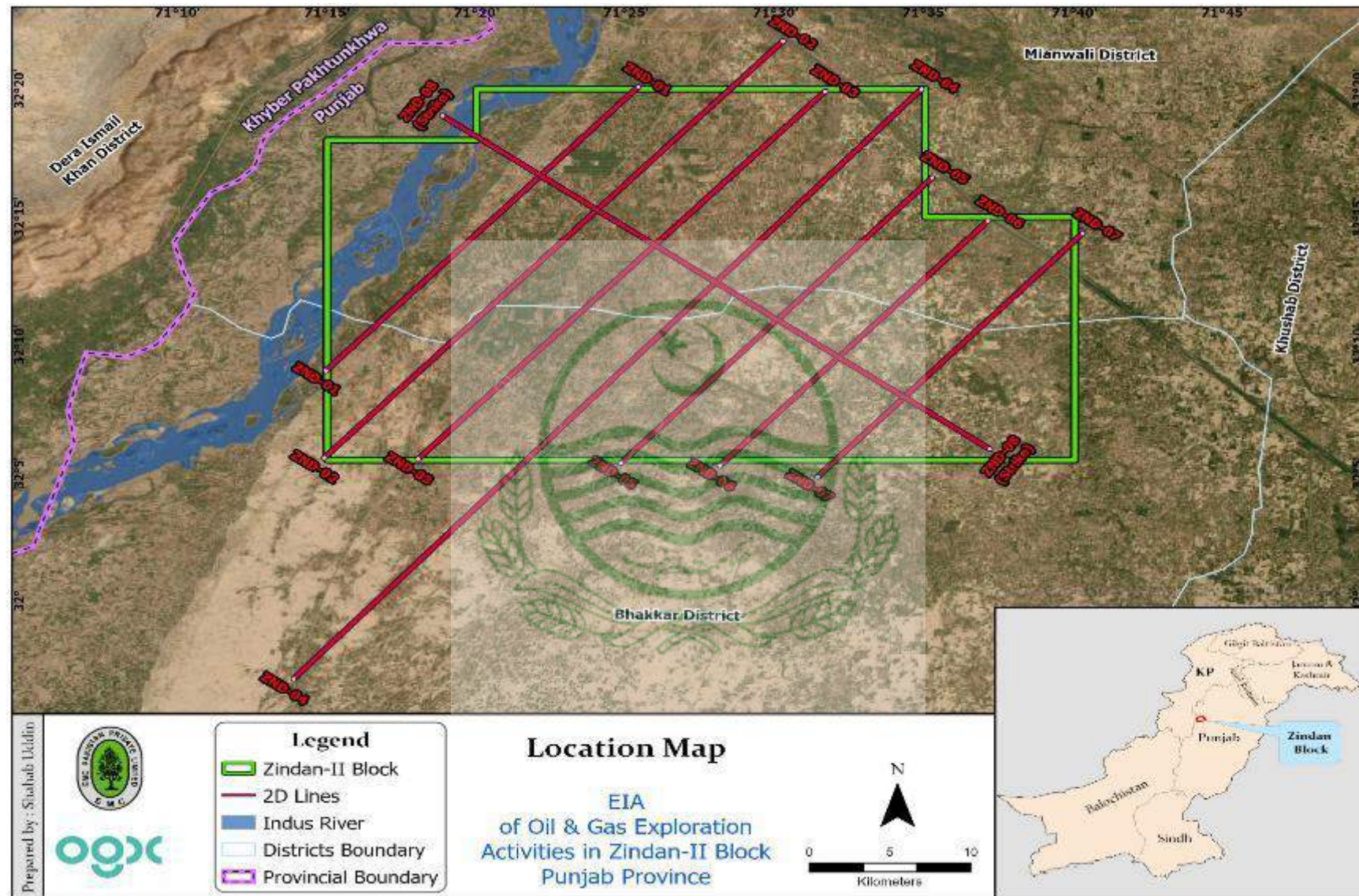


Figure 2.1: Location Map of the Project Area

It is noteworthy to highlight that the positioning of the seismic lines mentioned above may undergo some deviations upto 500 - 1000 m at the time of the on-ground execution of the project activities.

2.3. Site Layout

One Base Camps with accompanying fly camps (if required) may be established in the project area to house the seismic crew. Area of campsite (Base Camp) will be about 200m x 200m. A Magazine Camp may also be established for the storage of the explosives. The total area required for the Magazine Camp will be 9600 sq. m. The layout of the Base Camp and Magazine Camp is shown in Fig. 2.2 & 2.3. The tentative coordinates of the Base camp are 32°49'5.78"N, 72°38'4.17"E.

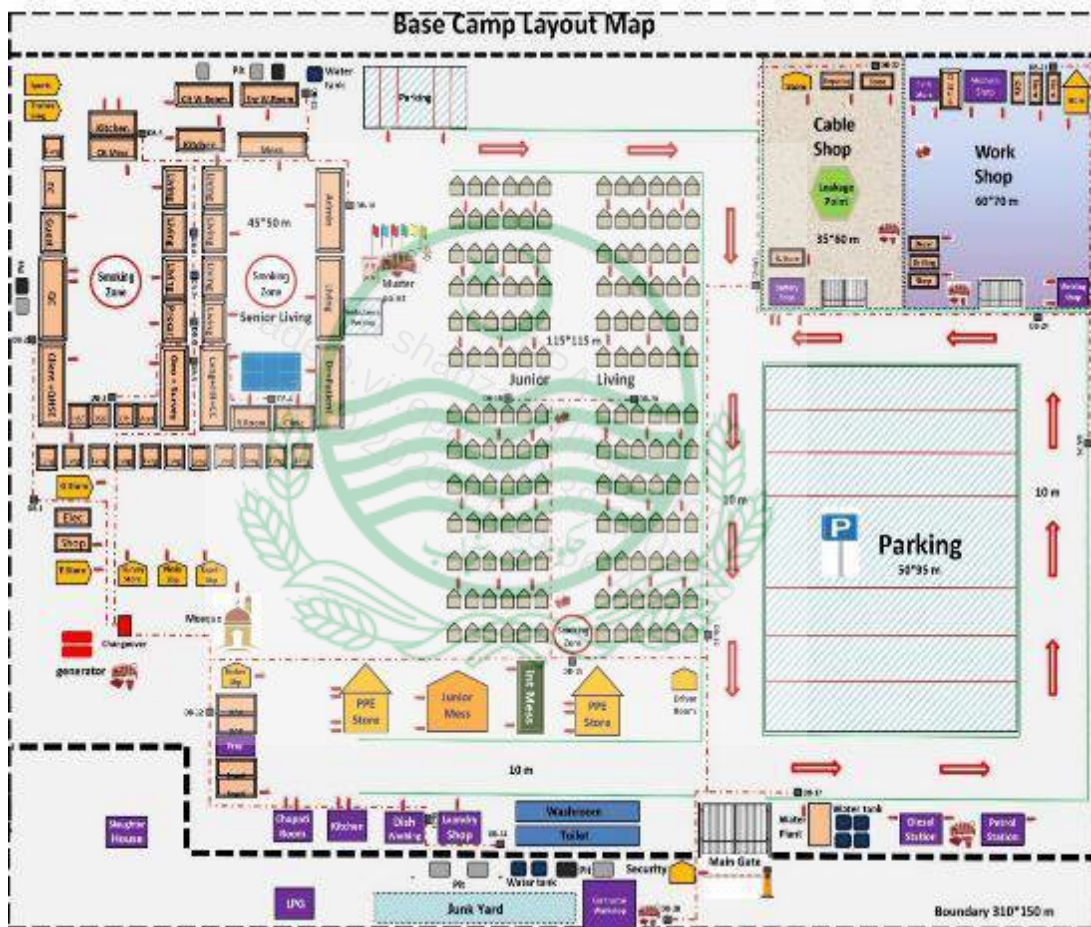


Figure 2.2: Generic layout of base camp

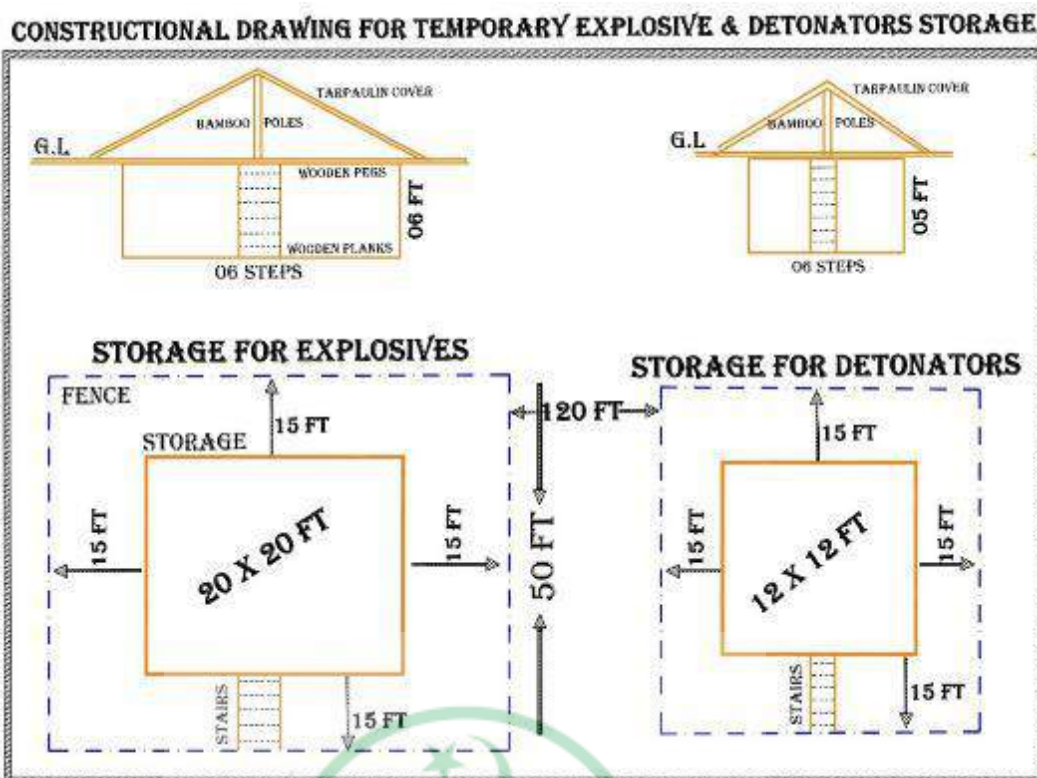


Figure 2.3: Proposed layout of Magazine camp

2.4. Land Use of the project area

The land surrounding of the proposed project area in Districts Bhakkar and Mianwali is characterized by a predominantly rural landscape, comprising agricultural land, rangelands, desert scrub, riverine plains, and localized hilly terrain.

In District Bhakkar, the proposed 2D seismic survey activities are largely confined to flat to gently undulating plains associated with the Thal Desert, interspersed with rain-fed and canal-irrigated agricultural fields. Settlements are scattered and sparsely distributed, and urban development is minimal. Vegetation cover is generally sparse, consisting mainly of desert scrub, grasses, and cultivated crops, with limited tree cover restricted to canal banks and village plantations. No major protected forests occur within close proximity to the proposed seismic lines.

In District Mianwali, the proposed seismic survey lines traverse a more diverse landscape, including fertile alluvial plains along the Indus River, agricultural land, rangelands, and undulating to hilly terrain in the northern and north-western parts of the district. Population density remains low to moderate, with land primarily utilized for agriculture and livestock grazing. Vegetation density varies from low in desert and upland areas to moderate in riverine belts and foothill zones. Notable ecological features in the broader district include riverine forests along the Indus River and forested hill areas associated with the Salt and Surghar ranges.

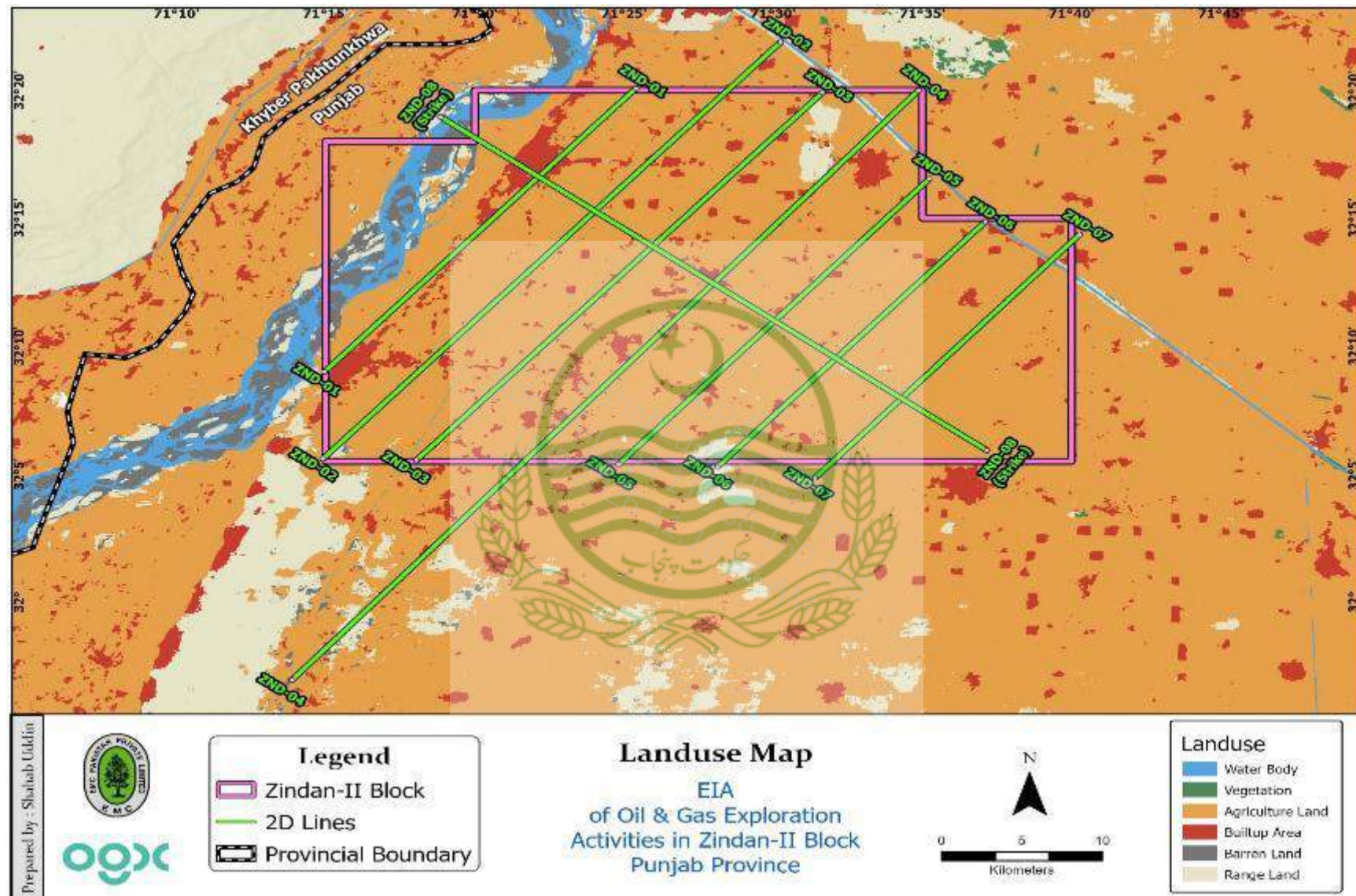


Figure 2.4: Land Use Classification Map of Project Area

2.5. Road Access

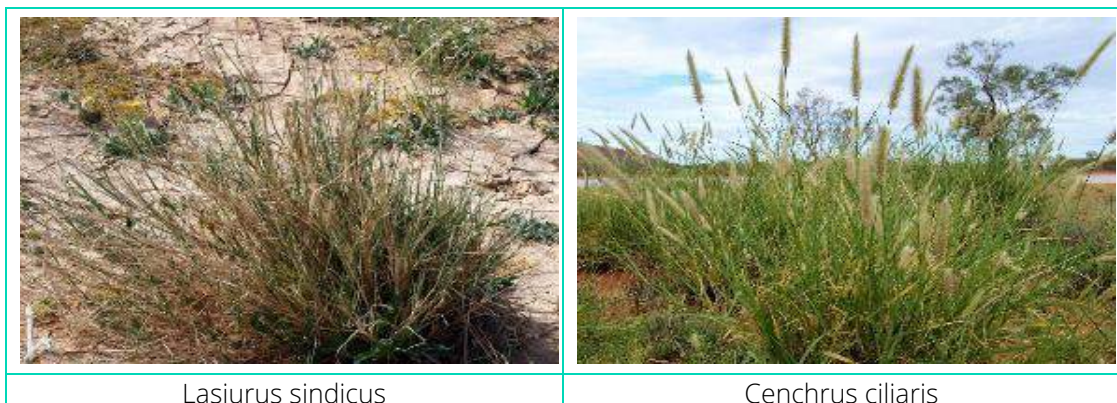
The project will make maximum possible use of existing road infrastructure. However, if needed, temporary tracks will be setup for vehicle movement in the rural areas. For this purpose, the surface will be compacted and graveled if necessary for the movement of vehicles. Upon completion of activity, the tracks will be restored as part of site restoration activity. The area situated in Districts Bhakkar and Mianwali can be accessed via Darya Khan – Kallur Kot Road, MM Road, Kallur Kot – Adhi Kot Road, and Wah Bhacharan Harnoli Road. The adjacent areas can be easily accessible via link roads that are in good condition.



Figure 2.5: Common condition of road network in project area

2.6. Vegetation features of the site

The current project activities will be carried out in the densely populated areas of District Bhakkar and extends towards the District Mianwali where population density is very low. Tree density is very low in area selected for the seismic activities. No tree cutting will be carried out during the survey. The proposed seismic survey activities will be carried out within the acquired land. No impact to the forest is anticipated.



Lasiurus sindicus

Cenchrus ciliaris

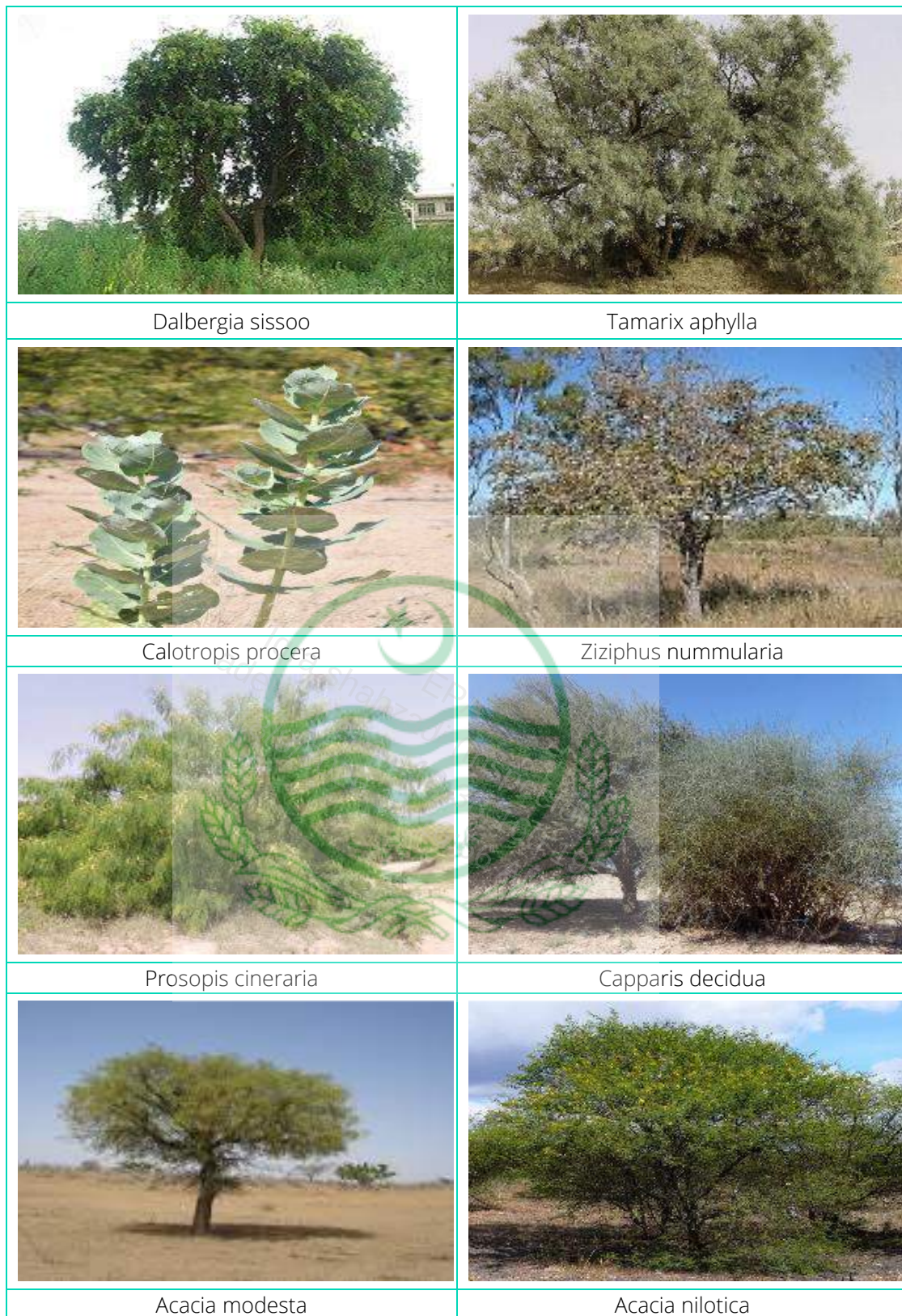


Figure 2.6: Floral Diversity of Districts Bhakkar and Mianwali

2.7. Site Suitability

The Zindan-II Block has been allocated to Oil & Gas Development Company Limited (OGDC) by the Government of Pakistan for oil and gas exploration activities. The Block is located

within Bhakkar and Mianwali districts of Punjab Province, covering a diverse geographical and administrative setting suitable for seismic exploration.

The proposed seismic surveys within the Zindan-II Block involve 2D seismic data acquisition across selected areas of District Bhakkar and District Mianwali. District Bhakkar is characterized by a predominantly rural landscape, comprising agricultural land, rangelands, scrub vegetation, and gently undulating terrain, with low to moderate population density. District Mianwali encompasses scattered rural settlements, cultivated alluvial plains, and localized hilly terrain, with population density generally lower in areas located away from major settlements and transportation corridors.

The proposed seismic lines have been planned to avoid densely populated areas and critical infrastructure such as residential settlements, educational institutions, health facilities, cemeteries, and places of cultural or religious significance. Population density generally decreases along the seismic corridors extending into rural and hilly areas. All seismic operations will be conducted in accordance with applicable safety standards, maintaining adequate buffer distances from sensitive receptors to ensure public safety, minimize disturbance, and reduce potential environmental and social impacts.

2.8. Description of Project Activities

The project encompasses seismic activities covering approximately 400 L. km for 2D survey as depicted in **Figure 2.1**. It's important to note that the extent of 2D seismic coverage may be subject to adjustment on technical requirements arising from processing results. The details of the activities that will be carried out during the project are as under:

- Temporary land acquisition (on rent)
- Construction of access road
- Development of camp-sites (base-camp and fly-camp if required)
- Mobilization of seismic crew
- Seismic Data Acquisition
- Restoration and rehabilitation of disturbed land

Key features of the project are given in Table 2.2 below.

Table 2.2: Key features of project	
Location of the project	District Bhakkar and District Mianwali
Seismic survey procedure	2D Seismic Survey for Oil & Gas Exploration
Total land area for data acquisition	~400 L km
Data acquisition techniques	Seismic P-Wave data acquisition
Duration of seismic survey	10 months
Equipment and machinery	a) Land Survey • GPS receivers • Survey data processing system b) Energy Source • Vibrator trucks • Dynamite c) Up-hole Equipment • Water truck • Portable recording system • Manual energy source • Down-hole detectors

	d) Receiver and Recording Equipment • Recording truck • Cable station units • Cables • Geophones strings
Data collection in hilly terrain	Shot hole /dynamite technique
Data collection on surface water bodies	Marshphone/hydrophones
Data collection in densely vegetated areas	In densely vegetated areas, use dynamite as source of energy to refrain from footprints
Explosives storage arrangements	Magazine camp as per international safety standard

2.8.1. Seismic Survey

During the 2D seismic survey, subsurface geological information is collected by directing seismic (sound) energy into the ground and recording the time it takes for the energy to reflect off the underlying rock layers. Geophones or motion detectors (sensitive microphones) are employed to capture the reflected energy. These signals are generated either by a controlled impulsive source, such as seismic explosives, or by vehicle-mounted vibrator trucks.

Various methods can be utilized for seismic surveys, including deep holes, shallow holes (pop shot methods), or Vibroseis. The choice of a specific method is influenced by factors such as the type of land, economic considerations, and environmental considerations. In instances where minimal clearing of agricultural lands is needed or in hilly/mountainous terrain, dynamite technology will be employed as a source of energy. Key activities during the 2D seismic survey include:

- Temporary land acquisition (on rent)
- Construction of access road
- Development of camp-sites (base-camp and fly-camp if required)
- Mobilization of seismic crew
- Seismic Survey/ Data Acquisition
- Restoration and rehabilitation of disturbed land

2.8.2. Equipment

Following equipment will be used during exploration activities. These are as under:

Table 2.3: Equipment used for seismic activities

S#	Purpose	Equipment
1	Land Survey	• GPS receivers • Survey data processing system
2	Energy Source	• Vibrator • Dynamite
3	Receiver & Recording Equipment	• Recording truck • Cable station units • Cables • Geophones strings
4	Up-hole Equipment	• Water truck • Portable recording system • Manual energy source • Down-hole detectors



Figure 2.7: Seismic Survey Equipment

2.8.3. Seismic Survey procedure

Various activities are involved in a typical 2D seismic survey which are discussed as under.

2.8.3.1 Land Permitting

The seismic contractor's team, along with the advance party, will arrive at the site. The team's early presence is crucial for initiating various activities, including engaging with local landowners and authorities to apprise them of the upcoming operations and coordinate necessary arrangements. The permitting team will be responsible for identifying land ownership within the areas earmarked for the seismic operation. Additionally, they will address matters such as establishing access roads, assessing potential crop damage, and determining compensation rates. This proactive approach ensures effective communication, collaboration, and resolution of logistical considerations before the commencement of the seismic activities.

2.8.3.2 Mobilization and Camp Establishment

Once the access track to approach the camp location is complete, mobilization and camp establishment activities will begin. Camps will be located and constructed such that minimum clearing of vegetation or land is involved. Campsite will include accommodation area including tents and portable cabins, staff's kitchen and mess, laundry area, toilets, workshops, vehicle parking area, equipment storage areas, fuel and oil storage area, generator area, septic tanks and soak pits and a waste storage / garbage pit. Camps will be fenced for security reasons. It will take around 2 weeks to complete camp establishment. The rest of the seismic crew will be mobilized once the camp is fully operational. Survey work will start only after satisfactory set up of the base camp. Water will be required during the operation for domestic and seismic survey activities.

2.8.3.3 Line Survey Preparation

In this activity, the seismic lines will be marked on the ground by survey teams, each team comprising of 4 to 5 people. The survey teams will use a global positioning system (GPS) to mark shot points on the seismic lines at around every 50-meter interval with whitewashed stones or wooden peg. Clearing of trees and dense patches of vegetation will be avoided by adjusting the location of seismic line as much as possible. Where, inevitable, vegetation will be cleared from the area only up to the extent required. A record of vegetation removal will be maintained along with species type and number. The material that is removed will be pushed to either side of the line creating low windrows along the length of the line.

2.8.3.4 Explosive and Drilling

In this method, an explosive such as Dynamite is loaded in a shot hole and covered by soil. The dynamite provides the energy source in this case. It is labor intensive for making shot holes. Explosive sources such as dynamite are the preferred seismic sources in rough terrains, in areas with high topographic variability or in environmentally sensitive areas e.g. marshes, farming fields, mountainous regions etc.

2.8.3.5 Cabling

Geophones (sensitive motion detectors or microphones) buried just below the ground are used to record the seismic waves generated by the vibroseis or the explosion. A cable is laid to join all geophones to the purpose-built recording truck that houses the main electronic hardware used for recording data. Approximately 70-80 laborers will be employed for laying and retrieving of cables.

2.8.3.6 Data Acquisition

During the seismic survey, information about subsurface geology is gathered by directing seismic (sound) energy into the ground and recording the time taken by it to reflect off the subsurface rock layers. The reflected energy is recorded using geophones or motion detectors (sensitive microphones), which receive sound signals generated either by a controlled impulsive source such as seismic explosion or by vehicle mounted vibrator trucks.

Seismic survey will be carried out using combination of Vibroseis and Seismic explosive (dynamite). For the seismic survey a single base camp with accompanying fly camps (if

required) will be established to house the seismic crew. Seismic activities may be carried out in multiple seismic campaigns.

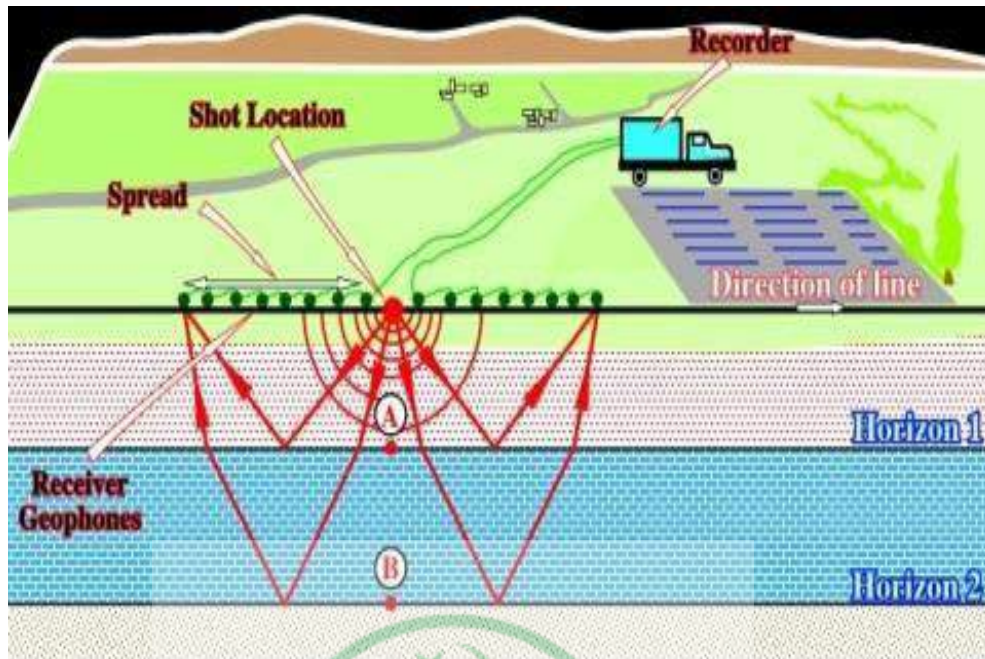


Figure 2.8: Seismic Data Acquisition Process

2.8.4. Decommissioning and Site Restoration

Upon the completion of the seismic survey in a given area, a dedicated 'green team' will be deployed for restoration and rehabilitation efforts to return the activity site to its original condition. This team will meticulously inspect all holes and pits to ensure thorough backfilling and confirm the absence of any debris or trash.

The restoration of seismic lines will encompass the demobilization of all equipment and machinery. Additionally, it will involve the removal of cables, geophones, station units, flags, stakes, and any associated waste from the lines. To provide a visual record for reference purposes, photographic documentation of selected sections of seismic lines will be captured both before and after the operation.

2.8.5. Data Acquisition Method

2.8.3.1 Dynamite

Dynamite is the mostly used seismic source on land. Dynamite itself is very cheap; the costs involved are mainly the costs of drilling the shot-holes to place the dynamite. It is labor intensive for making shot holes. Dynamite is a chemical compound which burns extremely fast when ignited.

2.8.3.2 Vibroseis

This technique will make use of vibrators as an energy source. The vibrator consists of a heavy mass (up to 50 tons) attached to a steel plate mounted on a truck. The truck will lower the steel plate to rest on the ground while suspending the body of the truck in air by means of hydraulic jacks. The steel plate will be made to vibrate for few seconds at each point, creating energy waves that will travel downwards into the earth's surface. The reflected waves will be received on the ground by cables and geophones laid along the seismic line. A series of 4 vibrators will follow each other along the line. All 4 vibrators will

stop at a point called vibroseis point, and produce energy waves in the manner described above. With this technique approximately 3-5 kilometer of line can be recorded per day.

2.8.6. Explosives Storage

A bulk stock of dynamite will be transported to the project area. It will be stored in dynamite and detonators storage area located at a 500 m away from communities and the seismic camps. Explosives will be stored in an excavated pit and covered with tarpaulins. Area will be fenced and guarded for security reasons. Seismic Contractor has in place the procedures required for the storage, handling and transport of the explosives. Same will be implemented during the project implementation.

2.9. Schedule of Implementation

The exploration activities are expected to take about 10 months. The tentative duration of key activities is provided below:

Activity	Duration
Mobilization (if base camp is established)	01 month
Seismic Survey	5-6 month
Site restoration	01 month
Demobilization	02 month

2.10. Staffing & Supplies

2.10.1. Water Requirement

The estimated utility water required is approximately ~45,000 liters per day including domestic, operational and utilities which will be sourced locally. Drinking water requirements is estimated around 1,000 liters per day. The water requirement for utilities will be fulfilled through water bowsers from the suitable source. Bottled water will be used for drinking purpose. If water supply must be met through groundwater, water will be sourced locally at market rates.

Water Goals: In water scarce areas, maximum efforts are focused on water conservation and reuse. A combination of fresh and alternate water sources (rain water, grey water, AC Condensate) shall be used to prevent excessive freshwater usage. Where feasible, freshwater will be replaced with alternate water sources depending on nature of water demand. Implementation of EMP will ensure all planned water conservation measures are adopted and monitored.

2.10.2. Workforce

To effectively carry out the 2D seismic survey operations for oil and gas exploration, an estimated workforce of approximately 500 to 600 personnel will be required. This includes a wide range of professionals such as geophysicists, surveyors, 2D seismic data acquisition and processing specialists, as well as support teams including security personnel and general laborers.

2.10.3. Power Supply

During seismic survey operations, an uninterrupted and reliable power supply is essential to support both operational equipment and campsite needs. The estimated power

requirement during seismic activities is approximately 400 kW from diesel-based generators.

2.10.4. Fuel Requirement

The estimated fuel requirement is approximately 2000 liters per day, which includes usage across all operational components such as vehicles, generators, seismic recording equipment, and support logistics. It is essential to ensure a reliable and enough supply of High-Speed Diesel (HSD) to support all field activities.

2.11. Cost and Magnitude of the project

The magnitude of the project includes 2D seismic survey in the Zindan II Block, Districts Bhakkar and Mianwali, Punjab. Estimated cost of the project activity is USD 2.73 million (expected).

2.12. Restoration and Rehabilitation Plan

After work is completed in an area, a 'green team' for restoration and rehabilitation is mobilized to ensure that affected areas are left in a condition that is as close to the original state as possible. The team will inspect all holes and pits to make sure they are backfilled and that no debris or trash is left behind.

Restoration of seismic lines will include demobilization of all equipment and machinery, removal of all cables, geophones, station units, flags, stakes and wastes from the lines and back filling of all mud pits. For reference purposes a photographic record of selected sections of seismic lines could be taken before and after the operation.

2.13. Government Approvals

Petroleum Exploration License has been granted by Government of Pakistan to OGDC for Oil and Gas Exploration and Production in Zindan II Block.

3. PROJECT ALTERNATIVES

3.1. General

The objective of screening out alternatives during the EIA exercise, is to identify options that most effectively meet the project's environmental objectives, either by enhancing the environmental benefits of the proposed activity, or through reducing or avoiding potentially negative impacts. For the proposed project, alternatives considered include:

- No project options
- Site alternatives
- Design/Technology alternatives
- Environmental Alternatives
- Economic Alternatives

3.1.1. Project Consideration-Project and No Project Alternative

The project involves 2D seismic investigation to ascertain the existence of an oil or gas reservoirs in the area. Considering the potential economic advantages for Pakistan in the event of a substantial hydrocarbon discovery, the no-project option is not regarded as a favorable alternative. The successful exploration and development of a reservoir in the area would contribute to reducing the country's reliance on imported energy sources, fostering greater self-reliance.

This self-sufficiency becomes especially crucial given that the proposed operation is anticipated to have limited large-scale environmental impacts, minimizing the risk of significant loss of valuable or irreplaceable ecological resources. The strategic importance of achieving energy independence and the positive economic implications further underscore the necessity and desirability of proceeding with the seismic survey.

3.1.2. Site Alternatives

Potential site alternatives may be considered in areas which hold sensitivity either due to settlements, dense vegetation, specific land use, or other factors. In such scenarios, the location of the seismic profile may be slightly adjusted to avoid the impact or alternate method of data acquisition may be adopted.

The proposed alignments for the exploration area signify regions of the highest potential. Given the project's assessment, which indicates low to medium significance of associated impacts, there is no need for altering the alignment of majority of the survey lines. Where the location adjustment will be needed to safeguard environmental (vegetation, water body, habitats etc.) or social sensitivity (settlements, infrastructure), the alternate location or method options would be considered. Additionally, proactive measures have already been taken to avoid ecologically sensitive areas within the block, further demonstrating the proponent's commitment to environmental conservation and responsible exploration.

3.1.3. Design / Technology Alternatives

Two conventional techniques for collecting seismic data are available i.e. Vibroseis and dynamite. The selection between these methods hinges upon the terrain features and land use type prevalent in the project area. Vibroseis is generally suitable for terrains with gentle slopes, salt plains, and flat sandy areas, while dynamite is preferable in hilly terrain,

less populated areas, such as agricultural lands and others where access or operation of Vibroseis might be challenging.

3.1.4. Environmental Alternatives

Exploration activities are generally associated with minimal environmental impacts, which can be effectively managed through an Environmental Management Plan. Additionally, proponent will adhere to a Health, Safety, and Environment (HSE) policy, including contingency plans to further mitigate potential impacts. By proactively monitoring and controlling environmental factors, the project aims to maintain environmental quality while safely managing hazardous material storage.

3.1.5. Economic Alternatives

Pakistan relies heavily on oil and gas, to fulfill the country's energy requirements. The transport industry stands out as the primary consumer of oil, whereas the gas is predominantly utilized by industries, with a significant focus on the fertilizer sector. To meet the nation's demands, Pakistan imports crude oil and liquefied natural gas (LNG), exerting pressure on the balance of payments (BOP). Given the challenges in Pakistan's balance of payments, there is a pressing need for the country to delve into indigenous resources within the energy sector. A dependable and self-sustaining energy supply is critical in alleviating some of the burden on Pakistan's balance of payments. Natural gas emerges as a particularly appealing option, not only for its energy potential but also due to its minimal environmental impact in comparison to other fossil fuels. As Pakistan strives to address its balance of payments difficulties, the exploration and utilization of indigenous natural gas resources stand out as a strategic and environmentally favorable avenue. **Table 3.1** illustrates sector-wise oil and gas consumption.

Table 3.1: Sector wise Natural Gas, RLNG and Oil Consumption

Sector	July- March FY2024		
	Gas Consumption (MMCFD)	RLNG (MMCFD)	Oil Consumption (000 MT)
Power	461	433	520.70
Domestic	863	1	18.80
Commercial	43	6	1182.89
Transport	58	3	9764.55
Fertilizer	721	43	815.32
General Industry	366	209	
Total	2515	695	12302.25

Source: Ministry of Energy (Petroleum Division)¹

3.1.6. Alternative with respect to project schedule

The timing of the operation is flexible and can be adjusted to address potential issues such as monsoon spells, which may cause flash floods, or local crop harvesting within the block. The proponent is committed to carefully scheduling project activities to minimize disturbances to the environment and local communities while ensuring the health and safety of the community/crew. This adaptive approach demonstrates the proponent's dedication to responsible environmental management and community welfare.

¹ https://finance.gov.pk/survey/chapter_24/14_energy.pdf

4. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

4.1. Introduction

The success of development projects also depends upon the ability of regulatory institutions to effectively manage their environmental and social issues. Sustainable development is a concept that has emerged over the past three decades to explain a new framework intended at economic and social development whilst maintaining the long-term integrity of the ecological and social system. The philosophy of sustainable development is in the course of being included into national policies and legislation in Pakistan through various statutory instruments.

Before initiation of any project, the mandatory legislations enacted by government and other regulatory agencies need to be studied. Different governments from time to time have enacted several environmental rules, regulations, laws and guidelines specifying different requirements for a diverse kind of projects. Therefore, it would be necessary to study the environmental laws pertaining to different projects before its execution so that protection of environment can be ensured.

In this section, same methodology would be followed by studying those rules, regulations and laws as well as the institutional set-up that are relevant to the environmental and social aspects of the "Seismic Activities in Zindan II Block falling in District Bhakkar and Mianwali, Punjab". The assessment has been carried out to comply with local, provincial as well as OGDC's health and safety guidelines. The main among these are:

- Health, Safety and Environment (HSE) Policy of OGDC.
- National Environmental Laws & Legislations;
- Provincial Environmental Laws & Legislations;
- Environmental and Social Guidelines;
- International Treaties and Conventions;
- Institutional Setup for Environmental Management;

4.2. National Legislations and Guidelines

4.2.1. National Environmental Quality Standards (Self-Monitoring and Reporting by Industry) Rules, 2001

Pakistan Environmental Protection Council constituted an Environmental Standards Committee in 1996 to devise realistic modalities for NEQS enforcement and simplified monitoring procedures with the consultation of representatives of industrial interest groups, non-governmental organizations (NGOs) and other stakeholders. Their efforts succeeded in the bringing up of "Self-Monitoring and Reporting System for Industry" in 2001. As per the rules set by this system, industries must monitor effluents and emissions in compliance with the NEQS and report it to provincial or federal EPAs. This system classifies industry into three categories A, B and C each corresponding to a specified reporting frequency². Oil and gas exploration activities fall under Category B of the Self-Monitoring and Reporting Rules, 2001.

² National Environmental Quality Standards (Self-Monitoring and Reporting by Industries) Rule, 2001

4.2.2. Pakistan Penal Code, 1860

Section XIV of PPC deals with the offences affecting the public health, safety, convenience, decency and morals. Person may be guilty of public nuisance if his act or omission causes common injury, danger or annoyance to the public or results in spread of infection of diseases dangerous to life. The section also deals with environmental pollution.

Provisions under this Act relating to environment are no longer being enforced after promulgation of the Pakistan Environmental Protection Act, 1997. However, pollution offences can still be tried under the Pakistan Penal Code, 1860.

4.2.3. Antiquities 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 and 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.

The proponent will ensure safety of the archeological sites that lie within or immediately neighboring the project site and will also immediately stop and report the concerned department if during the excavation process any such discovery is made in future³.

4.2.4. Land Acquisition Act, 1894

The Land Acquisition Act (LAA) of 1894 amended from time to time has been de facto policy governing land acquisition, resettlement and compensation in the country. The LAA is the most used law for acquisition of land and other properties of development projects. It comprises of 55 sections pertaining to areas notifications and surveys, acquisition, compensation and apportionment awards and disputes resolution, penalties and exemptions⁴. Temporary land will be acquired on rent for the project to support oil and gas exploration activities without permanent ownership.

4.2.5. The Biodiversity Action Plan, 2000

The Biodiversity Action Plan, 2000 has been the most significant direct step towards addressing the issue of biodiversity loss. It details the status & trends and direct & indirect causes of biodiversity; its principles, goals and aims; proposals for action plan including planning & policies, legislation, identification and monitoring, in situ & ex situ conservation, sustainable use, research and training, public education and awareness, Environmental Impact Assessment, information extraction and financial resources etc.

The Wild Birds and Animals Protection Act 1992, the West Pakistan Wildlife Protection Ordinance 1959, the Wildlife Protection Rules 1972, provide for the protection of flora and fauna in the territory, including vegetation and protected forests. This EIA study has addressed all aspects of conservation, including wildlife, and forest.

³ Act VII of 1976 (Gazette of Pakistan, Extraordinary, Part 1, 14th January, 1976)

⁴ The Land Acquisition Act 1894 (Act of 1894)

4.3. National Legislation on Oil and Gas Exploration and Production

4.3.1. The Petroleum Act, 1934

This Act deals with the import, transport, storage, production, refining and blending of the petroleum products (chapter 1: Control over petroleum). Chapter 3 of this Act talks about the general penalties for the offenses under this Act, reports of accidents with petroleum and inquiries into serious accidents with petroleum. This Act specifies the nature and condition of pipelines in which the petroleum may be transported and the forms and conditions of licensing for the transport and storage of petroleum products.

4.3.2. The Regulation of Mines and Oilfields and Mineral Development (Government Control) (Amendment) Act, 1976

The Regulations of Mines and Oilfields and Mineral Development (Government Control) Act, 1948 and the Pakistan Petroleum (Production) Rules, 1949 and Pakistan Petroleum (Exploration and Production) Rules, 1986 empowers the Ministry of Petroleum to oversee the petroleum exploration, development and production operations. The Mines and Oil Field Act also specify penalties including imposition of fines and/or imprisonment.

4.3.3. The Model Petroleum Concession Agreement, 2013

As for safety, the Model Petroleum Concession Agreement implementing the 1986 Exploration and Production Rules, specifically required observance of the 1974 Safety regulations. The penalties imposed in the 1986 Exploration and Production Rules allow the Director General Petroleum Concession to revoke a license if the rules are not satisfied by the operator. The Mines and Oil Field Act also specify penalties including imposition of fines and/or imprisonment.

4.3.4. The Pakistan Petroleum (Exploration and Production) Rules, 2013

In exercise of the powers conferred by section 2 of the Regulation of Mines and Oil fields and Mineral Development (Government Control) Act, 1948 (Amended 1976), the Federal Government Notified the following rules, namely: The Pakistan Petroleum (Exploration and Production) Rules, 2013.

The section 58 of the rule states “A holder of petroleum right shall undertake to execute all operations in a proper, prudent and diligent manner, in accordance with good international oilfield practices and shall not unreasonably obstruct or interfere with other activities such as navigation, fisheries and agriculture. All reasonable precautions shall be taken to prevent pollution or damage to the environment and surroundings.

4.3.5. Petroleum Exploration and Production Policy, 2012

The purpose of this Petroleum Exploration and Production policy 2012 (Policy) is to establish the policies procedures, tax and pricing regime in respect of petroleum exploration and production (E&P) sector. The principal objectives of this Policy are:

- To accelerate E&P activities in Pakistan with a view to achieve maximum self – sufficiency in energy by increasing oil and gas production.
- To promote direct foreign investment in Pakistan by increasing the competitiveness of its terms of investment in the upstream sector.
- To promote the involvement of Pakistani oil and gas companies in the country's upstream investment opportunities.

- To train the Pakistani professionals in E&P sector to international standards and create favorable conditions for their retaining within the country.
- To promote increased E&P activity in the onshore frontier areas by providing globally competitive incentives.
- To enable a more proactive management of resources through establishment of a strengthened Directorate General of Petroleum Concessions (DGPC) and providing the necessary control and procedures to enhance the effective management of Pakistan's petroleum reserves.
- To ensure the energy security of the country by enhancing domestic exploration.
- To decrease reliance on imported energy by providing additional incentives to exploration and production companies for enhancing indigenous production.
- To undertake exploitation of oil and gas resources in a socially, economically and environmentally sustainable and responsible manner.

4.3.6. The Pakistan Onshore Petroleum (Exploration & Production) Rules, 2013)

These rules contain provisions related to reconnaissance surveys; license for petroleum exploration, lease for petroleum development and production; accounts, records, inspection, reports; and, miscellaneous matters. The rules allow any company incorporated inside or outside Pakistan to apply for reconnaissance permit, exploration license or a development and production lease. The way application may be made has also been prescribed i.e. in writing, mentioning principal place of business of applicant, furnishing of guarantee and deposit of fees etc. The petroleum right, if not exercised within three months, shall lapse. Every permit, license or lease shall be subject to terms and conditions mentioned in these rules included in second schedule and any other conditions which Government may deem fit to insert.

Permit for reconnaissance survey, petroleum exploration would be granted by the Government to any company in accordance with the rules and the holder must perform the work program stipulated in the license. The holder would not be entitled to extract any petroleum from discoveries other than such test production as the Government may in its discretion permit. Initial period of license shall not exceed three years.

The grant of lease for development and production, not exceeding twenty-five years, with certain terms and conditions including the work program shall be granted by the Government on being satisfied that the deposit can be commercially produced. The lease holder shall have exclusive right to perform activities in connection with the development and production including the right to undertake transportation subject to approval. The holder shall pay royalty at the rate of 12.5 percent of the wellhead value of the petroleum produced and saved. In addition to these powers of Government for recovering yearly lease rent, surface rent and revocation of lease have also been described.

The lease or license holder shall maintain full and accurate accounts, and shall submit periodic or occasional reports to DG, Petroleum Concessions. Any person authorized by Director General, Petroleum Concessions, or any other competent authority shall have power to examine the wells, plants, appliances etc. The lease or license holder shall maintain safety in operations including non-interference with navigation, fisheries and agriculture. All reasonable precautions shall be taken to prevent pollution or accumulation of trash and to prevent damage to the environment and surroundings. Pakistani goods

and services should be used subject to their quality, employment and training of Pakistani personnel to develop the capability should be ensured. Indemnity and force majeure have also been provided.

4.4. Provincial environmental Laws and Legislations

4.4.1. Punjab Environmental Protection Act, 1997 (Amended 2012 & 2017)

Punjab Environmental Protection Act, 1997 (amended 2012 & 2017) is the principal provincial legislation in Punjab for the:

- Protection, conservation, rehabilitation and improvement of the environment,
- Prevention and control of pollution, and
- Sustainable development.

The salient features of the Act are mentioned below:

1. Prevention of polluting discharges and Emissions: Section 11 of the Punjab Environmental Protection Act, amended 2012 & 2017 requires a person to ensure that no release is done to the environment in the form of harmful discharges / effluents or emissions which could cause degradation of the ambient environmental quality. However, release of effluents/air emissions is allowed if the concentration of its constituents is within the limits as prescribed in the National Environmental Quality Standards.
2. Environmental Quality Standards: The Act provides for fixing the Punjab Environment Quality Standards (PEQS) and their strict enforcement. For default, the Government has been empowered to levy a pollution charge.
3. IEE/EIA: Under Section 12, no project including construction activities or any change in the existing physical environment can be started unless the IEE or EIA has been conducted and its approval obtained from the Responsible Authority, in the present case from Punjab EPA.
4. The imports of hazardous waste into the country have been banned and the transport of hazardous substances and dangerous chemicals or toxic material or explosive substances etc. has been regulated, through licenses, under prescribed rules and procedure.
5. For the effective implementation of the provisions of the law, the Pakistan Environmental Protection Agency, headed by a Director General with other staff has been constituted. This Agency is responsible for enforcing the policy and implementing the provisions of the law. On the same pattern, Provincial Environmental Protection Agencies have been created in each province.

4.4.2. Punjab Environmental Protection (Review of IEE & EIA) Regulations, 2022

These regulations were prepared by Punjab Environmental Protection Department. These regulations divide projects in different Schedules depending upon the severity of environmental impact of the project. The project would fall in Schedule I, if the project has lower environmental impacts and thus requiring an IEE. And, the project would fall in Schedule II, if the project has significant environmental impacts and thus requiring an EIA. But all projects located in environmentally sensitive areas would require an EIA under these regulations.

The project “Oil & Gas Exploration Activities in Zindan II Block” falls in Schedule II requiring an EIA as the project is categorized as:

A. Energy: 5. Oil & gas extraction projects including exploration, production, gathering systems, separation and storage.

4.4.3. Punjab Environmental Policy, 2015

The Punjab Environment Policy 2015 aims to promote sustainable development by integrating environmental considerations into economic planning and decision-making. Its vision is the “promotion and attainment of sustainable development in the province through integration of environmental considerations while achieving economic growth and development”.

The policy sets key objectives, including raising environmental awareness, strengthening regulatory control on pollution, updating Environmental Quality Standards, building institutional capacity, promoting research, preventing pollution, and facilitating the adoption of environmentally friendly technologies.

The policy highlights that environmental protection is essential for long-term economic growth, as reducing pollution burdens improves public health, promotes sustainable resource use, and ensures a clean and safe environment for current and future generations.

Following the 18th Constitutional Amendment, the policy operates under the Punjab Environmental Protection Act (amended 2012), empowering the Environment Protection Department to protect, conserve, rehabilitate, and improve the environment, prevent pollution, and support sustainable development.

To implement its objectives, the policy outlines several strategic interventions, such as installing ambient air quality monitoring stations, upgrading EPA laboratories, assessing industrial pollution (e.g., Hudiana Drain), strengthening EPA’s enforcement capacity, revising EQS and industry-specific standards, and introducing model clean-technology initiatives like the Vertical Shaft Brick Kiln.

4.4.4. Punjab Environmental Quality Standards, 2016

In exercise of the powers conferred under clause (c) of subsection (1) of section 4 of the Punjab Environmental Protection Act, 1997 (XXXIV of 1997), the Environmental Protection Council has approved the PEQS for Municipal and Liquid Industrial Effluents, Drinking Water, Motor Vehicle Exhaust and Noise, Ambient Air, Noise, and Industrial Gaseous Emissions, with Notification No. SO (G)/EPD/7-26/2013 which were issued in 2016.

Table 4.1: PEQS for Ambient Air

Pollutant	Time- weight average	Concentration in ambient air	Method of measurement
Sulfur dioxide (SO ₂)	Annual average*	80 µg/m ³	Ultraviolet Fluorescence method
	24 hours**	120 µg/m ³	
Oxides of nitrogen as (NO)	Annual average	40 µg/m ³	Gas phase Chemiluminescence
	24 hours **	40 µg/m ³	
	Annual average	40 µg/m ³	Gas phase Chemiluminescence

Oxides of nitrogen as (NO ₂)	24 hours **	80 µg/m ³	
Ozone (O ₃)	1 hours	130 µg/m ³	Non-dispersive UV absorption method
Suspended Particulate Matter (SPM)	Annual average	360 µg/m ³	High volume sampling (Average flow rate not less than 1.1 m ³ /min)
	24 hours**	500 µg/m ³	
Respirable particulate matter PM ₁₀	Annual average	120 µg/m ³	Preferably β-Ray absorption method
	24 hours**	150 µg/m ³	
Respirable particulate matter PM _{2.5}	Annual average	15 µg/m ³	Preferably β-Ray absorption method
	24 hours**	35 µg/m ³	
	1 hours	15 µg/m ³	AAS method after sampling using EPM 2000 or equivalent filter paper
Lead (Pb)	24 hours**	1 µg/m ³	
	1 hours	1.5 µg/m ³	
Carbon Monoxide (CO)	8 hours	5 µg/m ³	Non-dispersive infrared (NDIR) method
	1 hours	10 µg/m ³	
* Annual arithmetic means of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval * 24 hourly /8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive days Table 3.2 shows Punjab environmental quality standards for municipal and liquid industrial effluents (mg/l, unless otherwise defined)			

Table 4.2: PEQS for Municipal and Liquid Industrial Effluents

Parameter	Into inland water	In sewage treatment
Temperature or temperature increase	≤3 C	≤3 C
pH value (H ⁺)	6-9	6-9
Biochemical oxygen demand (BOD ₅) at 20 C (1)	80	250
Chemical oxygen demand (COD) (1)	150	400
Total suspended solids (TSS)	200	400
Total dissolved solids (TDS)	3500	3500
Grease and Oil	10	10
Phenolic compounds (as phenol)	0.1	1.3
Chloride (as Cl ⁻)	1000	1000
Fluoride (as F ⁻)	10	10
Cyanide (as CN ⁻) total	1.0	1.0
An-ionic detergents (as MBAs) (2)	20	20
Sulfate (SO ₄ -2)	600	1000
Sulfide (S-2)	1.0	1.0
Ammonia (NH ₃)	40	40
Pesticides (3)	0.15	0.15
Cadmium (Cd)(4)	0.1	0.1

Chromium (trivalent and hexavalent) (4) (1)	1.0	1.0
Copper (Cu) (4)	1.0	1.0
Lead (Pb) (4)	0.5	0.5
Mercury (Hg) (4)	0.01	0.01
Selenium (Se) (4)	0.5	0.5
Nickel (Ni) (4)	1.0	1.0
Silver (Ag) (4)	1.0	1.0
Total toxic metals	2.0	2.0
Zinc (Zn)	5.0	5.0
Arsenic (As) (4)	1.0	1.0
Barium (Ba) (4)	1.5	1.5
Iron (Fe)	8.0	8.0
Manganese (Mn)	1.5	1.5
Boron (B)(4)	6.0	6.0
Chlorine (Cl ₂)	1.0	1.0

Table 4.3: PEQS for Industrial Gaseous Emissions

No	Parameter	Source of emission	Standard (PEQS Limits)
1	Smoke	Smoke opacity not to exceed	40% or 2 Ringelmann scale or equivalent smoke number
2	Particulate matter ⁽¹⁾	(a)boilers and furnaces	
		(i) Oil fired	300
		(ii) Coal fired	500
		(iii) Cement kilns	300
		(b) grinding crushing clinker coolers and related processes metallurgical processes converters blast furnaces and cupolas	500
3	Hydrogen chloride (HCl)	Any	400
4	Chlorine	Any	150
5	Hydrogen fluoride (HF)	Any	150
6	Hydrogen sulphide (H ₂ S)	Any	10
7	Sulphide oxides ^(2x3)	Sulfuric acid /sulfonic acid plants	5000
		Other plants except power plants operation on oil and coal	1700
8	Carbon monoxide (CO)	Any	800
9	Lead (Pb)	Any	50
10	Mercury (Hg)	Any	10
11	Cadmium	Any	20
12	Arsenic	Any	20
13	Copper (Cu)	Any	50
14	Antimony (Sb)	Any	20
15	Zinc (Zn)	Any	200
16	Oxides of nitrogen	Nitric acid manufacture unit 3000	
		Other plants except power plants operating on oil or coal	

Table 4.4: Sulfur Dioxide Background Levels Microgram per cubic meter ($\mu\text{g}/\text{m}^3$) Standard

Background air quality (SO_2 Basis)	Annual average	Max.24-hour interval	Criterion I Max. SO_2 emission (ton per day per plant)	Criterion II Max. allowable ground level increment to ambient ($\mu\text{g}/\text{m}^3$) (one-year average)
Unpolluted				
moderately polluted	<50	<200	500	50
Low	50	200	500	50
High	100	400	100	10
Very polluted**	>100	>400	100	10

* For intermediate value between 50 and 100 $\mu\text{g}/\text{m}^3$ linear interpolations should be used

**No project with sulfur dioxide emission will be recommended

Table 4.5: Standards for motor vehicle exhaust and noise (for in-use vehicles)

No.	Parameter	Standards (PEQS Limits)	Measuring methods	Applicability
1	Smoke	40% or 2 on the Ringelmann Scale during engine acceleration mode	To be compared with Ringelmann Chart at 6 meters or more	Immediate effect
2	Carbon monoxide	6%	Under idling conditions: non-dispersive infrared detection through gas analyzer	
3	Noise	85 dB(A)	Sound-meter at 7.5m from the source	

4.4.5. Punjab Local Government Act, 2013

Under Clause 48 of the 8th Schedule of this Act, the local governments are empowered to restrict any project causing pollution to air, water or land. They may also initiate schemes for improving the environment vide this legislation. The local government offices at union council level are given the authority through this law, to monitor any polluting activity and issue instructions to the responsible person for undertaking pollution prevention measures.

OGDC will be responsible to ensure that the proposed activities in Zindan II Block (District Bhakkar and Mianwali, Punjab) are undertaken in accordance with the environmental management requirements and recommendations given in this EIA as well as the NOC which will be issued for this project.

4.4.6. Punjab Hazardous Substances Rules, 2018

The Punjab Hazardous Substances Rules, 2018 provide a complete regulatory framework for the safe handling, storage, transport, import, use, and disposal of hazardous chemicals in Punjab. The Rules require all manufacturers, importers, transporters, and users of hazardous substances to obtain a license and maintain a detailed inventory of the chemicals they handle. They mandate proper labeling, safe storage systems, worker training, the use of protective equipment, and preparation of safety reports and waste-

management plans. The Rules also specify that hazardous waste and empty containers must be safely treated and disposed of, and prohibit unsafe practices such as using unlabeled chemicals or reusing chemical containers for food. In case of accidents, spills, leaks, or dangerous releases, operators must immediately report to the authorities and are held liable for environmental damage or loss of life. The Punjab EPD is authorized to inspect facilities, issue improvement notices, and enforce penalties, including suspension or cancellation of licenses for non-compliance. Overall, the Rules aim to protect human health, workplace safety, and the environment by ensuring that hazardous substances are managed responsibly and transparently throughout their lifecycle.

4.4.7. The Punjab Forest (Amendment) Act, 2025

The Punjab Forest (Amendment) Act, 2025 updates and strengthens the Punjab Forest Act of 1927 to improve forest protection, conservation, and governance in the province. The amendment broadens the legal definition of forest to include reserved forests, protected forests, and all government-notified forest areas, ensuring stronger legal coverage. It enhances penalties for illegal cutting, encroachment, grazing, removal of forest produce, and damage to forest land, introducing harsher fines and imprisonment to deter forest-related crimes.

The Act empowers the Forest Department with greater enforcement authority, including the power to arrest without warrant, seize illegally obtained timber, and remove encroachments more effectively. It also authorizes the government to declare new forest areas, regulate private forests, and promote sustainable forest management. Additionally, the amendment introduces stricter controls on the use of forest land for non-forest purposes and strengthens provisions related to biodiversity conservation, wildlife protection, and prevention of deforestation.

4.4.8. Punjab Forest Policy, 2019

The Punjab Forest Policy, 2019 aims to “protect, conserve, expand and sustainably manage forest resources in Punjab” by promoting ecological stability, biodiversity conservation, and climate resilience. It emphasizes increasing forest cover, restoring degraded ecosystems, promoting community-based forest stewardship, and strengthening institutional capacity for sustainable forest governance. The policy calls for strict protection of natural forests, rehabilitation of watersheds, prevention of illegal encroachments, and the promotion of private forestry and agroforestry to meet rising timber and fuelwood demands. It aligns provincial forest management with Pakistan's national climate commitments and encourages partnerships with communities, the private sector, and civil society.

4.4.9. The Punjab Plantation and Maintenance of Trees Act, 1974

The Punjab Plantation and Maintenance of Trees Act, 1974 is a provincial legislation designed to promote the plantation and maintenance of trees in the province of Punjab. It extends to the whole of Punjab. The Punjab Plantation and Maintenance of Trees Act, 1974 aims to enhance the green cover of the region. It consists of provisions such as defining key terms, including the responsibilities of the Forestry and Wildlife Department, government, land occupiers, and the rules related to the plantation and maintenance of trees. The Punjab Plantation and Maintenance of Trees Act, 1974 requires the planting and maintenance of three trees per acre by land occupiers, with penalties for non-compliance.

The penalty is determined as a fine and can be recovered as arrears of land revenue. The Act also empowers the government to make rules for implementing its provisions, specifying matters such as the types of trees to be planted in various areas and the procedure for maintaining tree records. Additionally, the government may exempt specific lands or occupiers from the Act's requirements through official Gazette notifications.

4.4.10. The Punjab Wildlife (Protection, Preservation, Conservation, and Management) Act, 1974 (Amended January, 2025)

The Punjab Wildlife (Protection, Preservation, Conservation, and Management) Act, 1974 (Amended October, 2007) caters to the protection of wildlife resources in the province. Besides ensuring an environment conducive for their rearing and livelihood, the Act also regulates hunting, poaching, possession, and trade in birds and animals. Government can notify and amend lists of protected ecosystems, national parks, wildlife sanctuaries, safari parks, and game reserves. The updated lists of the protected and special areas can be obtained from the National Council for Conservation or alternatively from the Forest and Wildlife Department, Government of Punjab.

Key features of the Punjab Wildlife Protection Act include:

- Ban on hunting of protected animals unless permitted otherwise in accordance with the requirements of the Act.
- Prohibition of any activity (residence, cultivation, land use that could damage vegetation, hunting, killing or capturing of any wild animal etc.), inside a wildlife sanctuary or National Park.
- Prohibition of any activity (hunting and shooting etc. of a wild animal) in the game reserve, except under a special permit.
- Penalties for those who contravene the provisions of the law.

Under the powers conferred to the government of Punjab through this Act, the government can declare certain areas reserved for the protection of wildlife and control activities within in these areas.

4.4.11. The Punjab Protected Areas Act, 2020

The Punjab Protected Areas Act, 2020 provides a comprehensive legal framework for the protection, conservation, and management of ecologically important areas within the province. The Act enables the Government of Punjab to declare wildlife sanctuaries, national parks, nature reserves, and other conservation zones, while establishing regulations to prevent activities that may degrade biodiversity, wildlife habitats, or ecological integrity. It outlines the responsibilities of management authorities, prescribes mechanisms for sustainable use, and sets penalties for violations to ensure long-term conservation of natural resources. The Act serves as a key environmental safeguard by regulating potentially harmful activities and promoting ecological preservation through structured oversight and enforcement.

For the planned seismic activities in Punjab, the Punjab Protected Areas Act, 2020 regulates operations within designated protected areas. Before project execution, it must be ensured that survey lines, access routes, equipment placement, and shot-point locations do not fall within or negatively affect declared protected ecosystems or wildlife habitats. If any portion of the project area overlaps with protected lands, additional clearances, mitigation measures, and compliance with site-specific management guidelines will be

required. Adherence to the Act helps minimize ecological disturbance and ensures the project proceeds in an environmentally responsible and legally compliant manner.

The protected areas of Bhakkar and Mianwali serve as critical ecological corridors within Pakistan's arid and riverine landscapes, managed primarily as wildlife sanctuaries and plantation reserves. In Mianwali, the Harnoli Plantation stands out as a vital sanctuary for diverse bird species and reptiles, while the region's proximity to the Indus River provides a habitat for the endangered Indus River dolphin. Bhakkar is characterized by its extensive network of protected plantations, such as Rakh Ghulaman, Chak, and Fateh Major, which are essential for the conservation of desert-dwelling species like the Chinkara gazelle and Nilgai. These man-made forests and protected zones not only prevent soil erosion in the Thal Desert but also offer a safe haven for migratory birds and local fauna, playing a pivotal role in maintaining the regional biodiversity of the Punjab province.

4.4.12. Punjab Irrigation, Drainage and Rivers Act, 2023

The Punjab Irrigation, Drainage and Rivers Act, 2023 establishes a comprehensive legal framework for the management, regulation, development, and protection of irrigation systems, drainage networks, and river infrastructure in Punjab. The Act grants the government authority to construct, maintain, and operate irrigation and river-related infrastructure; regulate water distribution; protect canals, riverbanks, drainage lines, and flood protection structures; and prevent unauthorized activities that may damage irrigation or river systems. It empowers the Irrigation Department to enforce penalties, remove illegal obstructions, regulate water usage, prevent pollution of irrigation channels, and protect government land associated with river and canal networks.

The Act also outlines procedural requirements for land acquisition, compensation, inspections, emergency actions during floods, and enforcement of safety measures. It modernizes water governance by clearly defining institutional responsibilities, enhancing monitoring and enforcement powers, and ensuring the safe, equitable, and sustainable management of Punjab's water resources.

4.4.13. The Punjab Special Premises (Preservation) Ordinance, 1985

The Punjab Special Premises (Preservation) Ordinance, 1985 provides a legal framework for preservation of premises of historical, cultural, archaeological, and architectural value in the province. The Ordinance specifically prohibits implementation of developmental schemes or new constructions within a radius of two hundred feet from notified special premises. The number of protected sites notified under the Punjab Special Premises Ordinance is 246. The proposed activities in project area will follow the requirements of this ordinance; no activity will be initiated by OGDC in the premises of any site protected under this Ordinance. There are no such sites at or near the proposed project area.

4.4.14. Punjab Heritage Foundation Act, 2005

The Punjab Heritage Foundation Act 2005 establishes the Punjab Heritage Foundation, an autonomous body responsible for preserving, promoting, and managing the cultural, historical, and architectural heritage of Punjab. The Act defines the structure, powers, and functions of the Foundation, including conservation of heritage sites, museums, artifacts, folk traditions, and cultural assets. It also authorizes the Foundation to conduct research, organize cultural programs, raise funds, collaborate with national and international institutions, and advise the government on heritage-related policies. The Act provides

mechanisms for registration, protection, and documentation of heritage and enables penalties for unauthorized damage or misuse of heritage sites. Overall, it ensures a systematic and professional approach to safeguarding Punjab's cultural legacy.

4.5. Sectoral Guidelines

The environmental as well as social guidelines related to the proposed project are as discussed under:

4.5.1. Policy & Procedures for the Filing, Review and Approval of Environmental Assessments, 2000

The Policy & Procedures for the Filing, Review and Approval of Environmental Assessments, 2000, prepared by the Pak-EPA under the powers conferred upon it by the Pakistan Environmental Protection Act, provide the necessary details on the preparation, submission, and review of the Initial Environmental Examination (IEE) and the Environmental Impact Assessment (EIA).

This EIA Study has followed the procedures defined in the PEPA, 1997 and Review guidelines, 2000, and the EIA will be submitted to the Punjab EPA in whose jurisdiction the project will be implemented. The PEPA has, however, been given the right to review any environmental report at any time and the power to revoke the decision of the provincial EPA, if it deems this to be necessary.

4.5.2. Guidelines for Preparation & Review of Environmental Reports

These guidelines require proponents to prepare terms of reference for the environmental assessment reports. It requires that all studies should contain baseline data on the area and must contain an assessment of the potential environmental impacts and the recommended mitigation measures.

4.5.3. Guidelines for Operational Health, Safety and Environmental Management, 1996

These guidelines are the outcome of a study commissioned by the Directorate General Petroleum Concessions, Ministry of Petroleum and Natural Resources, Government of Pakistan. The guidelines list down the relevant laws related to the operational health, safety and environmental management and recommends environmental controls and management practices to be adopted in Oil & Gas exploration projects. These guidelines are extensive and fully supportive of the Environmental Protection Act of 1997.

4.5.4. Sectoral Guidelines for Environmental Reports – Oil and Gas Exploration and Production

These guidelines identify and explain issues that should be addressed for a proposal involving exploration for, or production of, oil and gas. It is important to focus on key issues for specific proposals. The matters identified in this guideline should provide guidance for the preparation and assessment of most exploration and production proposals. It is intended that Companies involved in Oil and Gas Exploration and Production will self-regulate and undertake monitoring to meet or exceed the provisions of the Package and these sectorial guidelines; the Responsible Authority reserves the right to spot check field operations from time to time.

4.6. International Conventions and Treaties

International environmental treaties and conventions, endorsed by Pakistan are mentioned below:

4.6.1. Climate Change

- United Nations Framework Convention on Climate Change, 1992
- Paris Agreement 2015 on Climate Change aimed at combating global warming by limiting temperature rise to well below 2°C (preferably 1.5°C) above pre-industrial levels.

4.6.2. Waste and Pollution

- Basel Convention on the Control of Trans boundary Movement of Hazardous Wastes and their Disposal, 1989.

4.6.3. The Convention on Biological Diversity

The Convention on Biological Diversity 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 programs 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 biological diversity.

4.6.4. The Convention on Conservation of Migratory Species of Wild Animals, 1979

The Convention on the conservation of Migratory Species of Wild Animals (CMS), 1979, requires countries to act to avoid endangering migratory species. The term “migratory species refer to the species of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries. These parties are also required to promote or co-operate with other countries in matters of research on migratory species.

The Convention contains two appendices. Appendix I contain the list of migratory species that are endangered according to the best scientific evidence available. For these, species the member states to the Convention are required endeavor to:

- Conserve and restore their habitats
- Prohibit their hunting, fishing and capturing, harassing and deliberate killing.
- Remove obstacles and minimize activities that seriously hinder their mitigation.
- Control other factors that might endanger them, including control of introduced exotic species.

Migratory species that need or would significantly benefit from international cooperation are listed in Appendix II of the Convention. These species, either individually or by taxonomic group, are the basis for establishing instruments – regional or global – under CMS. For this reason, the Convention encourages the Range States to conclude global or regional Agreements.

4.6.5. Cultural Heritage

Convention concerning the Protection of the World Cultural and Natural Heritage, 1972 obligates the states to ensure identification, protection and transmission of natural heritage to future generations.

4.6.6. ILO Conventions

Pakistan has been a member of the ILO since 1947 and has thus far ratified 36 conventions. Of these, 33 are in force, whereas 3 have been denounced. The fundamental conventions which are being implemented across Pakistan through applicable labor laws include:

- C029 - Forced Labor Convention, 1930 (No. 29);
- C100 - Equal Remuneration Convention, 1951 (No. 100);
- C105 - Abolition of Forced Labor Convention, 1957 (No. 105);
- C111 - Discrimination (Employment and Occupation) Convention, 1958 (No. 111);
- C138 - Minimum Age Convention, 1973 (No. 138) Minimum age specified: 14 years;
- C182 - Worst Forms of Child Labor Convention, 1999 (No. 182)

4.6.7. National Fire Protection Association (NFPA)

NFPA 30 is applied for the safe storage, handling, and use of flammable and combustible liquids by the manufacturers, producers, distributors, and end users and is enforceable under OSHA and many state & local regulations. Design, material of construction, installation, ventilation, drainage, inspection of tank building, detection and alarm for tank building, piping system, etc. are prescribed to safeguard against fire hazards and explosion. In case of emergency caused by eruption of fire, training to employees is also recommended.

NFPA helps to mitigate risks during safe installations, failures, leaks, storage, handling, transportation, and use that could lead to fires and explosions.

4.6.8. Guidelines of the American Petroleum Institute (API) and Louisiana Statewide Order 29-B (LSO 29-B)

The American Petroleum Institute (API) guidelines for disposal of oil and gas exploration and production wastes and the Louisiana Statewide Order 29-B (LSO 29-B) deal with the disposal of oil and gas exploration and production wastes. Both API and LSO 29B standards recognize land treatment techniques, which include land spreading i.e. spreading of the waste over a land area and dilution by mixing with native soil, land farming i.e. mixing of the waste with soil and encouraging natural remediation and burial on-site i.e. burial of the waste into unlined waste pits after dilution with native soil, as feasible options for the treatment and disposal for drilling wastes. The two standards also specify maximum permissible levels (MPL) for various parameters (including pH, metals, oil and grease, sodium adsorption ratio etc.) in the waste or the waste soil mixture.

5. ENVIRONMENTAL AND SOCIAL BASELINE

5.1. General Introduction

This section provides a comprehensive profile of district Bhakkar and District Mianwali (macro environment); where the proposed seismic survey will be conducted by OGDC. The study will cover the physical, biological and socio-economic environment of the area prior to the beginning of its various activities.

This categorization would aid in understanding the prevalent macro and micro environment of this project and would enable assessment of possible environmental impacts that may arise as a result of the activities associated with the project. It would also assist the design team in defining the mitigation measures that would be required to minimize if not eliminate the negative impacts which are pointed out in this study.

5.2. Study Area

The study area for the EIA comprised the district Bhakkar and district Mianwali where the proposed exploration activities will be carried out. Microenvironment has been studied as location of exploration activities and their surrounding areas.

5.3. Methodology

The information for the baseline was collected using both primary and secondary information sources. Primary data was acquired through field surveys using checklist and questionnaire as well as focus group discussions with the local communities to obtain first hand data on the environmental and social aspects of project area. Information was also collected from relevant department's e.g. local government, EPA offices etc. to identify sensitive issues of project that may necessitate special attention during EIA. Secondary data sources encompassed literature review including reports from print and electronic media, as well as published maps from the Geological Survey of Pakistan and Soil Survey of Pakistan. It also involved review of District Census Reports (DCRs), previous district-specific studies, and other studies conducted by EMC in the region.

5.4. Project Location

The proposed project includes 2D Seismic Activities which will be carried out in Zindan-II Block, Districts Bhakkar and Mianwali, Punjab. The total area falls in the districts Bhakkar and Mianwali is approximately 400 L. km where the OGDC will carry out 2D seismic activities for the identification of oil and gas resources.

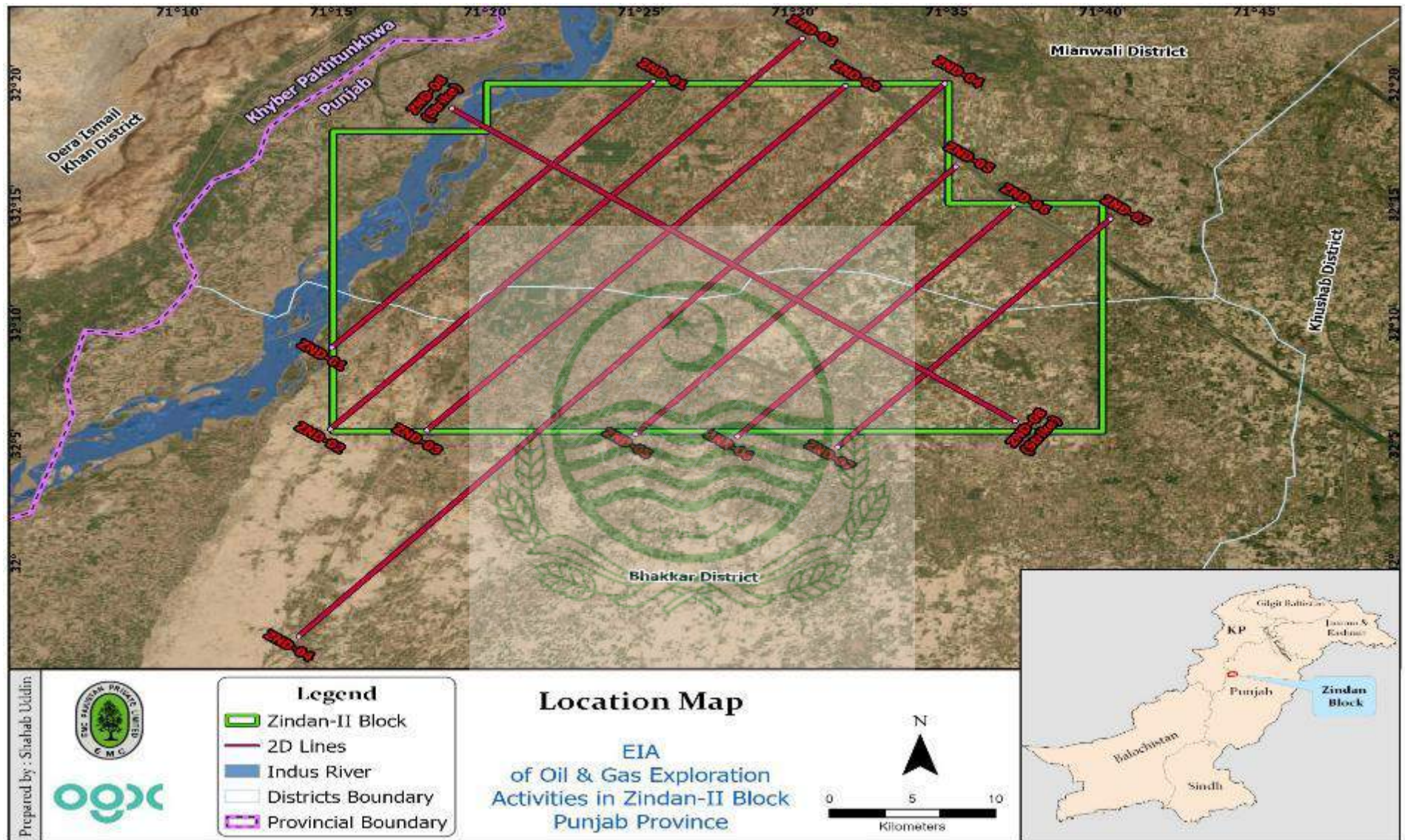


Figure 5.1: Location map of project area

5.5. Suitability of the Site

The selected area is suitable to undertake the project for following features:

- The site is hilly terrain, barren and mostly consists of the loose and eroded material.
- The project activities will not affect any protected and environmentally sensitive area.
- No form of resettlement or removal of business is required for project execution.

5.6. Environmental Monitoring of the area

Environmental monitoring of ambient air, groundwater, and soil has been conducted to establish baseline conditions. The monitoring reports are attached as Annex-III.

5.7. Physical Environment

5.7.1. Topography

Bhakkar district: Topographically, Bhakkar is predominantly flat to gently undulating, characterized by sandy plains, dunes, and desert landscapes associated with the Thal Desert. The district lacks major hill systems; however, slight undulations and stabilized sand ridges are common features. The land can be broadly classified into river plains, sandy desert plains, wind-blown dunes, and alluvial floodplains near the Indus River.

Mianwali district: Mianwali has diverse terrain with river plains, piedmont plains, hills, plateaus, and mountains. The Indus River flows along the western side of the district. The eastern and southeastern parts gradually merge into the Thal Desert, while the northern and western regions rise into the Salt Range and Surghar Range. The Surghar mountain range, part of the outer Himalayan foothills, dominates the northwestern portion of Mianwali, with elevations exceeding 4,000 feet. The hills are rugged, rocky, and dissected by seasonal streams.



Figure 5.2: Topography of project area

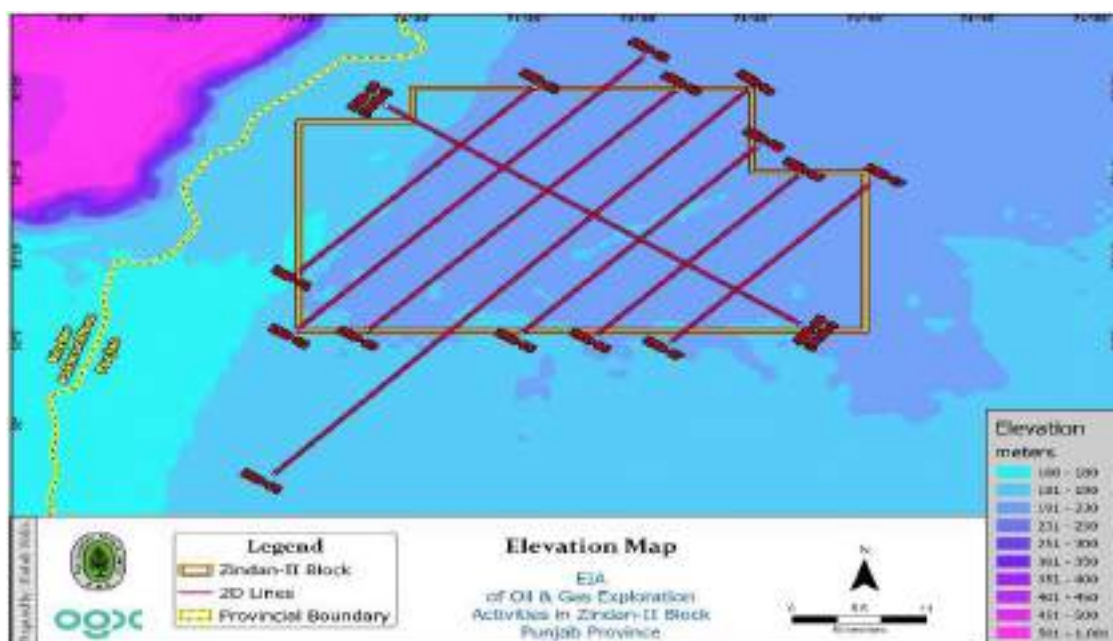


Figure 5.3: Elevation Map of Project Area

5.7.2. Geology

Bhakkar district: Geologically, District Bhakkar lies within the Indus Basin and is predominantly covered by Quaternary alluvial and aeolian deposits, largely associated with the Thal Desert and the Indus River floodplain. The surface geology mainly consists of unconsolidated sand, silt, clay, and loamy deposits, transported and deposited by wind and fluvial processes. These deposits form extensive flat to gently undulating plains with occasional stabilized sand dunes. The Indus River has contributed thick sequences of recent alluvium, forming fertile riverine belts. Subsurface stratigraphy beneath the alluvial cover includes Tertiary sedimentary formations, which are part of the broader Indus Basin petroleum system. Due to the thick overburden of alluvium and desert sands, older formations are not exposed at the surface. The district is not known for surface coal occurrences; however, its geological setting is considered prospective for hydrocarbons at depth, which has led to exploration activities in the region.

Mianwali district: The geology of District Mianwali is more diverse and complex, reflecting its transitional position between the Indus Plains and the Salt-Surghar Range system. The district exposes a wide range of sedimentary rocks ranging from Precambrian to Tertiary age, particularly in the northern and north-western parts. The Surghar Range, an extension of the Salt Range, dominates the north-western portion of the district and consists mainly of limestone, sandstone, shale, and marl formations. Prominent geological units include Permian, Triassic, Jurassic, Cretaceous, and Eocene formations, such as Datta Sandstone, Samana Suk Limestone, Lockhart Limestone, and Sakessar Limestone. These carbonate and clastic sequences indicate marine to shallow-marine depositional environments. Coal-bearing horizons of Paleocene age, particularly within the Patala Formation, are present in parts of the district, though coal seams are generally thin and structurally disturbed due to folding and faulting associated with the Himalayan orogeny. The southern and eastern parts of Mianwali transition into alluvial plains and Thal Desert margins, where surface geology is dominated by recent alluvium and wind-blown sands similar to Bhakkar.

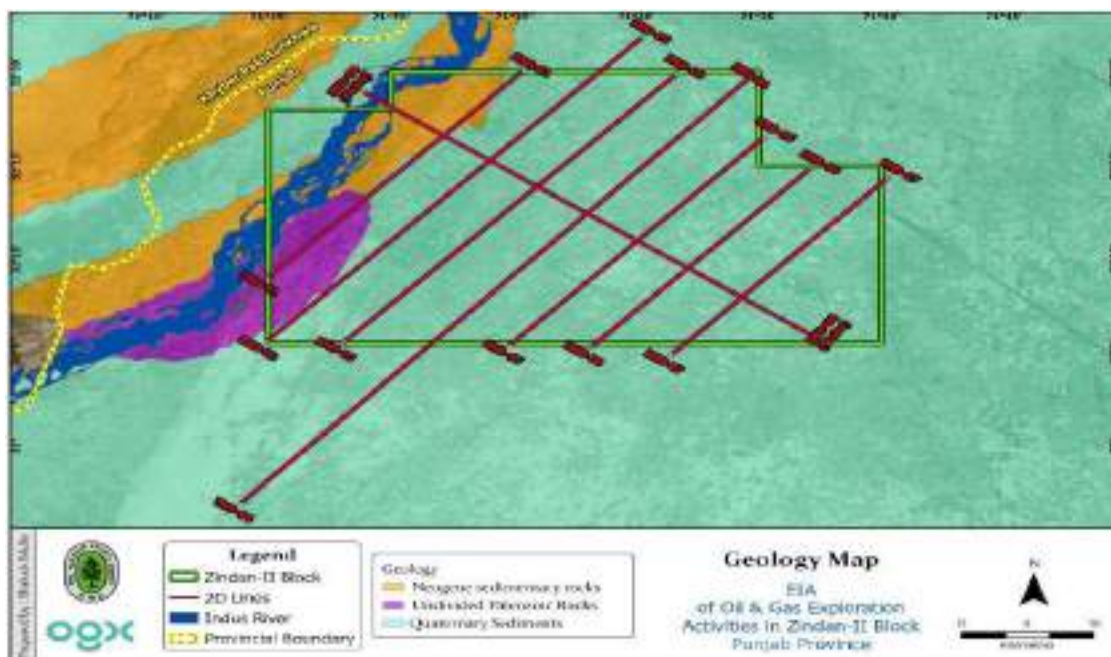


Figure 5.4: Geological Map of the Project Area

5.7.3. Land Cover distribution

Districts Bhakkar and Mianwali exhibit distinct land use and land cover patterns shaped by their arid to semi-arid climate, proximity to the Indus River, and diverse physiographic features. Bhakkar is largely dominated by the Thal Desert, with extensive desert and semi-desert landscapes. Land use mainly comprises rangelands, sandy scrub, and rain-fed agriculture, while irrigated cultivation is concentrated along the Indus River. Vegetation is sparse, consisting primarily of desert shrubs and grasses. Forest cover is negligible and limited to small plantations and riverine patches. Built-up areas occupy a very small proportion of the district, and surface water is confined to canals, ponds, and seasonal depressions. In contrast, Mianwali has more diverse land cover due to its varied topography, including alluvial plains along the Indus River, Thal Desert margins, and hilly terrain associated with the Salt and Surghar ranges. Agriculture dominates the fertile plains, while rangelands and scrub vegetation occur in desert and upland areas. Forests are present in hill ranges and protected areas. Built-up areas remain limited, and water bodies are mainly associated with the Indus River and irrigation infrastructure. Detailed land-use statistics are presented in **Table 5.1**.

Table 5.1: Land Use / Land Cover Statistics of District Bhakkar and Mianwali

LULC Class	Bhakkar Area (km ²)	Bhakkar (%)	Mianwali Area (km ²)	Mianwali (%)
Agriculture / Cropland	3,100	38%	3,300	56%
Rangeland / Scrub / Shrubland	3,700	45%	1,500	26%
Forest / Tree Cover	250	3%	550	9%
Bare Soil / Sandy / Rocky Terrain	850	10%	300	5%
Built-up / Settlements	180	2%	140	2%
Water Bodies (Rivers, Canals, Ponds)	73	2%	50	1%
Total District Area	8,153 km²	100%	5,840 km²	100%

Source: Urbanization-led land cover change impacts terrestrial carbon storage capacity: A high-resolution remote sensing-based nation-wide assessment in Pakistan (1990–2020)

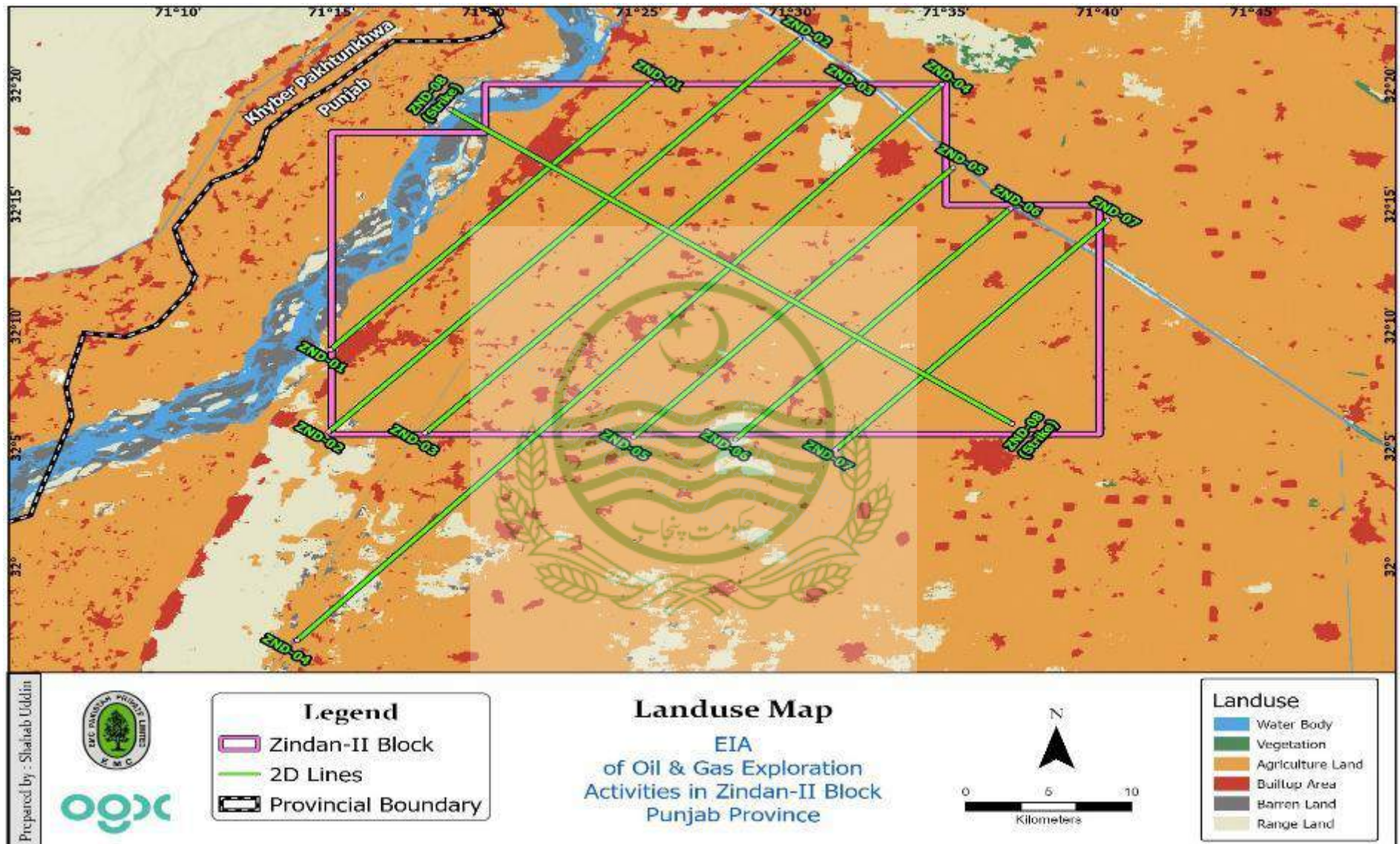


Figure 5.5: Land use map of the Project Area

5.7.4. Soil Characteristics

Bhakkar District: The soils of Bhakkar are largely sandy due to its location in the Thal Desert, with loose sand ridges and some loamy inter-dune areas. They are generally calcareous, with patches of saline-sodic soils, especially in the Indus floodplain, which also contains more fertile alluvial soils. Overall, soils are low in organic matter and fertility, coarse in texture, and prone to erosion without vegetation cover.

Mianwali District: Soils in Mianwali vary significantly, ranging from fertile alluvial soils in river plains to sandy and gravelly soils in desert and piedmont areas, and shallow stony soils in hilly regions. Soil erosion, particularly in hilly and sloping terrains, is a common issue. Rainfall runoff is rapid due to sparse vegetation cover, and seasonal streams (nullahs) become active during monsoon rains. The southern Thal region has sandy, low-fertility soils, while the Indus plains and canal-irrigated areas contain more fertile alluvial and loam soils suitable for crops. Upland and hill-adjacent areas feature clay-loam soils supporting rain-fed agriculture, but overall organic matter remains low, requiring careful water and soil management.

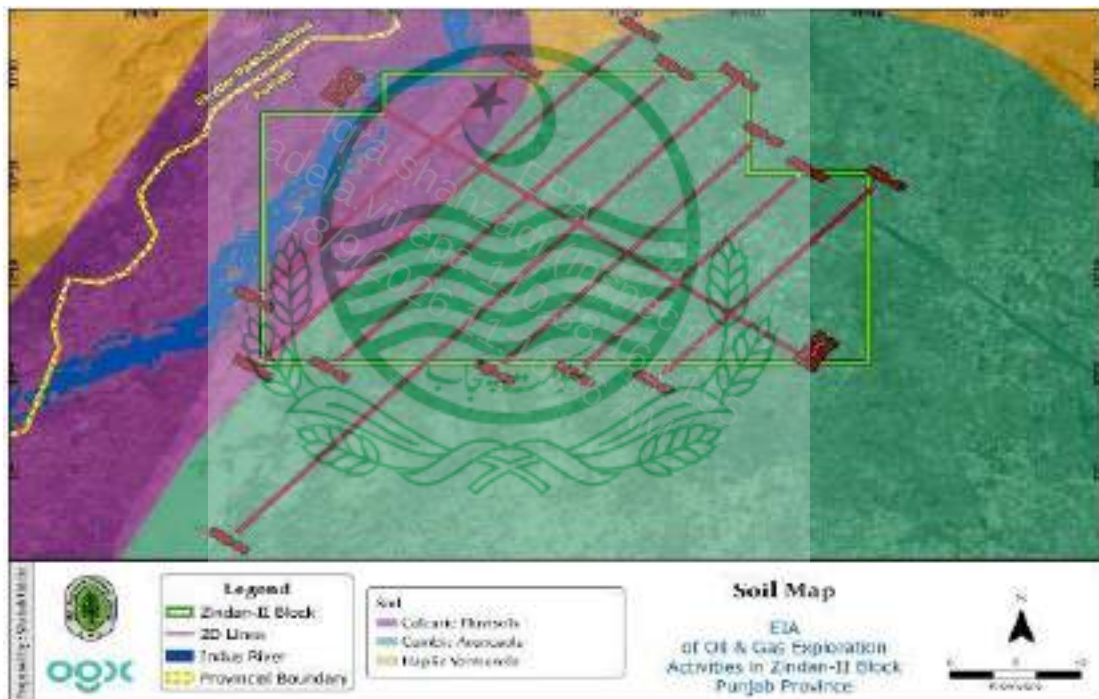


Figure 5.6: Soil Map of the Project Area

5.7.5. Seismicity

Horizontal and vertical seismic forces transmitted to support structures by an earthquake can impose significant mechanical stresses on engineering structures, including roads. Seismic adaptation in these areas depends primarily on proper design of support structures and connections between units. Bhakkar and Mianwali districts are both located in Seismic Zone 2A, indicating a region of low to moderate earthquake risk. These districts experience relatively minor seismic activity compared to northern Pakistan, although occasional small to moderate earthquakes have been recorded. Larger and more frequent seismic events are concentrated in the northern and western mountainous regions of the country, due to the collision of major tectonic plates, while Bhakkar and Mianwali remain comparatively less affected.

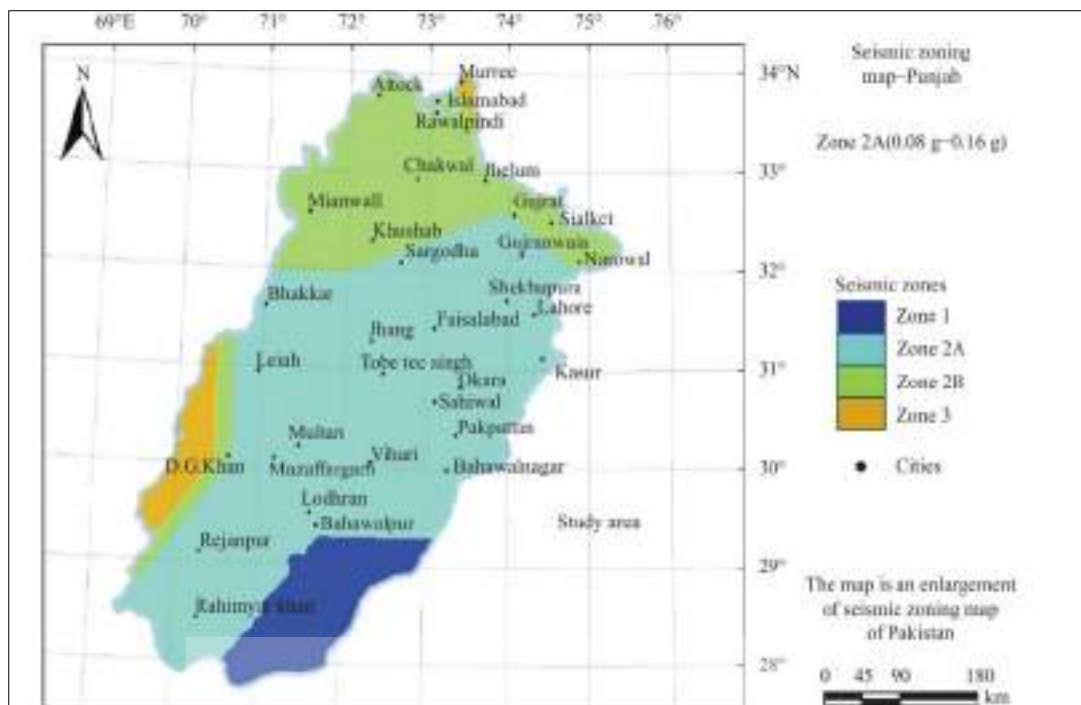


Figure 5.7: Seismic Zoning Map of Punjab Province

5.7.6. Climate

5.7.6.1 Temperature

Bhakkar district

In Bhakkar, the hot season lasts for about 4.0 months, roughly from April to July, with average daily high temperatures well above 95°F (35°C) and peaking in June with typical highs around 110°F (43-44°C) and lows near 90°F (32-33°C). The cool season spans about 3.0 months, from December to February, when average highs fall below about 72°F (22-23°C) and lows drop to around 50-54°F (10-12°C), with January being the coldest month. Overall, Bhakkar experiences extremely hot summers and mild to cool winters.

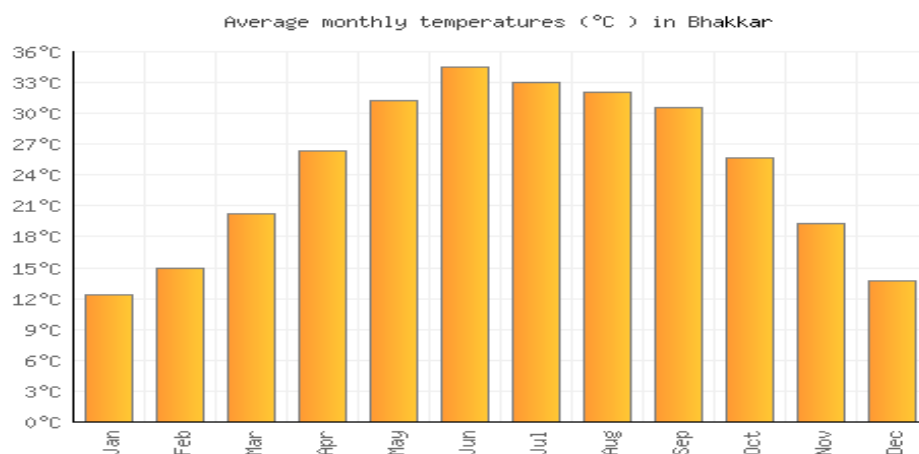


Figure 5.8: Average High and Low Temperature in District Bhakkar

Mianwali district

In Mianwali, the hot season typically extends for about 4.5 months, from May through September, with average daily high temperatures above roughly 100°F (38°C) and peaking

in June with average highs near 109°F (42.8°C) and lows around 89–92°F (32–33°C). The cool season lasts about 3.0 months, from December to February, with average daily highs below about 68°F (20°C) and average lows dropping to around 47–51°F (8–11°C), with January usually the coldest. Overall, Mianwali has a long, hot summer and a short, cool winter.

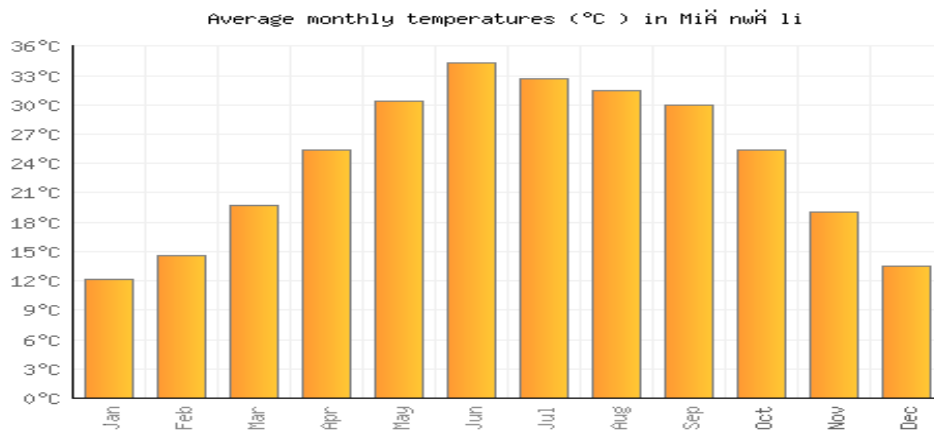


Figure 5.9: Average High and Low Temperature in District Mianwali

5.7.6.2 Precipitation

Bhakkar district

A wet day in Bhakkar is defined as a day receiving at least 0.04 inches (≈1 mm) of precipitation. Rainfall is highly seasonal, with the wet season occurring from late June to early September due to monsoon activity. During this period, the probability of a wet day peaks at around 22% in late July, and July records the highest average number of wet days (about 10–11 days). The remainder of the year is generally dry, particularly from September to June, with December being the driest month, averaging fewer than one wet day. Rainfall in the area occurs almost entirely as rain, with peak precipitation during July and August.

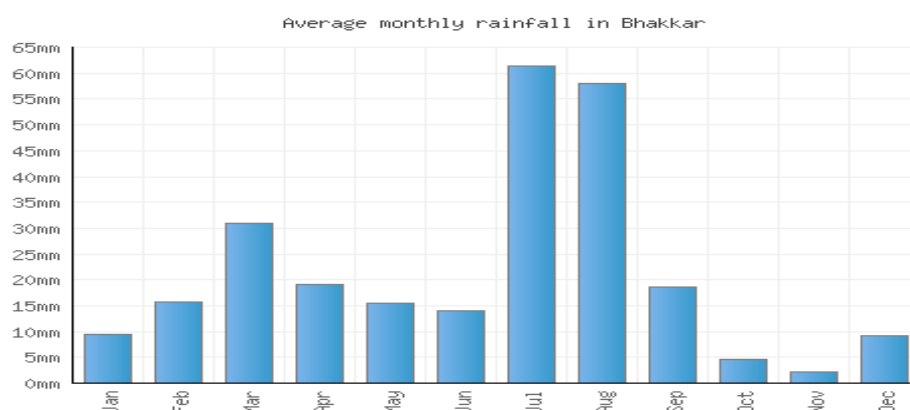


Figure 5.10: Daily Chance of Precipitation in Bhakkar

Mianwali district

In Mianwali, a wet day is also defined as having at least 0.04 inches of precipitation. The wetter season in the district generally occurs from July through September, corresponding with the monsoon, when the frequency of wet days is highest. Average monthly precipitation peaks in July and August, with these months recording the greatest number

of rainy days each year. Outside the monsoon period, the drier season lasts from around October through June, with much lower probabilities of wet days and minimal rainfall. The driest months are typically November and December, with very few wet days. As in the surrounding region, the predominant form of precipitation in Mianwali is rain alone, occurring mostly during the monsoon season.

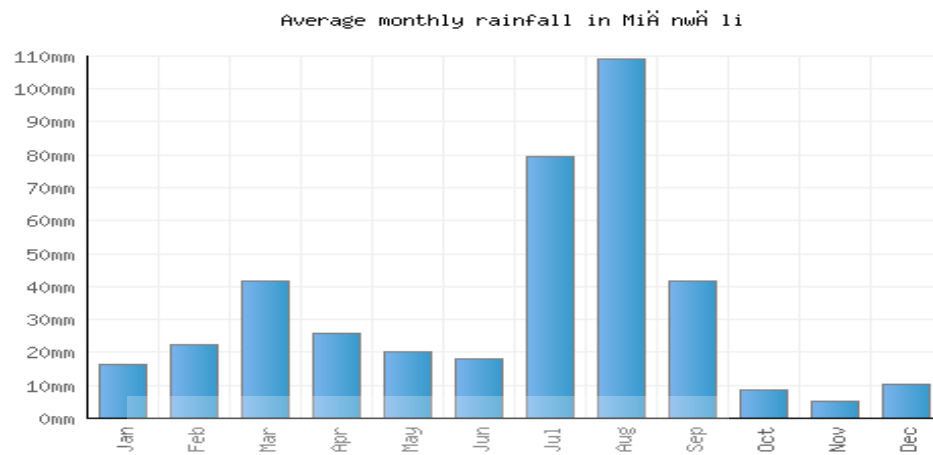


Figure 5.11: Daily Chance of Precipitation in Mianwali

5.7.6.3 Humidity

Bhakkar district

Bhakkar experiences extreme seasonal variation in perceived humidity due to its arid desert climate. The muggier period lasts approximately 3.5–4 months, from mid-June to mid-September, during which conditions are muggy, oppressive, or uncomfortable at least 20–25% of the time. The peak mugginess usually occurs in July and August, coinciding with the monsoon rains, while the least muggy period is in February, when humidity is minimal and dry conditions dominate.

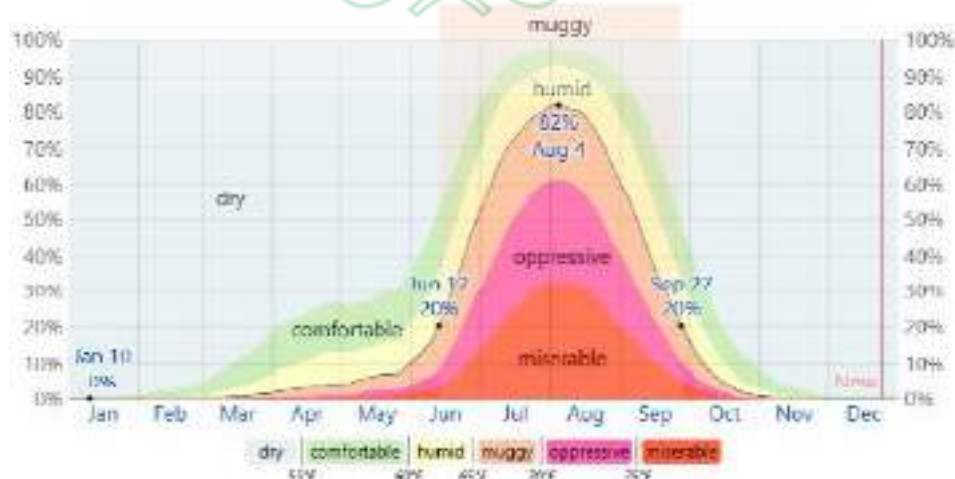


Figure 5.12: Humidity Comfort Levels in District Bhakkar

Mianwali district

Mianwali also shows strong seasonal changes in humidity. The muggier season lasts about 3.5 months, from mid-June to mid-September, when the comfort level can feel muggy, oppressive, or unpleasant around 22–24% of the time. August typically records the highest number of muggy days, whereas February and early March have the lowest humidity, with

very few muggy days. Monsoon rainfall largely influences the muggier conditions in this region.



Figure 5.13: Humidity Comfort Levels in District Mianwali

5.7.6.4 Wind

Bhakkar district

Wind patterns in Bhakkar vary with local topography, with instantaneous speed and direction fluctuating more than hourly averages. The windier part of the year lasts about 8–8.5 months, roughly from November to July, with average hourly wind speeds above 5.0 miles per hour. The windiest month is typically April, with an average hourly wind speed of 5.8–6.0 miles per hour. The calmer season lasts about 3–3.5 months, from August to November, with the calmest month being September, when wind speeds drop to around 4.0–4.3 miles per hour.

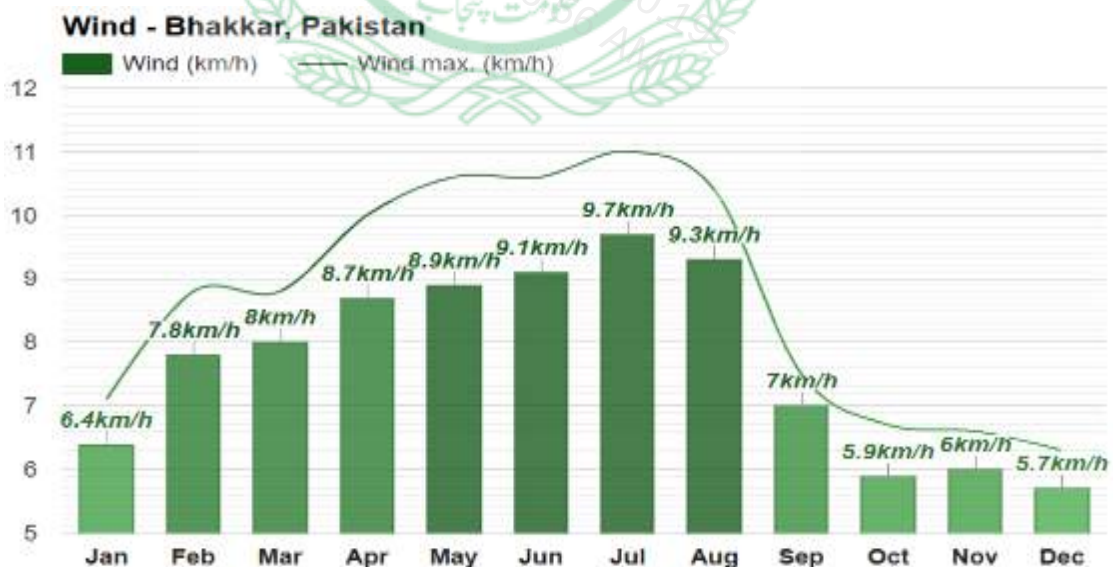


Figure 5.14: Average Wind Speed in Bhakkar

Mianwali district

In Mianwali, average hourly wind speeds show mild seasonal variation. The windier period lasts roughly 8–8.5 months, from November to July, with speeds generally exceeding 5.2 miles per hour. April is usually the windiest month, with average hourly wind speeds around 5.9 miles per hour. The calmer period spans 3–3.5 months, from August to

November, with September being the calmest month, averaging 4.2–4.5 miles per hour. Wind direction and speed can vary locally due to topography and desert influences.

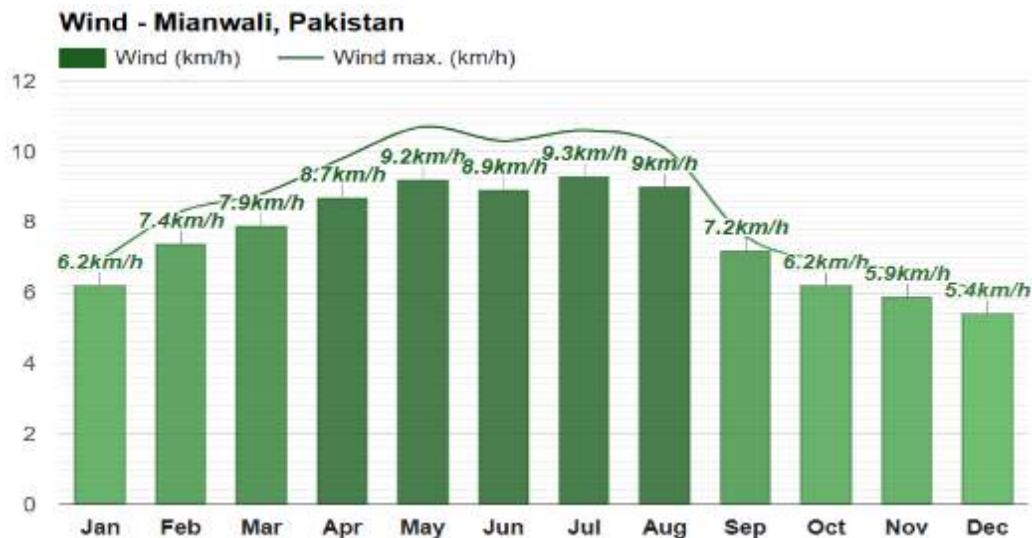


Figure 5.15: Average Wind Speed in Mianwali

5.7.7. Ambient Air Quality & Noise Level Monitoring

Ambient air monitoring data shows consistently low pollutant levels over a 24-hour period, with average concentrations of 0.79 mg/m³ for CO and 14.4 µg/m³ for NO₂. Peaks in concentration occurred in the early afternoon, suggesting elevated traffic or industrial activity, while overall air quality remains stable.

Table 5.2: Ambient Air Quality Monitoring of Project Area

Sr. No.	Time	CO	NO	NO ₂	NO _x	SO ₂
		(mg/m ³)	(µg/m ³)	(µg/m ³)	(µg/m ³)	(µg/m ³)
1	14:00	1.25	10.64	18.51	29.15	29.02
2	15:00	1.15	10.1	18.19	28.3	26.96
3	16:00	0.99	9.97	17.72	27.69	26.44
4	17:00	0.87	9.86	16.28	26.14	26.07
5	18:00	0.81	9.64	15.47	25.11	25.21
6	19:00	0.78	9.04	14.14	23.18	24.11
7	20:00	0.73	8.66	13.97	22.63	23.17
8	21:00	0.69	8.18	13.67	21.85	22.31
9	22:00	0.63	7.79	13.35	21.14	21.21
10	23:00	0.58	7.52	13.18	20.7	23.25
11	0:00	0.54	7.18	12.69	19.87	22.31
12	1:00	0.47	6.56	10.44	17	21.5
13	2:00	0.43	5.99	9.84	15.83	21.73
14	3:00	0.49	6.44	9.65	16.09	20.32
15	4:00	0.55	7.05	12.84	19.9	18.6
16	5:00	0.62	7.52	11.92	19.44	19.77
17	6:00	0.67	8.39	13.46	21.85	23.46
18	7:00	0.72	8.83	14.72	23.55	23.82
19	8:00	0.78	9.42	14.42	23.84	27.3
20	9:00	0.83	8.41	13.59	22.01	28.39
21	10:00	0.99	9.12	16.47	25.59	29.57

22	11:00	1.04	9.69	17.48	27.17	30.22
23	12:00	1.12	9.86	17.31	27.17	32.47
24	13:00	1.21	10.21	17.29	27.51	31.06
Average Concentration		0.79	8.59	14.4	23.03	24.93

5.7.8. Noise Level Monitoring

The noise monitoring data presented in Table 5.3 indicates that the acoustic environment of the project area remains well within the Punjab Environmental Quality Standards (PEQS). During the daytime, noise levels peaked at 53 dB(A) with an average of 49 dB(A), significantly lower than the permissible limit of 65 dB(A). Similarly, nighttime levels were consistently quiet, averaging 45 dB(A) against a regulatory limit of 55 dB(A). The steady decline in noise during late-night hours and the gradual increase during the morning suggests a typical environmental pattern influenced by local activity, indicating no significant noise pollution concerns for the site.

Table 5.3: Noise Monitoring					
Sr. No.	Time	Noise dB (A)	Sr. No.	Time	Noise dB (A)
1	14:00	51	13	2:00	45
2	15:00	52	14	3:00	44
3	16:00	53	15	4:00	43
4	17:00	52	16	5:00	44
5	18:00	51	17	6:00	45
6	19:00	50	18	7:00	46
7	20:00	49	19	8:00	47
8	21:00	48	20	9:00	47
9	22:00	47	21	10:00	48
10	23:00	46	22	11:00	49
11	0:00	45	23	12:00	50
12	1:00	44	24	13:00	50
Average Day Time/PEQS			49/65		
Average Night Time/PEQS			45/55		



Figure 5.16: Ambient Air and Noise Level Monitoring

5.7.9. Hydrology

The surface water quality is of great importance due to its effects on human health and aquatic ecosystems. Running water is highly vulnerable to pollution attributing to their role in carrying off the municipal and industrial wastewater and run-off from agriculture in its

vast drainage basins. Anthropogenic influences, as well as natural processes, deteriorate surface water and impair their use for drinking, industrial, agricultural, recreation or other purposes. In Pakistan, due to lack of proper facilities of waste disposal only 1% of wastewater is treated before being discharges directly into water bodies.⁵ It is general trend that concentration of different pollutants in urban areas is high as compared to suburb and natural environment, which indirectly indicates anthropogenic activities.

People in the project area need to rely on a groundwater. Groundwater is extracted through tube wells and hand pumps for domestic activities as well irrigation purpose.

5.7.9.1. Surface Water

Bhakkar District: Surface water resources in Bhakkar are limited and largely influenced by the Indus River, which flows along the western boundary of the district and serves as the primary surface water source. The river supports irrigation, groundwater recharge, and limited domestic use. Besides the Indus, the district has several seasonal nullahs and rain-fed streams, which remain dry for most of the year and carry water mainly during the monsoon season. Due to the arid climate and low annual rainfall, surface water availability is generally scarce.

Groundwater is the main source of water for domestic and agricultural use in Bhakkar. It is extracted through tube wells and hand pumps; however, groundwater quality varies spatially, with many areas reporting saline or brackish water, particularly in desert and low-lying zones. Over-extraction and limited recharge further stress groundwater resources, making water management a critical issue in the district.

Mianwali District: Mianwali has comparatively better surface water resources due to the presence of the Indus River, which flows along the eastern boundary of the district and plays a major role in irrigation, agriculture, and groundwater recharge. Several seasonal nullahs and streams originating from the surrounding hills drain into the Indus, carrying runoff during the monsoon season and remaining dry during the rest of the year.

Groundwater is widely used for domestic and agricultural purposes through tube wells and hand pumps. In canal-irrigated areas, groundwater quality is generally suitable; however, in some parts of the district, water quality deteriorates due to salinity and mineral content. Similar to other semi-arid regions of Punjab, surface water flow increases during the monsoon months, while water availability declines significantly during the dry season.⁶

⁵

https://www.researchgate.net/publication/374217775_Wastewater_Treatment_in_Pakistan_Issues_Challenges_and_Solutions

⁶ <https://www.scribd.com/document/216088660/Water-Resources-of-Pakistan>

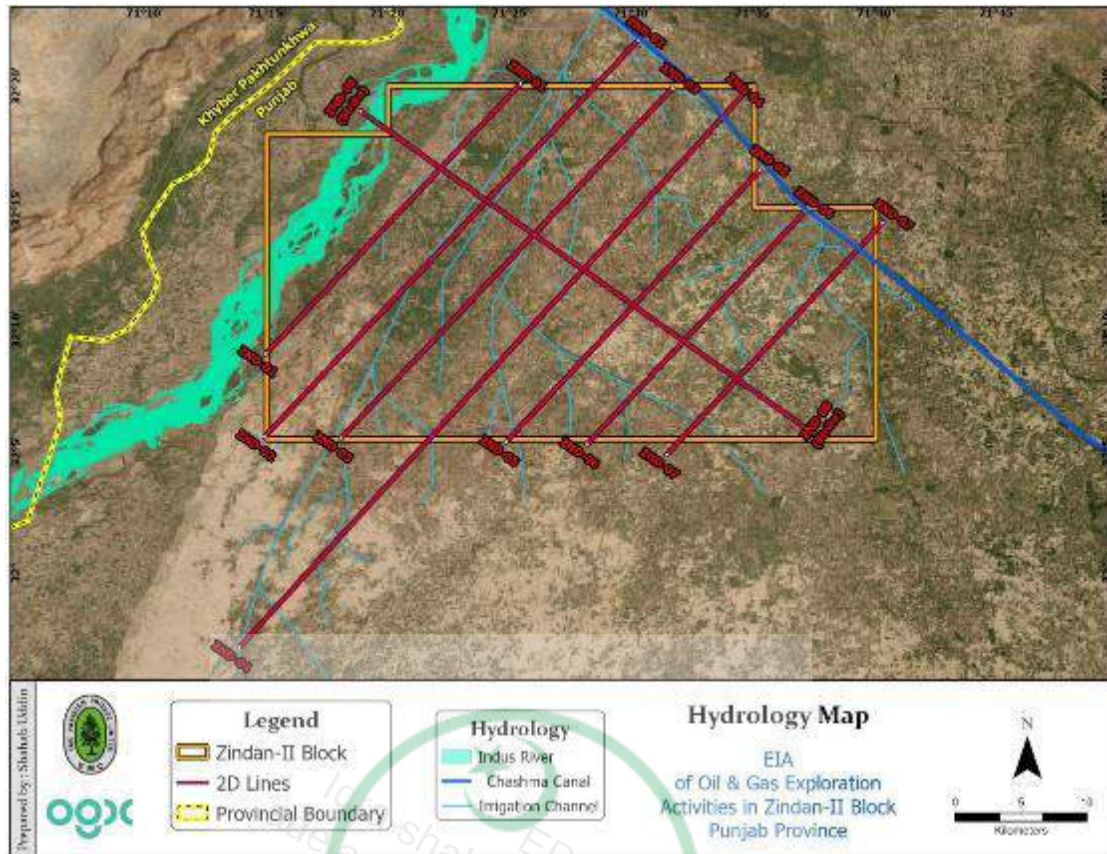


Figure 5.17: Hydrology map of the project area



Figure 5.18: Surface water resources in project area

5.7.9.2. Ground Water Quality

The scarcity of drinking water in the area is a significant concern, compounded by the fact that underground water resources are available at depths ranging from 50 to 120 feet. In some villages, clean drinking water is not available and the water is saline.

Table 5.4: Depth of the water table in the surveyed villages

S. No.	Villages	Water table (ft)
1	Ghanjera	50-60
2	Harnoli	70-100
3	Hafizwala	100
4	Piplan	50-60
5	Kallur Kot	40-70
6	Akeran Wala	50-60
7	Rodi	80-100
8	Chandni Chowk	100-110
9	Mahmood Wala	80-90

Three groundwater samples were collected from Ransial, Padhar, and Chumbi villages for physico-chemical water quality analysis. The results indicate that groundwater samples from Ransial and Padhar villages contain Total Dissolved Solids (TDS) and Total Hardness exceeding the permissible limits prescribed under the Punjab Environmental Quality Standards (PEQS), rendering the water unsuitable for drinking purposes. In contrast, the groundwater sample collected from Chumbi village shows all analyzed parameters within the permissible limits of PEQS and is therefore considered suitable for drinking. The elevated levels of TDS and hardness observed in Ransial and Padhar are attributed to the geological characteristics of the Potohar region, particularly the mineral-rich sedimentary formations. Further details of the groundwater quality analysis are presented in Table below.

Table 5.5: Ground water analysis

Date of sampling: 2nd March, 2026

Nature of Sample: Groundwater

Sample 1: Harnoli

Sample 2: Government Model High School

Parameter	PEQS	Sample 1	Sample 2	MU (CL95%)
Color*	≤ 15 TCU	0	0	N.A.
Taste*	Non- Objectionable	Non- Objectionable	Non- Objectionable	N.A.
Odor*	Non- Objectionable	Non- Objectionable	Non- Objectionable	N.A.
Turbidity*	< 5 NTU	0	0	N.A.
Total Hardness (as CaCO ₃) **	< 500 mg/L	104	300	± 10.70
Total Dissolved Solids (TDS)**	< 1000 mg/L	393	516	± 8.78
pH**	6.5- 8.5	7.93	7.82	± 0.04
Aluminum (Al)	≤ 0.2 mg/L	BDL	BDL	N.A.
Antimony (Sb)	≤ 0.005 mg/L	BDL	BDL	N.A.
Arsenic (As)	≤ 0.05 mg/L	BDL	BDL	N.A.
Barium (Ba)	0.7 mg/L	BDL	BDL	N.A.

Boron (B)	0.3 mg/L	BDL	BDL	N.A.
Cadmium (Cd)	0.01 mg/L	BDL	BDL	N.A.
Chloride (Cl-) **	< 250 mg/L	112	94	± 6.07
Chromium (Cr)	≤ 0.05 mg/L	BDL	BDL	N.A.
Copper (Cu)	2.0 mg/L	0.164	BDL	N.A.
Cyanide (CN-) *	≤ 0.05 mg/L	0	0	N.A.
Fluoride (F-) **	≤ 1.5 mg/L	0.71	0.57	± 0.06
Lead (Pb)	≤ 0.05 mg/L	BDL	BDL	N.A.
Manganese (Mn)	≤ 0.5 mg/L	BDL	BDL	N.A.
Mercury (Hg)	≤ 0.001 mg/L	BDL	BDL	N.A.
Nickel (Ni)	≤ 0.02 mg/L	BDL	BDL	N.A.
Nitrate (NO ₃ -) **	≤ 50 mg/L	1.25	2.47	± 0.05
Nitrite (NO ₂ -) *	≤ 3.0 mg/L	0	0	N.A.
Selenium (Se)	0.01 mg/L	BDL	BDL	N.A.
Residual Chlorine (Cl ₂) *	0.2 to 0.5 at Consumer & 0.5-1.5 at Source mg/L	0	0	N.A.
Phenolic Compounds (as Phenols) *	NGVS mg/L	0	0	N.A.
Zinc (Zn)	5.0 mg/L	0.038	0.044	N.A.
Microbiological Analysis				
Total Coliforms*	0 CFU / 100 mL			0 N.A.
Fecal Coliforms *	0 CFU / 100 mL			0 N.A.



Figure 5.19: Collection of ground water samples from the project area

5.8. Ecological Environment

The flora and fauna of Bhakkar and Mianwali districts vary in response to differences in climate, rainfall, topography, and soil characteristics. Both districts lie in arid to semi-arid ecological zones where vegetation is primarily influenced by low rainfall, high temperatures, and sandy to alluvial soils. The climate ranges from hot and dry conditions in the plains and desert areas to relatively milder conditions near riverine and irrigated zones.

Rainfall is generally low and irregular, with most precipitation occurring during the monsoon season, which supports seasonal vegetation growth. Natural vegetation mainly

comprises xerophytic shrubs, grasses, and scattered trees, particularly in desert and rain-fed areas, while denser vegetation and cultivated crops are found near the Indus River and irrigated lands.

The faunal diversity includes species adapted to dry and open habitats, such as small mammals, reptiles, and a variety of bird species. Riverine belts and wetlands along the Indus support aquatic life and migratory birds, especially during the winter season. The combination of climatic variation, soil types, and water availability results in distinct ecological communities across the two districts, reflecting adaptations to arid and semi-arid environmental conditions.

5.8.1. Floral Attributes of the Project Area

Bhakkar District

The vegetation of Bhakkar district reflects its arid to semi-arid climate and desert-alluvial landscape, with flora mainly adapted to low rainfall and sandy soils. The dominant tree species include jand (*Prosopis cineraria* / *Prosopis spicigera*), Kikar (*Acacia nilotica*), phulai (*Acacia modesta*), karir (*Capparis decidua*), and aak (*Calotropis procera*). These species are commonly found in desert plains, road sides, and agricultural boundaries.

The grass cover mainly consists of sewan grass (*Lasiurus indicus*), dhaman grass (*Cenchrus ciliaris*), khabal grass, and other drought-resistant grasses that provide grazing for livestock. Shrubs such as harmal (*Peganum harmala*) and lanne (*Ziziphus nummularia*) are also widespread.

Medicinal and wild plant species commonly found in the district include bhang (*Cannabis sativa*), aak (*Calotropis procera*), bathua (*Chenopodium album*), akk (*Calotropis gigantea*), and harmal, which are traditionally used for medicinal and domestic purposes. Vegetation density increases near canal-irrigated areas and along the Indus belt.

Mianwali District

The flora of Mianwali is diverse due to the presence of riverine areas, desert tracts, and piedmont zones. The dominant tree species include kikar (*Acacia nilotica*), phulai (*Acacia modesta*), shisham (*Dalbergia sissoo*), ber (*Ziziphus mauritiana*), tamarix (*Tamarix aphylla*), and jand (*Prosopis cineraria*). These species are commonly found along riverbanks, agricultural lands, and rain-fed areas.

The grass flora consists of dhaman grass, khabbal, bhabar, and sewan grass, which support grazing and livestock rearing. In desert and semi-desert areas, vegetation is sparse and dominated by drought-resistant shrubs such as karir (*Capparis decidua*) and aak (*Calotropis procera*).

Along the Indus River and associated wetlands, vegetation becomes denser and includes reeds (*Phragmites karka*), Typha species, *Saccharum spontaneum*, and aquatic plants that support fish and migratory birds. Medicinal plants such as harmal, asgand (*Withania coagulans*), shahtra (*Fumaria indica*), and bathua are commonly found in cultivated and uncultivated lands. The dominant species in the project area are listed in **Table 5.6**.

Table 5.6: Floral Attributes of the Project Area

District	Category	Common Name	Scientific Name	IUCN Status (Global)
Bhakkar	Tree	Jand	<i>Prosopis cineraria</i> / <i>Prosopis spicigera</i>	Least Concern (LC)
Bhakkar	Tree	Kikar	<i>Acacia nilotica</i>	Least Concern (LC)
Bhakkar	Tree	Phulai	<i>Acacia modesta</i>	Least Concern (LC)
Bhakkar	Shrub	Karir	<i>Capparis decidua</i>	Least Concern (LC)
Bhakkar	Shrub	Aak	<i>Calotropis procera</i>	Least Concern (LC)
Bhakkar	Grass	Sewan grass	<i>Lasiurus indicus</i>	Least Concern (LC)
Bhakkar	Grass	Dhaman grass	<i>Cenchrus ciliaris</i>	Least Concern (LC)
Bhakkar	Shrub	Harmal	<i>Peganum harmala</i>	Least Concern (LC)
Bhakkar	Shrub	Lanne / Jharber	<i>Ziziphus nummularia</i>	Least Concern (LC)
Bhakkar	Medicinal plant	Bhang	<i>Cannabis sativa</i>	Least Concern (LC)
Bhakkar	Medicinal plant	Bathua	<i>Chenopodium album</i>	Least Concern (LC)
Mianwali	Tree	Kikar	<i>Acacia nilotica</i>	Least Concern (LC)
Mianwali	Tree	Phulai	<i>Acacia modesta</i>	Least Concern (LC)
Mianwali	Tree	Shisham	<i>Dalbergia sissoo</i>	Least Concern (LC)
Mianwali	Tree	Ber	<i>Ziziphus mauritiana</i>	Least Concern (LC) – Invasive
Mianwali	Tree	Tamarix / Farash	<i>Tamarix aphylla</i>	Least Concern (LC)
Mianwali	Tree	Jand	<i>Prosopis cineraria</i>	Least Concern (LC)
Mianwali	Shrub	Karir	<i>Capparis decidua</i>	Least Concern (LC)
Mianwali	Shrub	Aak	<i>Calotropis procera</i>	Least Concern (LC)
Mianwali	Grass	Dhaman grass	<i>Cenchrus ciliaris</i>	Least Concern (LC)
Mianwali	Grass	Bhabar	<i>Eulaliopsis binata</i>	Least Concern (LC)
Mianwali	Grass	Sewan grass	<i>Lasiurus indicus</i>	Least Concern (LC)
Mianwali	Aquatic plant	Reeds	<i>Phragmites karka</i>	Least Concern (LC)
Mianwali	Aquatic plant	Cattail	<i>Typha</i> spp.	Not Evaluated (NE)
Mianwali	Aquatic plant	Kans grass	<i>Saccharum spontaneum</i>	Least Concern (LC)
Mianwali	Medicinal plant	Harmal	<i>Peganum harmala</i>	Least Concern (LC)
Mianwali	Medicinal plant	Asgand	<i>Withania coagulans</i>	Least Concern (LC)
Mianwali	Medicinal plant	Shahtra	<i>Fumaria indica</i>	Least Concern (LC)

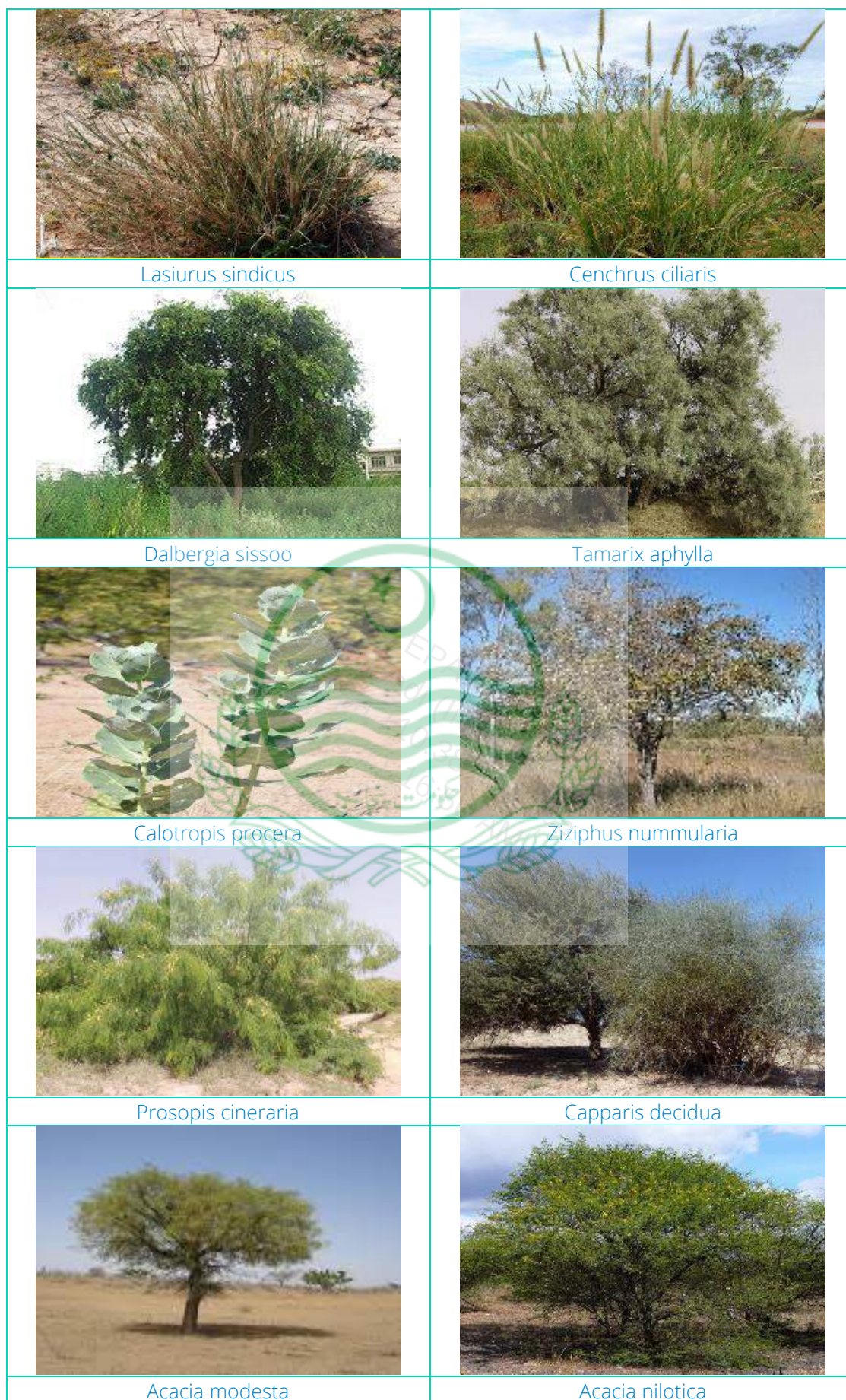


Figure 5.20: Floral species of the project area

5.8.2. Faunal attributes of the Project Area

Bhakkar District

The fauna of Bhakkar district reflects its arid to semi-arid environment, desert plains, and proximity to the Indus River. The mammalian fauna mainly includes wild boar, jackal, Indian fox, desert hare, Indian grey mongoose, and porcupine, which are commonly found in scrublands, agricultural fields, and riverine areas. Occasional sightings of wolves and wild cats have also been reported in remote areas.

Avifauna in Bhakkar is diverse, particularly in agricultural fields, wetlands, and along the Indus belt. Common bird species include grey partridge, black partridge, quail, common myna, house crow, cattle egret, pond heron, Indian roller, kites, and egrets. During the winter season, migratory birds such as ducks and geese visit the riverine and wetland areas.

Reptilian fauna includes monitor lizards, Indian cobra, common krait, rat snake, sand boa, and various species of lizards and frogs. Amphibians are found mainly in irrigated areas and near seasonal water bodies. The Indus River and associated canals support fish species such as rohu, catla, mrigal, tilapia, and common carp, which are important for local fisheries.

Mianwali District

Mianwali district supports a rich diversity of fauna due to its riverine ecosystem, desert plains, and hill tracts. The mammalian fauna includes wild boar, Indian fox, jackal, desert hare, Indian grey mongoose, porcupine, and occasionally leopard and wolf in remote and hilly areas. The district also supports populations of wild cats and civets.

Bird life in Mianwali is abundant, especially along the Indus River and wetlands, making it an important habitat for both resident and migratory birds. Common species include grey and black partridges, chakor, quail, herons, egrets, kingfishers, ducks, geese, coots, flamingos, and various birds of prey such as kites and eagles. The area serves as a seasonal stopover for migratory birds during winter.

Reptiles found in the district include monitor lizards, Indian cobra, krait, saw-scaled viper, geckos, and skinks, while amphibians such as frogs and toads are common near water bodies. The aquatic ecosystem of the Indus supports diverse fish species including mahseer, rohu, mrigal, catla, and tilapia, contributing significantly to local livelihoods.

Table 5.7: Faunal Attributes of the Project Area

District	Common Name	Scientific Name	Faunal Group	IUCN Category (Global)
Mianwali	Indus River Dolphin	Platanista gangetica minor	Mammal	Endangered (EN)
	Smooth-coated Otter	Lutrogale perspicillata	Mammal	Vulnerable (VU)
	Indian Jackal	Canis aureus	Mammal	Least Concern (LC)
	Red Fox	Vulpes vulpes	Mammal	Least Concern (LC)
	Jungle Cat	Felis chaus	Mammal	Least Concern (LC)
	Caracal	Caracal caracal	Mammal	Least Concern (LC)
	Nilgai	Boselaphus tragocamelus	Mammal	Least Concern (LC)
	Wild Boar	Sus scrofa	Mammal	Least Concern (LC)

	Indian Crested Porcupine	<i>Hystrix indica</i>	Mammal	Least Concern (LC)
	Blackbuck	<i>Antelope cervicapra</i>	Mammal	Least Concern (LC)
	Houbara Bustard	<i>Chlamydotis undulata</i>	Bird	Vulnerable (VU)
	Great Indian Bustard	<i>Ardeotis nigriceps</i>	Bird	Critically Endangered (CR)
	Chukar Partridge	<i>Alectoris chukar</i>	Bird	Least Concern (LC)
	Grey/Black Partridge	<i>Francolinus spp.</i>	Bird	Least Concern (LC)
	Bar-headed Goose	<i>Anser indicus</i>	Bird	Least Concern (LC)
	Little Egret	<i>Egretta garzetta</i>	Bird	Least Concern (LC)
	Indian Cobra	<i>Naja naja</i>	Reptile	Least Concern (LC)
	Common Krait	<i>Bungarus caeruleus</i>	Reptile	Least Concern (LC)
	Monitor Lizard	<i>Varanus bengalensis</i>	Reptile	Least Concern (LC)
Bhakkar	Chinkara (Indian Gazelle)	<i>Gazella bennettii</i>	Mammal	Least Concern (LC)
	Indian Jackal	<i>Canis aureus</i>	Mammal	Least Concern (LC)
	Desert Fox	<i>Vulpes vulpes pusilla</i>	Mammal	Least Concern (LC)
	Wild Boar	<i>Sus scrofa</i>	Mammal	Least Concern (LC)
	Indian Hare	<i>Lepus nigricollis</i>	Mammal	Least Concern (LC)
	Houbara Bustard	<i>Chlamydotis undulata</i>	Bird	Vulnerable (VU)
	Great Indian Bustard	<i>Ardeotis nigriceps</i>	Bird	Critically Endangered (CR)
	Sandgrouse	<i>Pterocles spp.</i>	Bird	Least Concern (LC)
	Common Quail	<i>Coturnix coturnix</i>	Bird	Least Concern (LC)
	Rosy Starling	<i>Pastor roseus</i>	Bird	Least Concern (LC)
	Spiny-tailed Lizard	<i>Saara hardwickii</i>	Reptile	Least Concern (LC)
	Monitor Lizard	<i>Varanus bengalensis</i>	Reptile	Least Concern (LC)
	Indian Cobra	<i>Naja naja</i>	Reptile	Least Concern (LC)
	Saw-scaled Viper	<i>Echis carinatus</i>	Reptile	Least Concern (LC)



Sandgrouse



Nilgai



Blackbuck



Caracal

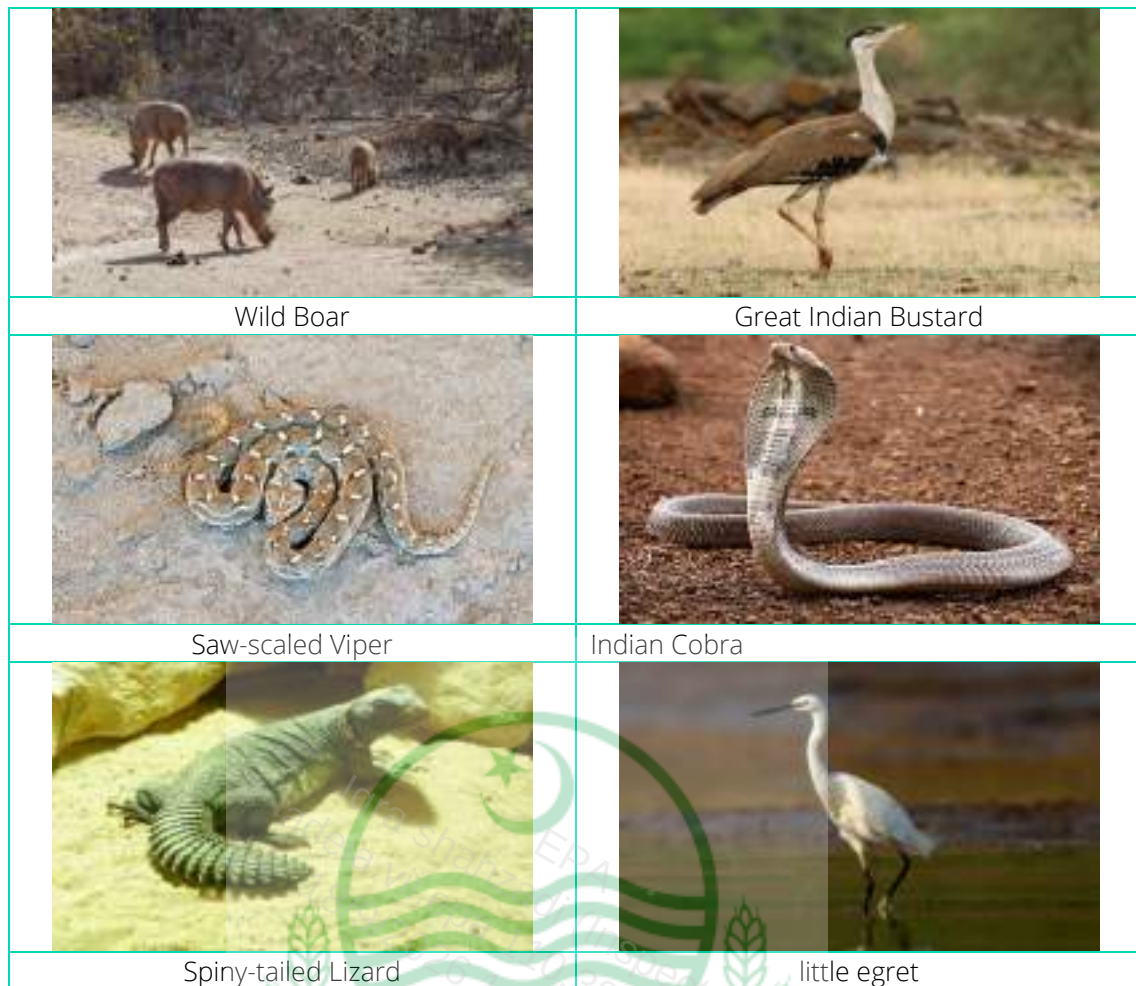


Figure 5.21: Faunal Attributes of Project Area

5.8.3. Protected Areas

Thal Game Reserve is a protected wildlife area located in the Thal Desert region of Punjab, Pakistan, extending across the districts of Bhakkar, Jhang, Khushab, Layyah, and Muzaffargarh. Established under the Punjab Wildlife (Protection, Preservation, Conservation and Management) Act, 1974, the reserve serves as an important habitat for desert flora and fauna and plays a significant role in biodiversity conservation. The area is characterized by sandy dunes, arid plains, scrub vegetation, and a fragile desert ecosystem that supports various mammal, bird, and reptile species. Common fauna includes chinkara (Indian gazelle), desert fox, jackal, hare, wild boar, grey partridge, black partridge, sandgrouse, doves, and several migratory bird species. The reserve is ecologically important for protecting wildlife habitats, controlling illegal hunting, conserving migratory bird populations, and maintaining the environmental balance of the Thal desert landscape.

Table 5.8: Faunal Species of Thal Game Reserve

Common Name	Scientific Name	IUCN Category (Global)
Chinkara (Indian Gazelle)	<i>Gazella bennettii</i>	Least Concern (LC)
Indian Hare	<i>Lepus nigricollis</i>	Least Concern (LC)
Golden Jackal	<i>Canis aureus</i>	Least Concern (LC)
Desert Fox	<i>Vulpes vulpes pusilla</i>	Least Concern (LC)
Indian Fox	<i>Vulpes bengalensis</i>	Least Concern (LC)

Wild Boar	<i>Sus scrofa</i>	Least Concern (LC)
Indian Pangolin	<i>Manis crassicaudata</i>	Endangered (EN)
Punjab Uril	<i>Ovis vignei punjabiensis</i>	Vulnerable (VU)
Grey Partridge	<i>Francolinus pondicerianus</i>	Least Concern (LC)
Black Francolin	<i>Francolinus francolinus</i>	Least Concern (LC)
Common Quail	<i>Coturnix coturnix</i>	Least Concern (LC)
Demoiselle Crane	<i>Anthropoides virgo</i>	Least Concern (LC)
Houbara Bustard	<i>Chlamydotis macqueenii</i>	Vulnerable (VU)
Indian Peafowl	<i>Pavo cristatus</i>	Least Concern (LC)
Monitor Lizard	<i>Varanus bengalensis</i>	Least Concern (LC)
Indian Cobra	<i>Naja naja</i>	Least Concern (LC)

The details of floral species found in the Thal Game Reserve are as under.

Table 5.9: Floral Species of Thal Game Reserve

Common Name	Scientific Name	IUCN Category (Global)
Kikar	<i>Vachellia nilotica</i>	Least Concern (LC)
Jand	<i>Prosopis cineraria</i>	Least Concern (LC)
Ber	<i>Ziziphus mauritiana</i>	Least Concern (LC)
Khip	<i>Leptadenia pyrotechnica</i>	Least Concern (LC)
Lana	<i>Haloxylon salicornicum</i>	Least Concern (LC)
Phog	<i>Calligonum polygonoides</i>	Least Concern (LC)
Capparis	<i>Capparis decidua</i>	Least Concern (LC)
Aak	<i>Calotropis procera</i>	Least Concern (LC)
Sewan Grass	<i>Lasiurus scindicus</i>	Least Concern (LC)
Dhaman Grass	<i>Cenchrus ciliaris</i>	Least Concern (LC)

The total area of the Thal game reserve is approximately 13295 sq km out of which 478 sq km falls in the Zindan-II Block. The 2D seismic lines falling in the game reserve are as under.

Table 5.10: Details of seismic lines falling in game reserve

Name	Total Length Km	Linear km falling in protected area
ZND-03	57.09	19
ZND-04	79.86	32
ZND-05	49.36	20
ZND-06	58.61	21
ZND-07	53.41	22
ZND-08	49.50	23
Total Length (L. Km)		137

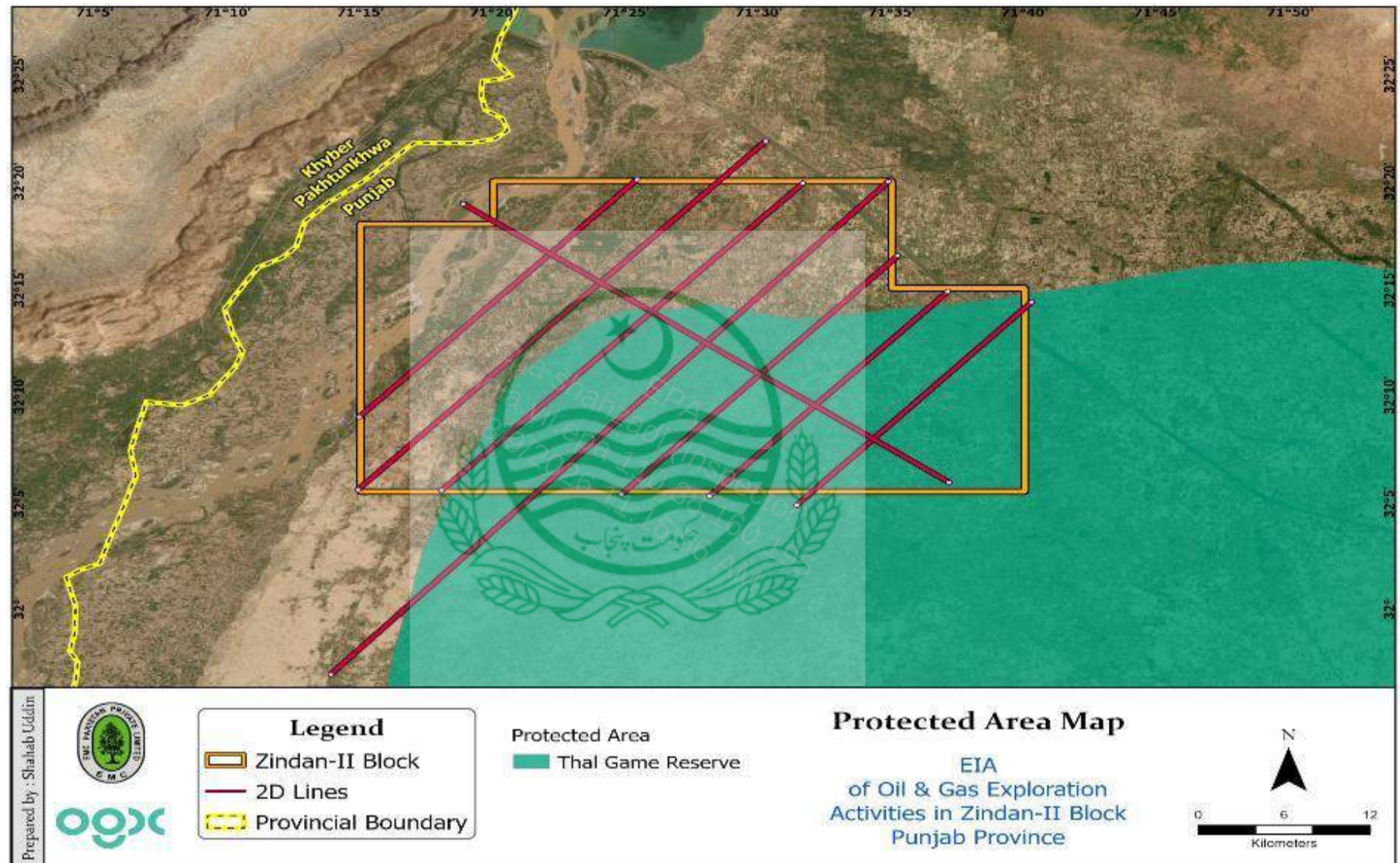


Figure 5.22: Map of Protected Areas

5.9. Socio- Economic Environment

5.9.1. Population

According to the 2023 Population and Housing Census of Pakistan, Bhakkar District has a total population of 1,957,470 persons, comprising 1,016,361 males, 941,032 females, and 77 transgender persons. The district's population is predominantly rural, with 1,605,036 people residing in rural areas and 352,434 living in urban centers, reflecting Bhakkar's largely agrarian and semi-desert settlement pattern. The gender distribution shows a slightly higher number of males compared to females, consistent with broader demographic trends in rural Punjab. The district's population growth is influenced by natural increase and rural household dynamics, with livelihood patterns centered around agriculture and livestock rearing. This data is drawn from the detailed results of the Pakistan Bureau of Statistics' digital census 2023.⁷

In comparison, Mianwali District has a total population of 1,798,268 persons based on the 2023 census, with 918,115 males, 880,088 females, and 65 transgender individuals. Like Bhakkar, Mianwali also has a predominantly rural population, where 1,434,815 residents live in rural areas and 363,453 in urban settlements such as Mianwali city and Isa Khel. The district displays a slightly higher male-to-female ratio, and its demographic structure reflects a mix of agricultural, riverine, and semi-urban communities. The relatively larger urban share compared to Bhakkar is attributed to the presence of key towns and better connectivity to regional economic centers. These figures are based on official census tabulations released following the 7th Population and Housing Census 2023.⁸

S. No.	Villages	No. of houses	Average household size
1	Ghanjera	250	8-10
2	Harnoli	120-200	
3	Hafizwala	200-300	
4	Piplan	200-220	
5	Kallur Kot	140-150	
6	Akeran Wala	80-100	
7	Rodi	120-140	
8	Chandni Chowk	200-220	
9	Mahmood Wala	180-200	

5.9.2. Tribes and languages

Bhakkar District is characterized by a tribal social structure shaped by its desert and agricultural landscapes. Prominent tribes in the district include Leghari, Kundi, Bhutta, Qureshi, Niazi, Marwat, and Kakar, along with several smaller clans engaged in farming and pastoral livelihoods. The dominant language is Saraiki, particularly in the southern and central parts of the district, while Punjabi is spoken in areas closer to the northern plains. Urdu is widely understood and used in official, educational, and administrative contexts.

⁷ <https://www.pakinformation.com/population/bhakkar.html>

⁸ <https://www.pakinformation.com/population/mianwali.html>

Tribal affiliations play an important role in local governance, social networks, and land ownership patterns.

Mianwali District also exhibits strong tribal influences, with major tribes including Niazi, Awan, Marwat, Bhatti, Kundi, Gakhar, and Jat, along with Syed and Qureshi communities. The linguistic landscape is diverse, with Saraiki and Punjabi being the primary spoken languages; a local dialect blend known as Thalochi or Potohari–Saraiki mix is common in hilly and riverine areas. Urdu serves as the official and educational language throughout the district. Tribal identity and clan affiliations continue to influence social organization, local leadership, and cultural traditions.

5.9.3. Agriculture and Irrigation

Bhakkar District is predominantly an agricultural and pastoral district, with farming largely dependent on rainfed (barani) conditions due to the arid climate and sandy soils of the Thal Desert. Major crops include wheat, gram, millet (bajra), sorghum (jowar), barley, and pulses, along with limited cultivation of oilseeds and vegetables in irrigated pockets. Irrigation is mainly supported through tube wells, small dams, and lift irrigation schemes, while canal irrigation is minimal and confined to areas near the Indus River. Livestock rearing, particularly goats and sheep, complements crop farming and forms an important part of the rural economy. Farmers in Bhakkar also practice mixed cropping and rotational cultivation to cope with limited rainfall and maintain soil fertility.

Mianwali District has a more diverse agricultural system due to its varied topography, which includes riverine plains along the Indus, hilly terrain of the Salt Range, and semi-arid regions. The district cultivates wheat, maize, gram, sugarcane, and oilseeds, while orchards of citrus, guava, and kinnow are common in irrigated areas. Irrigation infrastructure is comparatively well-developed, including tube wells, small dams, Chashma and Mianwali Canal systems, and lift irrigation schemes, which supplement monsoon rainfall. Riverine areas along the Indus provide fertile soil and reliable water supply, allowing for intensive cropping and multiple harvests annually in selected zones. Overall, agriculture in Mianwali combines rainfed and irrigated farming, supporting both subsistence and commercial crops, and contributes significantly to the livelihoods of rural communities.



Wheat field



Sugarcane field



Figure 5.23: Agriculture and irrigation in Area

5.9.4. Occupation

Bhakkar District is predominantly rural, and the majority of the population is engaged in agriculture and livestock rearing, including goat and sheep husbandry, which form the backbone of the local economy. Small-scale farming, particularly of wheat, millet, gram, and sorghum, provides both subsistence and market-oriented income. Other common occupations include daily wage labor, transport services, small businesses, and trade, while some residents are employed in public sector roles such as education, health, and local administration. Seasonal migration for labor in nearby industrial or urban centers is also observed due to limited local employment opportunities.

Mianwali District has a more diversified occupational structure due to its riverine plains, Salt Range foothills, and semi-urban centers. Agriculture and livestock remain the dominant sources of livelihood in rural areas, with crops such as wheat, maize, gram, sugarcane, and orchards contributing to income generation. In urban centers like Mianwali city and Isa Khel, many people are employed in government services, education, healthcare, trade, retail businesses, and small-scale industry. The presence of infrastructure such as the Chashma and Mianwali canals, Chashma Barrage, and Indus River projects also provides employment in irrigation, hydropower, and associated services. Overall, livelihoods in both districts reflect a combination of traditional rural occupations and emerging semi-urban employment opportunities, supporting the socio-economic framework of the region.

5.9.5. Housing

Bhakkar District predominantly features rural settlements, and housing conditions largely reflect the socio-economic status of residents and the arid climatic conditions of the Thal Desert. A significant proportion of households live in kacha houses, constructed from mud, thatch, and unbaked bricks, which are more vulnerable to seasonal weather extremes. Semi-pakka structures, combining mud walls with brick or cement foundations and tin or wooden roofing, are common in villages where families gradually upgrade their homes. Pakka houses, made of baked bricks, cement, and reinforced roofs, are mostly found in urban centers such as Bhakkar city and Darya Khan. Overall, the housing profile in Bhakkar is predominantly rural, with gradual improvements toward semi-pakka and pakka structures in better-off households.

Mianwali District exhibits a mix of rural and urban housing patterns due to its diverse topography, which includes riverine plains, semi-arid hills, and Salt Range foothills. In rural areas, kacha houses constructed from mud, clay, and thatch remain common, especially in remote villages. Semi-pakka houses combining mud or brick walls with tin or reinforced concrete roofs are gradually increasing, particularly in peri-urban settlements. Urban centers such as Mianwali city and Isa Khel have a higher proportion of pakka houses, built with bricks, cement, and reinforced roofing, reflecting better economic conditions and access to construction materials. Overall, Mianwali's housing profile reflects a transition from traditional rural dwellings to more durable urban structures, with significant variation across different areas of the district.

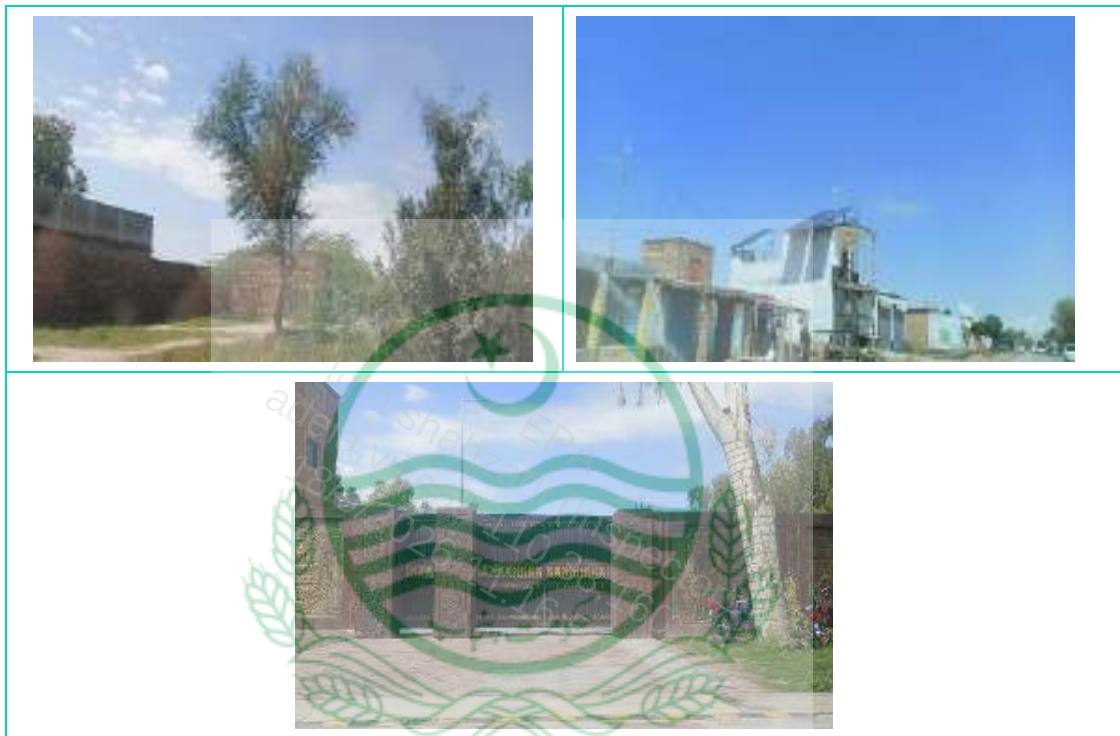


Figure 5.24: Housing infrastructure of project area

5.9.6. Common Social Issues

Bhakkar and Mianwali districts face several socio-economic and infrastructural challenges, particularly in rural areas. Healthcare facilities are limited, with urban centers providing better services than remote villages. Access to clean drinking water is inadequate, and solid waste management remains underdeveloped. Primary education is generally available, but higher education opportunities are concentrated in urban centers, restricting access for rural students, especially girls. Many villages lack natural gas connections, and frequent electricity shortages and load shedding force reliance on solar-powered pumps or alternative energy sources. The majority of households depend on agriculture and livestock, and limited local industry contributes to widespread poverty. The absence of small dams, check dams, and retention ponds increases vulnerability to monsoon flooding, while inadequate public transportation further limits mobility and access to essential services. Overall, both districts exhibit a predominantly rural character with socio-economic constraints that affect livelihoods, education, health, and infrastructure.

5.9.7. Road Network

Bhakkar District has a moderately developed road network that connects its rural settlements with urban centers such as Bhakkar city, Darya Khan, and Kaloorkot. Key provincial roads link the district to major highways, including the Indus Highway (N-55), providing connectivity to neighboring districts and facilitating trade, agriculture, and mobility. Rural areas rely on link roads and unpaved village tracks to access markets, health facilities, and educational institutions. The road network supports seasonal agricultural transport and local commerce, though some rural roads require maintenance, especially during the monsoon season.

Mianwali District benefits from a more extensive road infrastructure due to its strategic location along the Indus Highway (N-55) and proximity to major urban centers in Punjab and Khyber Pakhtunkhwa. The district is served by provincial and rural roads connecting towns such as Mianwali city, Isa Khel, and Kundian to the highway network. Link roads and local access routes provide connectivity to riverine plains, Salt Range foothills, and semi-arid areas. While urban areas have paved and well-maintained roads, rural routes often face challenges from seasonal flooding and erosion. Overall, the road networks in Bhakkar and Mianwali facilitate regional connectivity, support agricultural and commercial activities, and link rural communities to essential services.



Figure 5.25: Road network of project area

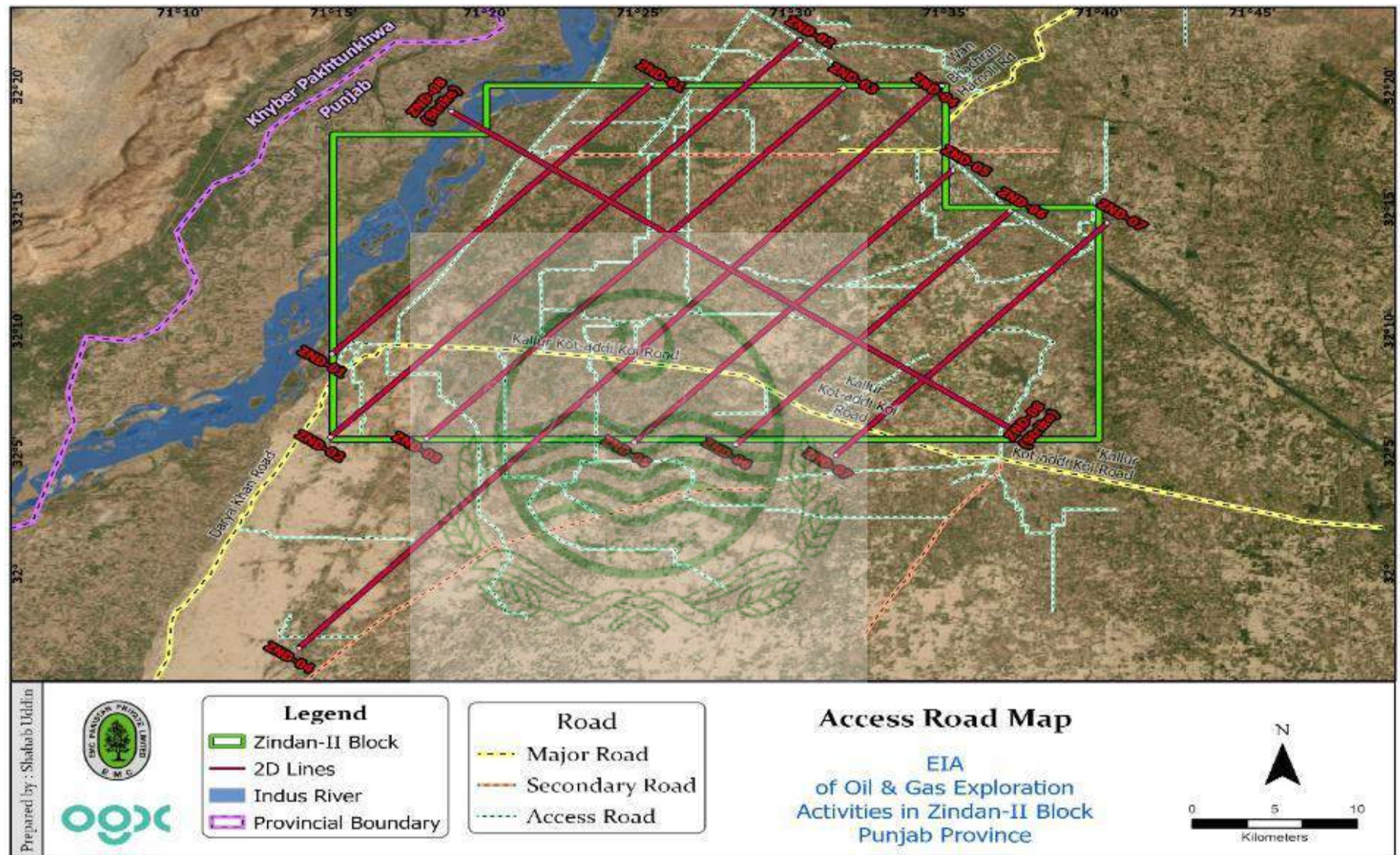


Figure 5.26: Map of Access Roads

5.9.8. Mode of Transportation

Bhakkar and Mianwali districts are connected through a network of provincial highways, link roads, and rural tracks, with the Indus Highway (N-55) serving as the main corridor for inter-district and inter-provincial travel. Rail connectivity exists in parts of Mianwali, linking the district to major cities, while Bhakkar has limited regional rail services. Local transportation in both districts relies on buses, vans, rickshaws, and private vehicles, providing mobility for urban and rural populations. Seasonal conditions, such as monsoon rains, can affect rural accessibility. Overall, transportation in the two districts supports agricultural trade, commuting, and access to essential services, though rural road conditions require ongoing maintenance and improvement.



Figure 5.27: Mode of transportation in project area

5.9.9. Health

Bhakkar and Mianwali districts have a combination of public and private healthcare facilities that serve both urban and rural populations. In Bhakkar, primary healthcare is provided by the District Headquarters (DHQ) Hospital Bhakkar, supported by Tehsil Headquarters (THQ) Hospitals in Darya Khan and Kaloorkot, along with rural Basic Health Units (BHUs) and Rural Health Centres (RHCs). Private clinics and small hospitals also contribute to general medical, maternal, and child healthcare, though services are limited in remote villages. In Mianwali, health infrastructure includes DHQ Hospital Mianwali and THQ Hospitals in Isa Khel, Kundian, and Piplan, complemented by BHUs and RHCs in rural areas. Private medical centres provide additional services, including general, surgical, and maternal health care. While urban centers in both districts have reasonably equipped facilities, rural areas still face challenges such as limited specialized services, shortages of medical staff, and accessibility issues, making healthcare provision uneven across the districts.

5.9.10. Education

Bhakkar and Mianwali districts host a range of educational institutions at primary, secondary, and tertiary levels, though opportunities are more limited in rural areas. In Bhakkar, notable institutions include Government Degree College Bhakkar, Government Girls Degree College Bhakkar, and various high schools and intermediate colleges, while some students pursue distance-learning programs from universities such as Allama Iqbal Open University. In Mianwali, key institutions include Government Degree College Mianwali, Government Girls Degree College Isa Khel, and technical institutes, with access to distance and private higher education programs. Both districts have primary and secondary schools dispersed across rural and urban areas, but higher education opportunities are mostly concentrated in urban centers, which can limit access for students from remote villages. The overall educational profile reflects a growing emphasis on literacy and skill development, though challenges remain in expanding quality education to all rural communities.



University of Mianwali



Namal University Mianwali



Figure 5.28: Education facilities in project area

5.9.11. Archeological and Cultural Sites

Bhakkar and Mianwali districts are home to several historically and culturally significant sites reflecting the region's heritage. In Bhakkar, key sites include Mankera Fort, an old fort in the Thal Desert with remnants of defensive walls, mosques, and tombs; Dilkusha Bagh, a Mughal-era Garden of historical significance; the Handera Tomb near Sheikh Rao Bridge, believed to be the burial place of Bhakkar Khan, the founder of the city; and Jinnah Gate, a remaining structure from the walled town built during the colonial period. These sites highlight Bhakkar's historical role as a strategic settlement along trade routes. In Mianwali, notable heritage sites include Bohr Bungalow, a 17th-century building located on the Indus River linked to regional Nawab families; Sher Shah's Baoli in Wan Bhachran, a historic stepwell built in the 16th century for travelers; and Namal Lake and Dam, a cultural landscape shaped by early settlement and water management. Additionally, various ancient masonry remains and burial sites near upland ridges indicate early settlement patterns and local archaeological interest. Collectively, these sites in Bhakkar and Mianwali districts reflect centuries of architectural, cultural, and social history.



Figure 5.29: Archeological and Cultural Sites in project area

6. STAKEHOLDERS CONSULTATION

6.1. Overview and Objectives

This section provides an overview of the stakeholder and public consultation process adopted by the consultant team and presents the findings of the stakeholder consultation activity conducted during the EIA. Public involvement is one of the key features of environmental assessment, which ensures better and more acceptable decision-making.

The overall objective of the consultation with stakeholders is to identify the environmental and social concerns of the stakeholders and to identify those which are not known or are unique to the project area. Stakeholder consultation presents an opportunity for mutual information-sharing and dialogue between the project proponent and stakeholders. An effective public consultation process provides concrete suggestions that can help improve project design, resolve conflicts at an early stage, identify management solutions to mitigate potentially adverse consequences and enhance positive impacts, and develop guidelines for effective monitoring and reporting of project activities throughout the project cycle. Providing the public with adequate reliable information of the planned project is significant in creating public trust and acceptance. Moreover, experience reveals that unexpected project impacts on the local community generally give rise to significant issues and concerns. Such problems can be avoided if people are properly informed and consulted about the project and given the opportunity to raise their concerns.

6.2. Stakeholders Identification and Analysis-Stakeholder Mapping

Stakeholders are individuals, groups, or institutions that may be affected by and can significantly influence the project activities, or are integral to the achievement of the objectives of a project. Stakeholders can be divided into 2 broad categories; primary and secondary; Tables 6.1(a) and (b).

Primary stakeholders are those who have a direct interest in the project which includes residents, commercial entities and institutions falling in the project area. Secondary stakeholders include the relevant government agencies and public interest groups which may indirectly influence or be influenced by the project. The concerns and input from both primary and secondary stakeholders are important to identify the issues arising from the construction and/or operation phase of the project and propose mitigation measures that minimize the negative project impacts and enhance the positive ones.

Table 6.1: Primary Stakeholders

S. No.	Stakeholder Groups	Stakeholders
1	Proponent	OGDC HSE team, Exploration Dept.
2	Settlements near the project area	- Ghanjera - Harnoli - Hafizwala - Piplan - Kallur Kot - Akeran Wala - Rodi - Chandni Chowk - Mahmood Wala

3	Commercial entities	Small business such as shops, hotels
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Table 6.2: Secondary Stakeholders

Stakeholder Groups	Department	Name and Designation
Government Departments	Environmental Protection Agency, Bhakkar	Mr. Hafiz Ghulam Abbas Assistant Director
	Environmental Protection Agency, Mianwali	Mr. Muhammad Ikram UDC
	Forest Department, District Bhakkar	Watchers
	Forest Department, District Mianwali	Muhammad Aqib Khan Forester
	Wildlife Department, District Bhakkar	Mr. Ghulam Muhammad Shahid Incharge Manager
	Wildlife Department, District Mianwali	Mr. Amjad Hussain Naib Qasid
Environment practitioners and experts	NUST Islamabad	Professor Dr. Zeshan, Department of Environmental Sciences, NUST, Islamabad

6.3. Consultation and Participation Process

The project utilizes various methods of engagement that were employed as part of its continuous interaction with project stakeholders. For the engagement process to be effective and meaningful, a range of various techniques were applied that were specifically tailored to the identified stakeholder groups. For ascertaining the perceptions of different stakeholders about the project consultations/meetings were carried out at following two levels:

- Consultations with Primary Stakeholders
- Consultations with Secondary Stakeholders.

Identification of stakeholders is one of the major steps for designing an effective consultation process. For this purpose, several site visits were carried out by the E&S team to identify the relevant stakeholders for consultation. Consultation meetings were conducted with the identified stakeholders. The stakeholders were briefed about the background and scope of the project at the beginning of the meeting sessions. Concerns and suggestions of the respondents were noted down by the team and pictures of the session were taken with the consent of the stakeholders. If the interviewees had any queries regarding the project, the team responded to their queries during the session.

Formal and informal group discussions were held as an additional tool for the assessment of the perceptions of the stakeholders about the project and potential impacts both positive and adverse likely to occur due to its implementation. Key Informant Interviews (KIIs) were conducted with project stakeholders to gather their perspectives on project implementation, and their feedback was formally documented.

6.4. Consultations with Primary Stakeholders-Community Engagement and Involvement

The main purpose of the consultation exercise was to disseminate project information to relevant stakeholders and solicit their feedback received at an early stage regarding potential issues and concerns based on the current project concept and design features. This way, local communities have proper engagement and involvement at the very outset of the project. Early community engagement in project planning stage ensures that communities are effectively heard and involved in project matters, and that decision making is sound and reflective of ground situation and issues. This in turn proactively addresses and at times avoid future issues.

Public Disclosure of EIA Findings: Community participation in EIA is a two-tier exercise. At Tier 1, community engagement and consultation are done at EIA stage whereby the local concerns, feedback and suggestions are taken and embedded in the EIA findings and management plans for later implementation. At Tier 2, when the EIA enters public disclosure stage i.e. public hearing, the public /local communities are once again provided with an opportunity to voice their concerns, feedback and suggestions, which are recorded and later used to base the decisions for project approvals.

6.5. Consultations with Secondary Stakeholders

Other interested parties, such as nongovernmental organizations and government departments were identified as key stakeholders and approached individually for consultations. These consultations were conducted through Key Informant Interviews (KIIs), allowing each department to provide detailed feedback and share their perspectives on various aspects of the project. This approach ensured that the views of all relevant stakeholders were considered in the project planning and implementation process creating a comprehensive understanding of their concerns, expectations, and recommendations.

Table 6.3: Stakeholder consultations timelines

S#	Types of Consultation/ Meeting	Dates
1	KII with Environmental Protection Agency, Bhakkar	08-04-2026
2	KII with Wildlife Department, District Bhakkar	08-04-2026
3	KII with Forest Department, District Bhakkar	08-04-2026
4	KII with Environmental Protection Agency, Mianwali	09-04-2026
5	KII with Forest Department, District Mianwali	09-04-2026
6	KII with Wildlife Department, District Mianwali	09-04-2026
7	KII with Environment practitioners and experts (NUST Islamabad)	05-04-2026

6.6. Consultation Feedback and Analysis

6.6.1. Primary Stakeholders

The comments, concerns, and suggestions received from the primary stakeholders during the survey have been collated in this section. The comments solicited from the primary stakeholders were helpful in the screening of the potential environmental and social aspects of the project.

The feedback from the locals is as follows:

- During informal consultations, community members emphasized the need for prior notification before project mobilization so that residents, landowners, and local institutions could prepare for field activities and minimize disruption to their daily routines.
- A major concern was the potential damage to standing crops and agricultural land, with stakeholders requesting that all possible precautions be taken and that fair compensation be provided in case of any unavoidable losses.
- Residents living near the proposed work areas, particularly around houses and schools, raised concerns regarding noise, vibration, and dust impacts, highlighting the need to schedule activities carefully and adopt mitigation measures.
- The community also stressed the importance of ensuring the safe movement of heavy vehicles and machinery, especially on local roads frequently used by pedestrians, schoolchildren, and farmers.
- Another key expectation was the creation of local employment opportunities, with preference for hiring local labor wherever feasible to support livelihoods and strengthen community acceptance of the project.
- Farmers specifically requested the protection of irrigation channels and watercourses to avoid disruption to agricultural activities and water supply.
- In addition, residents advised that project activities should avoid school timings and prayer hours to reduce disturbance to education and respect local religious and social practices.







Figure 6.1: Consultations with locals

6.6.2. Secondary Stakeholders

The comments, concerns, and suggestions received from the secondary stakeholders during the survey have been collated in this section. The comments solicited from the secondary stakeholders were helpful in the screening of the potential environmental and social aspects of the project. Details regarding Secondary stakeholder's feedback and suggestions are represented in Table 6.3 below:

Table 6.4: Feedback of secondary stakeholders

Departments	Date:	Feedback
Environmental Protection Agency, Bhakkar	09-04-2026	• Key consultation points discussed with the Assistant Director, EPA Bhakkar included • During the consultation, the AD was briefed on the proposed seismic survey methodology and field operations, including line cutting, geophysical data acquisition, and associated field logistics. • The discussion emphasized the identification of forested areas and plantation zones within District Bhakkar, which may be sensitive to temporary vegetation disturbance during survey activities. • It was further stressed that appropriate environmental management and site restoration measures shall be implemented in areas where vegetation clearance or disturbance occurs, in order to ensure rehabilitation of affected sites and minimize long-term ecological impacts.
Wildlife Department, District Bhakkar	09-04-2026	• Key consultation points discussed with the Incharge wild life department included: • During the consultation, key inputs were provided by the Wildlife Department regarding the ecological sensitivity of the project area. The discussion focused on the identification of protected areas, wildlife habitats, and plantation zones within Bhakkar District, including Rath Gulam Wildlife Sanctuary, Bhakkar Plantation, and Fateh Major Plantation. • It was further highlighted that restricted and ecologically sensitive areas, particularly Tehsil Mankera (Game Reserve), require special consideration during planning and execution of seismic activities to avoid disturbance to wildlife habitats and breeding areas. • The consultation also included an overview of the major faunal species of the region, with emphasis on their distribution and habitat use in relation to the proposed survey corridor, highlighting the need for precautionary measures to minimize potential impacts on local biodiversity.
Forest Department, District Bhakkar	09-04-2026	• No tree cutting shall be carried out during project activities without prior approval from the Forest Department.

		• In case of unavoidable tree removal, proper compensation shall be ensured as per Forest Department rules. • Backfilling and restoration of all road cut and fill areas shall be carried out to avoid soil erosion and landscape degradation. • Compensation estimates shall be prepared for shrubs, herbs, and trees affected during project execution. • Plantation shall be carried out on a compensatory basis in accordance with the approved afforestation plan. • Project activities shall avoid disturbance to natural vegetation and forest land as much as possible. • Movement of machinery shall be restricted to designated routes to prevent damage to surrounding vegetation. • No forest land shall be used for material storage or waste dumping.
Environmental Protection Agency, Mianwali	08-04-2026	• Key consultation points discussed with the Environment Protection Department (EPA), Mianwali included: • Documentation of local floral assemblages occurring within and along the proposed seismic survey corridor to establish the biological baseline and identify environmentally sensitive vegetation patches. • Careful routing of seismic lines and field movements to avoid disturbance to active plantation compartments, managed green belts, and regenerating vegetation areas, thereby minimizing direct impacts on forest and plantation resources. • Maintenance of an adequate ecological buffer around community woodlots, village plantations, and socially managed green spaces to reduce vegetation loss, prevent edge disturbance, and safeguard community-use natural resources during survey operations.
Forest Department, District Mianwali	08-04-2026	• During the seismic survey reconnaissance, consultations were held with the Forest Department, Mianwali to identify forest lands, plantation blocks, and environmentally sensitive areas falling within or adjacent to the proposed survey corridor. The discussion highlighted the presence of riverine, scrub, and irrigated plantation forests, including important plantation reserves such as Harnoli and Kundian plantation areas, which may provide habitat for wildlife and avifauna. • Special consideration was given to the alignment of seismic lines to avoid unnecessary disturbance to forest stands, protected vegetation, and associated

		biodiversity. The Forest Department also provided guidance regarding access routes, restricted zones, and precautionary measures required for survey activities in or near forest-managed lands to minimize ecological impacts.
Wildlife Department, District Mianwali	08-04-2026	- During the survey, various wildlife sanctuaries, plantation areas, and reserve sites within Mianwali District were identified and discussed in relation to their ecological significance. The prominent locations included Chashma Wildlife Sanctuary, Kungar Plantation, and Harnoli Plantation, as well as key protected and community-managed areas such as Numl Game Reserve, Chitri Public Game Reserve, and Mallku Wali Pati Community Conservation Area. - Particular attention was given to the faunal diversity of the region, with emphasis on the occurrence, habitat use, and seasonal presence of resident and migratory bird species, highlighting the ecological importance of these sites in supporting local biodiversity.
Environment practitioners and experts	05-04-2026	- The exploration activities may have adverse environmental effects if not managed properly. To mitigate these impacts, it is recommended to properly implement and monitor Environmental Management Plan (EMP). - The project proponent must ensure that no waste will be left behind after the completion of activities. - The project area features various perennial and non-perennial drainage patterns. It is advised to avoid using these drainage patterns for the disposal of waste materials, including gravels and other solids.



Wildlife Department Bhakkar



Forest Department Bhakkar



Figure 6.2: Consultations with Government Departments

7. POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

7.1. Introduction

This section evaluates the anticipated environmental and socio-economic impacts arising from the proposed project activities in the Zindan II Block, Bhakkar and Mianwali, Punjab. It also outlines suitable mitigation measures aimed at minimizing, mitigating, or offsetting any adverse effects associated with the proposed project.

The potential impacts of the proposed activities on surface and groundwater resources, air quality, ecological components (flora and fauna), noise levels, and the socio-cultural environment including effects on employment, agricultural land, and public health are discussed in detail in the following subsections.

7.2. Methodology for Risk Assessment

The potential environmental and socio-economic impacts associated with the proposed project were identified through a comprehensive review of relevant literature, evaluation of baseline environmental data, field observations, professional judgment, and an understanding of the proposed 2D seismic survey activities. The identified risks have been addressed through the formulation of appropriate mitigation measures aimed at minimizing the magnitude and significance of each impact. A structured assessment approach was adopted to evaluate the anticipated impacts on both the micro-environment and macro-environment of the project area. This approach comprised the following components:

- Review of General Guidelines.
- Identification of potential environmental impacts by conducting survey, public consultation.
- Assessment of the intensity and significance of potential impacts by obtaining expert opinion and carrying out environment analysis.
- Defining mitigation measures to reduce impacts to as low as practicable

Method for impact identification and assessment: A checklist-based approach was employed for impact assessment, and relevant guidelines were consulted to verify compliance with permissible environmental standards during project implementation. These guidelines were also used to classify the project site in terms of pollution status, soil characteristics, and ecological sensitivity, including fauna, flora, wildlife, and any historical or archaeological features.

Environmental aspects of the proposed project were identified through situation analysis, focusing on existing land use, potential vegetation disturbance, noise and other nuisances during construction activities, air quality impacts from fugitive dust emissions and equipment operation, as well as emissions from power generators.

The screening process was structured to ensure a comprehensive evaluation of potential impacts on both the macro- and micro-environment of the project area. Environmental impacts may occur at different stages of the project life cycle, as summarized below. The identification of potential impacts involved analyzing the relationship between project

activities and environmental receptors, with emphasis on the sources and pathways of impacts. The criteria used for impact assessment are presented in **Table 7.1**.

Table 7.1: Impact Assessment Criteria

Nature of Impact	Positive or negative
Extent	Localized or Regional/Expanded
Significance	Low significance-That the impact would not have an effect on the decision to approve the project (or a particular project alternative), Medium significance- The assessed impact should have an effect on the decision unless it is effectively mitigated. High significance- The decision would be influenced regardless of any mitigation.
Further investigation or monitoring	A recommendation for further investigation (prior to the commencement of the activity) or monitoring (prior to commencement and/or during operations or even post closure).

Table 7.2: Checklist for screening of potential environmental impact

Screening Questions	Yes	No	Remarks
Project Siting Is the project area...			
Densely populated?	×		Moderately populated settlements and scattered due to hilly and undulating terrain
Heavy with development activities?		×	The project area is situated in the Pothohar region. Development is confined in the Bhakkar and Mianwali. Mining activities such as extraction of salt, coal and stone is common in the area. Picnic spots (tourism spots) are seen near the Kalar Kahar.
Adjacent to or within any environmentally sensitive areas?	×		Yes, there are several protected sites such as reserved forests falling in the Zindan Block. OGDC will take prior approval for the working in the protected areas. In Mianwali, the Harnoli Plantation stands out as a vital sanctuary for diverse bird species and reptiles, while the region's proximity to the Indus River provides a habitat for the endangered Indus River dolphin. Bhakkar is characterized by its extensive network of protected plantations, such as Rakh Ghulaman, Chak, and Fateh Major, which are essential for the conservation of desert-dwelling species like the Chinkara gazelle and Nilgai.
Cultural heritage site		×	There are no cultural heritage sites in the project vicinity.
Protected area	×		Thal Game Reserve falls within Zindan II Block. OGDC will take prior approval for the working in the protected areas. In Mianwali, the Harnoli Plantation stands

			out as a vital sanctuary for diverse bird species and reptiles, while the region's proximity to the Indus River provides a habitat for the endangered Indus River dolphin. Bhakkar is characterized by its extensive network of protected plantations, such as Rakh Ghulaman, Chak, and Fateh Major, which are essential for the conservation of desert-dwelling species like the Chinkara gazelle and Nilgai.
Wetland or water body	×		Yes, Zindan II block contains several surface water bodies but the proposed seismic activities will not be carried out in the wetlands.
Buffer zone of protected area	×		
B. Potential environmental impacts			
Will the project cause...			
Dislocation or involuntary resettlement of people?		×	No resettlement will be required.
Deterioration of environmental conditions of surrounding of project site.		×	The impact of the exploration activities would be localized within the microenvironment immediate vicinity within 500 meters). The activities being temporary in nature will have short term impacts.
Degradation of land and ecosystems (e.g. loss of wetlands and wild lands, coastal zones, watersheds and forests)?		×	Ecosystem degradation not envisaged by the project activities as the most of the area is hilly and barren
Degradation of cultural property, and loss of cultural heritage?		×	Not envisaged. No such sites are found in the project area.
Disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		×	Not envisaged.
Pollution of receiving waters resulting in impact on residential area, agriculture land, and land resource?		×	Not envisaged. No runoff generating activities are planned.
Water resource problems (e.g. depletion / degradation of available water supply, deterioration for surface and ground water quality, and pollution of receiving waters?		×	Project is not water intensive. Water resource depletion is not envisaged from the project.
Air pollution due to emissions?	×		Temporary and localized impact is anticipated.

Social conflicts between construction workers from other areas and local workers?	×		Local workforce deployment for the project will reduce the risk of social conflicts. This can be further avoided by training of workers on social issues and grievance redressal mechanisms.
Noise and dust from construction activities?	×		Temporary and less significant, can be further minimized through better management practices.
Contamination of surface and ground waters due to improper waste disposal?	×		Possible if waste management is not adequately done.
Are there any demographic or socio-economic aspects of the Project area that are already vulnerable (e.g., high incidence of marginalized populations, rural-urban migrants, illegal settlements, ethnic minorities, women or children)?		×	The area is poverty struck and flood prone. Recent floods have significantly affected the livelihood of local population. The project area is not vulnerable with respect to any demographic or socioeconomic aspects.

7.3. Screening of Potential Impacts at Project Siting / Location Stage

The screening of potential environmental and socio-economic impacts associated with the seismic survey indicates that most impacts are temporary in nature and can be effectively minimized through the adoption of good practices, careful planning and design, and appropriate operational controls at each stage of the project.

The potential impacts arising from seismic survey activities, along with their corresponding mitigation measures, are discussed in the following sections:

7.3.1. Impacts on Land Use

Land use impacts are primarily associated with surface disturbance, potential habitat degradation, temporary fragmentation, and soil erosion resulting from proposed project activities such as the construction of access tracks (where required) and preparation of shot holes. These impacts can be avoided or significantly minimized through the effective implementation of the recommended mitigation measures.

Construction of Access Track

The existing road network will be utilized to the maximum extent possible during project implementation. However, in locations where seismic lines are not accessible through existing routes, the construction of temporary access tracks may be required. Such construction activities will involve limited cutting and filling operations. Track surfacing may be carried out using in-situ gravels or gravels sourced from nearby areas.

Potential impacts associated with access track construction include localized vegetation clearance, soil erosion, and possible land instability. These impacts may primarily result from wind erosion of earth-fill stockpiles and disturbance of loose surfaces during construction activities.

As the proposed project activities are temporary and expected to last only a few months, any changes in land use are anticipated to be short-term. Upon completion of the seismic

survey, all disturbed areas will be reinstated and restored, as far as practicable, to their pre-project conditions.

Mitigation Measures

- Land uptake for the project will be kept to minimum.
- Need of construction will be reduced by considering use of pre-fabricated materials and portable units e.g. cabins, etc.
- Site restoration plan will be implemented upon project completion.
- Dense patches of vegetation will be avoided by adjusting the location of campsites, base camps, fly camps and access tracks etc.
- Total land uptake by the camps and access tracks will be kept to the minimum required.
- Clearing of vegetation will be kept to a minimum. Cutting of trees will be avoided.
- Selection of route shall be carefully done to avoid dense patches of vegetation.
- The preparation of tracks will be carefully planned and done. Where an access track can be prepared through compaction alone, it be considered accordingly. Otherwise, graveled surface will be prepared.
- It will be ensured that the selected route does not affect any habitats and cause habitat fragmentation or damage.
- During the project, movement of survey vehicle/equipment will be restricted to work areas only to avoid unnecessary disturbance of soils in the project area.
- Access tracks will move around patches of vegetation and trees to avoid unnecessary clearing of vegetation.
- Preparation of new access tracks will be minimized and use of existing routes will be preferred as much as possible. Where improvement of existing tracks or development of short lengths of new tracks is unavoidable the width of the access track will not exceed 5 m.
- Vehicle speed will be regulated and monitored to avoid excessive dust emissions.
- Seismic camps will be located in existing clearing and levelled land, if possible. If this is unavoidable then the campsites will be located where minimum, land clearing is required.
- While travelling on banks of streams and watercourses slow speeds (not exceeding 20 km per hour or even lesser) will be maintained to avoid damage to the banks.
- Photographs will be taken before any activity to record the conditions of campsites, roads and seismic lines at locations that are likely to undergo soil erosion. Similar photographs will be taken at intervals throughout the survey to monitor any changes and soil conditions.
- Good engineering practices will be adopted during construction activities to ensure that unnecessary clearing of vegetation and disturbance to soils outside work areas are avoided.
- Seismic lines in undulating areas will be planned such a way to minimize disturbance to natural topography.
- During the construction phase, a single track shall be identified and approved along sections of the main track on which work is in progress. Vehicles shall be allowed to travel only on the approved track.
- During construction stage, gravel should not be dumped on or close to the access track being improved or constructed such that it causes a hindrance in the movement of local vehicles (if any) and pedestrians.

7.3.2. Sensitive Areas

The proposed project area includes one game reserve within the Zindan II block, namely the Thal Game Reserve, a protected wildlife area in the Thal Desert region of Punjab, Pakistan, spanning the districts of Bhakkar, Jhang, Khushab, Layyah, and Muzaffargarh. Approximately 137 L km of the project footprint falls within this protected area.

A number of seismic survey lines are planned across the project area; however, efforts will be made to minimize tree cutting and land clearing wherever feasible. Most of the proposed seismic activities are located away from settlements, public infrastructure, and major water resources, and no settlements are in close proximity to the survey lines.

Nevertheless, seismic operations within and around ecologically sensitive areas, including the Thal Game Reserve and adjacent reserved forests, may result in temporary, localized environmental impacts if not properly managed. These include vegetation disturbance during line preparation, shot-hole drilling, and equipment movement, leading to minor habitat alteration, soil compaction, and increased erosion susceptibility.

Noise and ground vibrations from seismic activities may also cause short-term stress and behavioral changes in wildlife, resulting in temporary displacement from feeding and movement areas. Increased human presence may further contribute to indirect impacts such as wildlife disturbance, accidental fires, and unauthorized resource use. However, these impacts are expected to be short-term, localized, and reversible with the implementation of appropriate mitigation and environmental management measures.

Mitigation Measures

- Avoid seismic lines within protected areas wherever feasible.
- Maintain adequate buffer distances from wildlife sanctuaries and reserved forests in consultation with Forest and Wildlife Departments.
- Utilize existing roads and trails to minimize new land disturbance.
- Minimize vegetation clearance; prefer manual cutting over mechanical methods.
- Avoid cutting mature trees unless explicitly approved by the Forest Department.
- Separate and reuse excavated soil during restoration.
- Conduct pre-survey ecological walkthroughs to identify sensitive habitats and wildlife presence.
- Schedule operations during daytime hours to reduce disturbance to nocturnal species.
- Restrict vehicle speed and movement within forest areas.
- Prohibit hunting, trapping, or harassment of wildlife by project personnel.
- Use controlled, low-energy seismic sources near sensitive habitats.
- Avoid operations during wildlife breeding or sensitive seasons, where applicable.
- Limit workforce access to essential personnel only.
- Provide environmental awareness training to all workers regarding forest and wildlife protection.
- Install clear signage to mark protected and sensitive areas.
- Restore all disturbed areas immediately after survey activities.
- Re-grade access tracks, refill shot holes, and stabilize soil to prevent erosion.
- Re-vegetate disturbed areas using native plant species where necessary.
- Implement regular environmental monitoring during seismic operations.
- Coordinate closely with Forest and Wildlife Departments throughout the project.

- Ensure compliance with all applicable environmental and wildlife protection regulations.

7.3.3. Social Amenities and Public Infrastructure

The selected locations of exploration activities mostly fall in remote abandoned areas where there are no anthropogenic interventions. Local infrastructure is limited. Hence, impact from the project on same is not envisaged.

7.4. Impacts from Project Design

7.4.1. Exploration Program

The proposed exploration activities will involve 2D seismic data acquisition over an estimated distance of approximately 400 Linear Kilometers (L. Km). Depending on the terrain and topographical conditions of the project area, both dynamite and Vibroseis methods will be employed.

Dynamite is the most widely used seismic source for onshore operations. This method is labor-intensive as it requires drilling shot holes to place explosive charges. It may lead to temporary physical disturbances, including minor ground scarring, soil erosion, vegetation loss, and generation of small amounts of waste. However, these effects are short-term and reversible, as the shot holes are backfilled and the site is restored after the completion of operations.

The Vibroseis technique, in contrast, is a non-explosive seismic method that generates controlled ground vibrations using vibrator trucks fitted with metal plates (vibrator pads) that transmit acoustic energy into the subsurface. Typically applied in accessible and relatively flat areas, this method minimizes environmental impacts because it does not require drilling or explosives. It reduces soil disturbance, vegetation damage, and noise pollution, making it an environmentally preferred option wherever conditions permit.

Overall, the environmental effects of the seismic survey are expected to be temporary and highly localized. These impacts can be further minimized through the implementation of the Environmental Management Plan (EMP).

Mitigation Measures

- Implementation of EMP shall be ensured.
- Regular monitoring of project activities for compliance will be carried out.

7.5. Potential Impacts from Exploration and Associated Activities

7.5.1. Land Use Changes

Temporary changes in land use are expected due to vehicle movement and seismic data acquisition activities; however, these changes will be short-term and will persist only for the duration of the exploration activities. Given the current land use in the project area, which is relatively low in intensity, the overall impact is anticipated to be minor and localized.

7.5.2. Dust and Gaseous Emissions

Dust emissions from transportation and other survey equipment and machinery e.g. generators and vehicles, are the main sources of air emissions during the project.

Movement of vehicles on unpaved tracks and preparation of survey line tracks can release dust emissions and soil erosion.

The scale of emissions can be significant due to soil aridity, a common soil feature in project area. The effect will be however localized and temporary. The stack emissions from generators that will be used at the seismic camp and in the field are expected to remain within PEQS except for NO_x and SO_x which can increase if the machinery is not well tune and combustion is not proper. This effect can be further controlled by keeping adequate distance from the communities. It is anticipated that the project operation will maintain appropriate distances from communities. However, survey staff may be exposed to increased PM levels.

Direct biogenic emissions from project activities will not occur. However, indirect emissions from tree cutting, land clearing and subsequent release of emissions from plant decay, change in soil microbial activity can cause release of CO₂, methane and other emissions to air. However, the overall probability of this is expected to remain low and small scale.

Mitigation Measures

- The black smoke from vehicles and other seismic machinery such as truck mounted rigs and jack robs, compressors shall be minimized by using well-tuned equipment and regular maintenance of the vehicles or other equipment.
- Use of paved routes as much as possible will be maintained. On unpaved routes, speed limits will be adjusted to prevent dust.
- Dust emissions due to road travel shall be further minimized by sprinkling water over the surface
- Tree cutting will be avoided as much as possible.
- If tree cutting cannot be prevented, compensatory plantation toward the end of project will be ensured. Burning of waste will be prohibited.
- Regular monitoring of emissions sources and access routes to identify and correct any non-compliance

7.5.3. Wastes and Effluents

Domestic wastes and effluents: Domestic wastes generated during seismic activities will include sewage, grey water (from kitchen, laundry, and showers), kitchen wastes, combustible wastes, and recyclable wastes.

Bentonite Mud: Bentonite mud will be used during seismic operations for drilling of up-holes and deep holes to avoid the holes from collapsing. The mud and the cuttings will be disposed of into earthen pits backfilled after drying the mud and cuttings. This mud is prepared by mixing bentonite with water. Bentonite is a natural clay material and non-hazardous in nature. The use of the mud and its preparation and disposal in earthen pits will therefore have no impacts on groundwater or soil quality. Careful planning of all ancillary activities including base camp activities will be important to prevent negative impacts. The main concept for waste management will be that the environmental impacts associated with the disposal of project-generated waste are within acceptable limits.

Wastewater: Wastewater will be generated from domestic activities including washroom and cleaning and washing activities. Disposal to land can contaminate soil and hence proper disposal is needed.

Mitigation Measures

- All waste management will be as per waste management plan.
- All effluents from project activities shall comply with PEQS discharge limits.
- Excavated soil can be used for backfilling the soak pits or other places.
- Site supervisor will ensure that the waste generated from campsite and site clearance for seismic lines is disposed as planned.
- Sewage generated at the campsites will be disposed in properly designed septic tanks and soak pits.
- Soak pits will be built in absorbent soil and located 500 m away from a surface water source or ground water well.
- Soak pits will be constructed in a manner that prevents surface runoff from entering the pits. In the event that the soak pits become filled during operations, the greywater will be sprinkled over access tracks after environmental monitoring testing confirms that all parameters comply with PEQS limits. Sprinkling of grey water will be carried out in a manner such that excess water is not collected on site creating swamps.

7.5.4. Impacts on Ambient Air Quality

The magnitude of air quality impacts will depend on factors such as the quantity and duration of emissions, the location of activities, the nature of pollutants, and prevailing meteorological conditions, including wind speed and direction, precipitation, and relative humidity. During seismic survey operations, air quality may be affected by emissions and dust generated from earth-moving equipment, vehicles, and generators. Key pollutants include particulate matter, nitrogen oxides (NO_x), carbon monoxide (CO), and sulfur dioxide (SO₂). The emissions associated with these activities are not expected to contribute significantly to climate change.

Mitigation Measures

- Dust emissions during construction activities should be minimized by good management practices such as locating stock piles out of the wind direction, keeping the height of the stock piles to a minimum, keeping earthwork areas damp, etc.
- During construction, levelling or widening (for the access road) will be done in sections, immediately followed by sprinkling of water and also preferably compaction (where required).
- During operation dust emissions due to road travel will be minimized by regulating vehicle speeds and watering of the access track (where required).
- Minimize the amount of disturbance and areas cleared of vegetation.
- Burning of waste and combustible material at the project site will be strictly prohibited.
- Generators, compressors and vehicles used during the operations will be maintained in a good condition to ensure that emissions are kept to a minimum level (compliant with PEQS standards).
- Cover construction materials and stockpiled soils if they are a source of fugitive dust.
- During seismic operations vehicle speeds will be regulated and monitored to minimize dust emissions.
- Keep soil loads below the freeboard of the truck.

- Minimize drop heights when loaders dump soil into trucks.
- Campsites will be located at 500 m away from major residential communities.
- Keep soil moist, if it is a source of fugitive dust, while loading into dump trucks and cover it with tarpaulin during transportation.
- During operation phase, emissions from all point sources should also be monitored to check compliance with PEQS.

7.5.5. Soil and Water Contamination

During seismic survey operations, fuel or oil spills, leaks, or stains can potentially contaminate soil and water resources. For management purposes, such incidents are classified as minor, moderate, or major, and the corresponding mitigation measures are outlined below.

Minor Spills: Minor leaks or spills from vehicles, equipment, or storage containers at campsites or work areas, as well as fuel or oil stains generated during handling and transfer operations, are considered minor if the affected area is less than 1 square meter and the depth of soil contamination does not exceed 0.3 meters.

Moderate Spills: Oil spills during transfer or handling operations resulting in spillage of no more than 200 liters of fuel or oil.

Major Spills: These may occur during transportation of oil to the camp sites or failure of the oil containment arrangement at the camp sites resulting in spillage of oil significantly more than 200 liters in volume.

Mitigation Measures

- All vehicles will be inspected before clearing them for use during the project. Only fit and well-tuned equipment and machinery will be used during the project.
- Fuel storage areas (if provided) will be built with secondary containment. All fuel containers will have adequate capacity and provided with liner sheets at the bottom.
- Regular monitoring of all fueling activities including fuel storage.
- Any leakage will be immediately repaired and vehicle will be retained until the issues is rectified.
- All fuel tanks will be properly marked to highlight their contents.
- Fuel and oil storage areas shall have secondary containment in the form of cemented or brick masonry bunds with plastered to prevent soil contamination in case of leaks or spills. The volume of the containment area will be equal to at least 110% of the total volume of fuel/oil stored or 110% of the volume of one largest tank. Secondary containment shall also have sump pit for collection of spillage material.
- Fuels tanks will be regularly checked for leaks and all such leaks will be plugged immediately.
- The soil contaminated from spills will be collected and handed over to Punjab EPD approved waste contractor for disposal.
- A spill prevention and contingency plan will be prepared to deal with moderate and major spills.
- Shovels, plastic bags, and absorbent material should be present near fuel and oil storage or handling areas to attend spills and leaks.
- During fuel and oil transfer operations such as refueling bulldozers through a dedicated fuel vehicle, drips and spills will be avoided and drip pans will be used.

- Vehicles will only be serviced in designated cemented paved washing areas within campsites.
- Bentonite mud used for the purpose of up-hole and deep-hole drilling will be prepared in earthen pits. The used mud will be disposed of in the same pit and left to dry. After the mud has dried the pit will be backfilled.

7.5.6. Noise and Vibrations

Sources of noise during seismic survey activities will be generators, vehicles, seismic machineries such as compressors, Vibroseis and truck mounted rigs. Vibrations will be produced from Vibroseis trucks and dynamite shootings which can affect local animal population and nearby communities. However, the impact is small scale and minor in nature as the ground motion is usually so low in amplitude that it is imperceptible to humans under normal conditions and can only be detected by sensitive instruments (broadband seismometers). Hence the vibrations will be barely perceivable to the communities and will not be felt at any significant distance from the source.

Noise from these activities will also be low. Detonation of dynamite in shot holes (20 m deep) will only be heard at the surface like a muffled thud. Other activities transportation and power generation will increase local noise levels which can affect nearby communities and animal life.

Measured at a distance of 15m, vehicular traffic is expected to generate 60 to 70 dB (A) of noise, and the diesel generators up to 82 dB(A). Noise levels from camps and from operation of bulldozers and trucks attenuate to ambient level of 55 dB (A) at 30m, 124m, and 400m distance respectively from the source.

Noise measurements during previous similar operations show that the noise levels attenuate to ambient levels at maximum of 125m from the source e.g. camps, bulldozers etc. As the project facilities are expected to be located at distances greater than 125m from the communities, therefore, noise levels at these receptors are expected to remain within PEQS limits.

Mitigation Measures

- Careful planning of activities can significantly reduce the impact levels e.g. schedule and location of activities, implementing controls like barriers, well-tuned equipment and machinery.
- The noisy activities (including blasting) will be scheduled in the least noise-sensitive times of the day (between 7 a.m. and 10 p.m. preferably).
- Blasting will be avoided as much as possible during proposed project activities to provide relief to the sensitive environmental receptors of the area
- It shall be ensured that generators, vehicles and other noisy equipment used will be in good condition.
- Noise levels at communities nearest to campsites and access tracks shall be regularly monitored. Non-compliances (to PEQS) will be recorded and reported for corrective action.
- The use of horns by project vehicles shall be minimized. The use of pressure horns shall not be allowed.
- Movement of all project vehicles and personnel shall be restricted to within work areas.
- Generators will be kept within enclosures to minimize dispersion of noise.

- Adequate PPEs will be provided to staff for occupation safety.

7.5.7. Impacts on water resources (surface water, ground water and natural drainage)

i. Ground Water

Water extraction for project activities may lead to a temporary reduction in groundwater availability, potentially affecting the immediate water accessible to nearby communities. However, this is not expected to have any long-term impact on the overall water resources of the area. Given that the project area is sparsely populated and that settlements are located more than 500 meters away from the seismic lines, the overall scale of this impact is considered low.

Mitigation Measures

- Water from a local well will only be used after ensuring that the available capacity at the tube well (safe yield minus local demand) is at least 50% greater than the project demand. Discharge from the tube wells will be regularly monitored to supervise any changes in the yield of the wells. If a single well fails to meet this requirement, water will be obtained from multiple wells such that each well meets the above-mentioned requirement.
- For all water obtained from local wells, the owner will be paid for water abstracted at the market rate.
- A complete record of water consumption during seismic and construction of camps will be maintained.
- The use of new water wells installed or to be installed by the proponent for community benefits will be allowed.
- The quantity of water used during seismic and camp construction operation will be kept to the minimum required by taking prudent water conservation measures on site.
- Contamination of surface and groundwater resources will be avoided.

ii. Surface Water

Impacts on surface water resources may occur as a result of land disturbance, soil erosion, altered runoff patterns, campsite wastewater, and water extraction associated with 2D seismic survey activities. However, the proposed seismic lines do not intersect major perennial water bodies, and given the generally arid and sparsely populated nature of the project area, the risk of significant adverse impacts on surface water resources is considered low. Appropriate measures will be implemented to manage runoff and prevent contamination of nearby streams and watercourses during project activities.

Mitigation Measures

- Identify and avoid unstable slopes and local factors that can cause slope instability (groundwater conditions, precipitation, seismic activity, slope angles, and geologic structures, etc.).
- Use special construction techniques in areas of steep slopes, erodible soils and stream crossings.
- Activities with potential of contaminating surface water bodies e.g. fueling, waste storage/disposal shall be done with proper containment systems.

- Do not alter or restrict existing surface drainage patterns, especially in sensitive areas such as erodible soils or steep slopes. Cross water bodies at right angles to the channel and/or at points of minimum impact.
- Apply erosion controls relative to possible soil erosion from vehicular traffic and during construction activities. The purpose is to retain the soil on disturbed land, such as a construction site, until the activities disturbing the land are sufficiently completed to allow revegetation and permanent soil stabilization to begin.
- Regularly monitor rights-of-way (ROWs), access roads, and other project areas for indications of erosion.
- Use drip pans during refueling to contain accidental releases and under fuel pump and valve mechanisms of any bulk fueling vehicles parked at the project site.
- Reestablish the original grade and drainage pattern to the extent practicable.

Natural Drainage

Given these topographical and hydrological conditions, the likelihood of construction activities such as access track development, land clearing/preparation, or campsite establishment causing blockage of natural drainage features is not expected to be significant. These small watercourses and runoff paths are typically active only during rainfall and are unlikely to be permanently disrupted by temporary seismic operations. Therefore, no specific mitigation measures are required solely to address natural drainage blockage. However, to ensure responsible execution of seismic activities and protection of local drainage, the following measures should be implemented:

Mitigation Measures

- Natural drainage will be protected as much as possible during the construction of campsite and other units.
- Natural drainage should not be blocked by the construction of campsite.
- Bridge Crossings for access route shall be provided at all stream crossings to avoid blocking of natural drainage. Pipe culverts shall be provided at small drainage channels if any.
- No dumping of the construction materials, soft soil, gravels shall be made in any drainage channel.

7.6. Occupational Health and Safety Hazards

During seismic survey operations, workers may be exposed to various occupational and health hazards, including noise, ground vibrations, handling of explosives, and movement of vehicles and heavy equipment. Fieldwork-related hazards, such as accidents or injuries, may occur due to the operation of vehicles, machinery, or the use of explosives if proper safety measures are not followed.

Mitigation Measures

- All operations will be conducted in compliance with OGDC HSE policy as well as industry best practices.
- Appropriate and well-stocked first aid kits and firefighting equipment will be available to all crew, and specific crew members should be trained on first aid administration and handling of firefighting equipment.
- Risk Assessment/ JSAs will be carried out for each activity.

- Job-specific personal protective equipment to be provided to the workers, training should be given, and their use made mandatory in designated areas.
- A Base Camp Clinic will be provided, manned by suitably qualified field medical staff equipped with equipment and medication as appropriate, including ambulance vehicle(s).
- Adequate warning or cautionary signage will be posted as required.
- All electrical equipment shall be properly installed, earthed and regularly inspected.
- Only properly trained and authorized employees shall operate equipment or machinery.
- Provision of an Emergency Response Plan, Evacuation Plan, Medevac Plan, and Flood Management Plan will be implemented in all concerned situations.
- Personnel on seismic survey operations and those on transit around the project area will be provided armed escort.
- Adequate site induction of all new personnel shall be done before starting with project.
- No residual impacts are expected in this case.

7.7. Socio-Economic Issues

All development initiatives give rise to impacts that affect socio-economic receptors in the project area. Socio-economic impacts vary from project to project and are not easily quantifiable. These are consequences of project activities on the human population that alter the ways in which people live, work, interact, relate to one another, organize to meet their needs and generally exist as members of society.

The potential social impacts may include long-term impacts such as cultural impacts involving changes to the norms, values, and beliefs that guide and rationalize their cognition of themselves and their society.

Activities that potentially impact the local communities may include loss of land (temporary), sharing of access routes/roads, community water sources, influx of non-local workforces, data acquisition process causing noise and wastes.

Potential social impacts from the project are discussed below.

7.7.1. Acquisition of Productive Land

OGDC has established procedures for leasing of land and its compensation following which the landowner will be paid a lease amount for the land and a compensation amount for the standing crop affected at the time of the lease as per government approved rates.

The project may cover livestock grazing areas in the project area. Compared to the total available grazing area, the uptake by the project will not be significant and will not have any measurable significant effect. Project vehicles will follow safe speed limits, especially on seeing a livestock herd near the road to avoid any road accidents.

7.7.2. Community Disturbance

Community disturbance is likely to become an issue during seismic work due to various field activities such as operation of field equipment which may disturb people in nearby houses due to noise from the equipment being operated. Access roads passing close to villages will also result in disturbance and annoyance to the local population from movement of vehicles on these access tracks. The aspects leading to community disturbance are discussed below.

7.7.3. Mobility and transportation

The project activities may affect mobility of local women, a sensitive matter in the Balochi culture. Project personnel will be given gender sensitization briefings and will be instructed to respect local norms, the local culture, particularly in relation to the womenfolk of the area. In connection to the usage of the access track by the women of the area, they will not be restricted in any way, and will be given due right to crossing the road in pursuit of the daily chores, such as collection of fuel wood and fetching water.

Mitigation Measures

- Campsites will not be established in areas which are used as access routes by the communities.
- Project vehicles and equipment will not be located randomly in the project area; the drivers will be instructed to consider the possible hindrance from parking the vehicles in such area which could create disturbance to the locals.
- Gender issues will be communicated to the project personnel before start of work.

7.7.4. Safety and Security

The operations may affect the safety and security of the inhabitants of the areas by affecting road safety, creating conflicts between residents and the contractors, safety and security issues pertaining to the carriage of firearms on the site.

Community sensitive project planning and implementation as prescribed through the recommended mitigation measures will minimize the occurrence of any such impacts.

7.7.5. Disturbance from Noise and dust

Communities that are located close to the access road may be exposed to dust emissions and seismic camps, and any incidental spillage of fuel or oil. If the mitigation measures relating to the control of dust emissions, oil or fuel spills, and project wastes are followed, no impacts will occur. Local complaints of dust emissions shall be noted and addressed immediately. Community complaints shall be duly addressed and appropriately resolved. Impact of noise will be very low to negligible since the seismic camps will be located at safe distance from communities (around 500m). Therefore, there will be no effect of the project noise on the local communities.

Mitigation Measures

To minimize the disturbance and noise impacts, the following mitigation measures will be implemented for conducting work close to settlements:

- Communities will be kept informed about all project activities and possible disturbance in advance.
- Although all project drivers will adopt safe driving practices, special care will be taken while passing by the settlements, and will reduce speed as required.
- Any new tracks will be aligned as far away from settlements as possible, even if this results in longer routes.
- If alternative routes exist, existing tracks passing close to settlements will not be used.
- Camps will be established well away from the communities.

7.7.6. Interactions with Communities/gender issues

Except for the presence of local people hired for the project, very little interaction is expected between seismic survey crews and local communities. However, the influx of

outsiders may affect the mobility of local women. The seismic survey workers will be trained on community interaction protocols and SOPs and any unnecessary interaction will be discouraged.

7.7.7. Availability of drinking water

For drinking purposes, bottled water will be used and local sources will be secondary option and utilized if bottled water supply cannot be made for security or logistics reasons. The impact of reduced availability of drinking water due to project is expected to be of minor scale as the water consumption of the project is anticipated to be low and conservation measures will be adopted to further lower the possibility of impact.

7.7.8. Community Grievances

OGDC will ensure constant and transparent contact with major stakeholders, particularly local communities, through all stages of project implementation. This is necessary to produce a sense of participation and develop a relationship of trust with the local communities, keeping in mind that the exploration may lead to the development of long-term interests in the region.

OGDC will keep communities informed of work schedules and of the nature of work being undertaken. They will also take advantage of local knowledge regarding any possible sensitive sites (such as sources of water), or sites of historical or cultural interest, that are located in close proximity to seismic operations. These sites will not be disturbed during the course of the project.

7.7.9. Community Health and Safety

Potential risks may include accidents from vehicles, disease transmissions, noise exposure, and social conflicts from disruption of cultural norms due to influx of non-resident workforce. The level of impact will vary and depend on the nature of each event. Since social issues can largely affect the execution and success of project, management of social issues will be critical.

Mitigation Measures

To reduce the possibility and scale of impact, the following mitigation measures will be implemented:

- The seismic crew will undergo medical examinations for any contagious disease.
- Local people will be informed in advance when work is about to start in an area. This may result in people keeping young children away from work areas.
- The field equipment will never be left unattended.
- Safe driving practices will be adopted, particularly while passing through settlements.
- Limited movement of workers will be ensured to reduce personal contact among the workers.
- Adherence to Standard Operating Procedures (SOPs) for the operations will be ensured including use of proper PPEs e.g. facemask, use of gloves, frequent use of hand sanitizers, and maintenance of 6-meter distance where possible.

7.7.10. Sustenance income

The livelihood of local communities largely depends on agricultural, livestock and other land related activities. For campsite land will have to be leased from locals. The project

activities can temporarily disturb the land-based livelihood activities during execution. Another risk, though less likely but possible is the reduction in farm income when agricultural lands become incapacitated as a result of oil spills into fields or water courses.

Since seismic surveys are temporary and of short duration, and the land is acquired through proper compensation procedures, the impact level is expected to remain low.

Opportunities for wage labor in the project area are very few. As a consequence, the expectations of local residents in relation to employment during the project will be high. Core activities of seismic operations, limited tracks and camp site construction require skilled and trained labor force, which is not available in the area. However, the project will also to a great extent require the services of unskilled workforce. The project will employ local people for unskilled jobs, although the number is expected to vary depending on the activities taking place. When hiring local people, preference will be given to people living within the affected areas, as they will be the most directly influenced by the project.

Mitigation Measures

- Standing crops will not be affected. If needed, the compensation rates, however, will be defined on the basis of prevailing market rates for land and crops and will be agreed with the local communities. It is recommended that the district administration be involved whilst disbursing the compensation amounts so that the rightful owners of the land are compensated. Any delays in disbursement of compensation amounts should also be avoided so that the already marginalized communities of the area are not affected.
- Local population will be considered for non-skilled works and non-material supplies.
- The project's grievance mechanisms will be in place to resolve amicably any issues that arise out of the project.

7.8. Impacts on Ecological Resources

Seismic survey activities require the mobilization of workers and vehicles, as well as limited vegetation clearing to establish seismic lines or drill shot holes. These operations can temporarily disturb wildlife in the project area. Small animals, birds, and reptiles may be displaced due to increased human activity, destruction of burrows or nests, and indirect impacts such as noise and vibrations from equipment and heavy vehicles. Overall, the impact on wildlife is expected to be minor, with potential effects primarily on reptiles, small mammals, and local bird species. Seismic shot holes and access points will be carefully located to avoid disturbance to active bird nests and burrows of small mammals and reptiles.

Mitigation Measures

- Seismic camps will be located in existing cleared and levelled land, if possible.
- The camp site areas will be kept to a minimum required.
- Crew personnel while working along seismic lines will be confined to a corridor of 5 m.
- Use of local wood as fuel will be prohibited.
- The number of access routes used will be kept to a minimum and road travel will be minimized.
- Preparation of new access tracks will be minimized. Where improvement of existing tracks or development of short lengths of new tracks is unavoidable the width of the access track will not exceed 5 m.

- Off-road travel will be strictly prohibited and observance of this will be monitored during the operation.
- The cutting of trees will be avoided. Where it is necessary to cut down trees in government land, relevant departments will be taken on board before cutting of trees. In case of private land, compensation will be paid to the land owner.
- If clearing of vegetation is unavoidable, the rootstock will be left in place to encourage better regeneration of vegetation.
- Hunting, feeding, trapping or harassment of wildlife will be strictly prohibited.
- Vegetation clearing and land uptake during all operations will be minimized.
- Camp sites for seismic and construction crew will be located preferably 300 m from surface water bodies.
- Drivers will be instructed to keep a watch for domestic animals or wildlife in order to minimize the risk of road accidents.
- Seismic deep holes and up-holes will avoid disturbing live bird nests and small mammal and reptile holes.
- Food wastes will not be left in the open.
- All mitigation measures recommended for waste management, noise and air emissions will be implemented.
- Compressors and vehicles will be maintained in good condition and provided with muffles to reduce noise.
- For preparation of access tracks, routes involving minimum clearing of vegetation will be selected.
- Clearing of dense patches of vegetation will be avoided.

7.8.1. Impacts due to Hazardous Materials and Solid Waste Generated

Impacts from hazardous materials and solid waste are associated with the type and quantity of equipment and machinery used, chemicals applied during various operations, worker training, and the methods employed in project activities. The seismic survey is expected to generate wastes such as plastics, paper, containers, food waste, human waste, used oils, filters, metal scrap, and minor fuel leaks or spills. Bentonite mud, which is non-hazardous, will be used during the drilling of up-holes and deep holes to prevent collapse. Its preparation, use, and disposal in designated earthen pits are not expected to have any adverse effects on soil or groundwater quality.

Mitigation Measures

- Prepare a comprehensive list of all hazardous materials to be used, stored, transported and disposed of during all phases of activity.
- Include a recycling strategy to be practiced by workers during all project phases.
- Develop a spill prevention and response plan for addressing spill prevention measures, training requirements, waste-specific spill response actions, spill response kits.
- Construct camp site (if developed) such that nearby water bodies are not contaminated in case of project site run-off.
- Train employees to promptly contain, report and/or clean up any oil or hazardous material spill.
- Provide secondary containment around all the fuel storage tanks and chemical storage area of suitable size (110% of the fuel storage area/largest tank capacity). Fuel storage should be a temporary activity and fuel storage facilities should be removed upon completion of the required activities.

7.8.2. Impacts on Cultural Resources/Sites of Archaeological Significance

In the project areas of Bhakkar and Mianwali districts, a range of cultural and archaeological features are known to exist, reflecting the historical depth of the wider region of Punjab. In Mianwali District, notable heritage landmarks include the Kafirkot temple complex, which consists of a series of early medieval Hindu structures located along the Indus River, and the Malakhel Fort, representing the defensive architecture of earlier periods. The district also contains various undocumented archaeological mounds and remains that are indicative of ancient settlements.

Bhakkar District, while comparatively less documented in formal archaeological records, is also associated with historical sites and cultural landscapes, including old settlements, shrines, and relics linked to regional history. The proximity of Bhakkar to the Indus River has historically supported human habitation, and there is potential for buried or unrecorded archaeological resources within the area.

Within the immediate seismic survey areas of Bhakkar and Mianwali, no specific archaeological, cultural, or historically significant sites have been formally identified that would be directly affected by the proposed project activities. However, considering the potential for undiscovered cultural heritage resources, precautionary measures will be implemented. All contractors engaged in seismic survey operations will be instructed to immediately report any chance finds such as artifacts, structural remains, or culturally significant features, to OGDC. Upon such discovery, work will be halted in the vicinity, and the relevant authorities will be notified to ensure appropriate assessment, documentation, and preservation actions are undertaken in accordance with applicable heritage protection regulations.

Mitigation Measures

- All contractors and field staff will receive training on the importance of cultural heritage and the procedures to follow if artifacts or historical sites are encountered.
- Regular field inspections will be conducted to ensure that seismic operations do not encroach upon or disturb known heritage areas.
- If any archaeological or cultural artifacts, structures, or sites are discovered during survey activities, contractors must immediately report to OGDC and halt work in the immediate vicinity.
- Relevant heritage authorities, such as the Department of Archaeology and Museums, Punjab, will be notified to evaluate the significance of the findings and guide further action.
- Temporary barriers or fencing may be installed around newly discovered sites to prevent damage or disturbance until formal assessment is completed.
- All discovered artifacts or sites should be documented through photographs, GPS coordinates, and brief descriptions before any intervention, in coordination with heritage authorities.
- Seismic operations in the affected area can only resume once the heritage authorities have completed their assessment and provided clearance.

7.8.3. Potential Environmental Enhancement Measures

The proposed project activities are expected to contribute positively to the local economy by creating employment opportunities for nearby communities and generating income for

local contractors. Indirect benefits may also arise from increased economic activity, such as the procurement of raw materials and other supplies from local markets, as well as corporate social responsibility (CSR) initiatives undertaken by the project.

7.9. Site Restoration

Site restoration after seismic survey operation

After completion of the seismic survey activities, the campsite, up-holes, etc. will be restored to as similar to original condition as possible. For reference purpose a photographic record of the campsite prior to the set-up will be taken.

Mitigation measures

- Demobilization of all equipment and machinery
- Disposal of any waste material remaining at the time of completion of the operation.
- Restoration of seismic lines will include removal of all cables, geophones, station units, flags, stakes and wastes from the lines and back filling of all mud pits.
- All the fencing or barriers surrounding the seismic base camp area will be removed, and the area will be levelled. The concrete structures if desired by the land owner will be left intact. If not, the concrete will be broken up and disposed, or reused for backfilling of pits/septic tank (below main rooting zone, 1 - 1.5 m) or provided to locals for re-use.
- Dispose wastewater of septic tanks in an environmentally friendly manner and restore it after dismantling in place (top roof and at least 1 meter wall or more if easily possible) and backfilling with at least 1 meter of native soil cover.
- Dispose wastewater of soak pits in environmentally friendly manner and restore soak pit after removing / handling of wastewater & cover and backfilling it with at least 1 meter of native soil cover.
- Contaminated bricks of black/grey water pits and others shall not be given to locals for any purpose.

Table 7.3: Environmental Impacts & Characterization Matrix

Activity & Source	Nature of Impact	Duration	Extent	Reversibility	Likelihood	Severity	Significance
Landscape & Soil Erosion							
Camp siting Construction of access tracks.	Direct	Short-term	Local	Reversible	Possible	Moderate	Low
Noise pollution							
Transportation of heavy machinery, materials, equipment & personnel.	Direct	Short term	Local	Reversible	Unlikely	Negligible	Low
Dust Emission							
Dirt tracks by project related vehicles. Earthworks and construction for campsite. Combustion products (NO _x , SO ₂ , PM and CO) from diesel generators used in the camps to generate electricity.	Direct	Short term	Local	Reversible	Possible	Minor	Low medium
Air Emissions							
Exhaust emissions produced by generators. Exhaust fumes from vehicles and construction machinery.	Direct	Short term	Local	Reversible	minor	Minor	Low medium
Soil and Water Contamination							
Domestic waste (sanitary and kitchen discharge). Oil and grease from vehicles and machinery. Sediments from altered land surfaces (campsite). Stored fuel, oil and other chemicals.	Direct	Short term (after implementation of mitigation measures)	Local	Reversible	Unlikely	Minor	Low Medium
Impacts on Wildlife							
Improvement and construction of the access road. Removal of vegetation only where required.	Direct	Short term	Local	Reversible	Possible	Minor	Low Medium

8. ENVIRONMENTAL MANAGEMENT PLAN

8.1. General

Environmental management is a critical part of overall project planning and implementation. It encompasses policy formulation, organizational structure, planning and scheduling of activities, assignment of responsibilities, development of procedures, and allocation of resources to establish, implement, monitor, and maintain an effective environmental program aimed at achieving environmental objectives.

This Environmental Management Plan (EMP) has been prepared in accordance with recognized environmental management guidelines. It identifies key measures to prevent, minimize, or mitigate the potential environmental impacts of the proposed seismic survey activities in Zindan II Block, Bhakkar and Mianwali, Punjab.

8.2. Purpose of EMP

OGDC has been committed to implementing a comprehensive EMP to ensure the environmental protection through the project. The purpose of EMP is to:

- Ensure implementation of mitigation measures proposed in the EIA report;
- Provide a mechanism for taking timely actions for unanticipated environmental situations;
- Define the various roles, responsibilities and provide a means of effective communication regarding environmental issues among them;
- Provide concise and clear instructions to project personnel and contractors regarding procedures for protecting the environment and minimizing environmental impact;
- To prevent or minimize emissions, effluents, spills and dumping, etc. into air, water and soils for protecting the environment;
- Communicate changes in the program through the revision process;

8.3. Environmental Management Framework

Given the nature and scale of the proposed activities, certain environmental risks are inherent to the project. To manage these risks and reduce them to the lowest reasonably practicable level, a range of control measures will be implemented. OGDC is committed to conducting its operations in a manner that either eliminates or minimizes environmental risks as far as possible.

Environmental management for the project will be carried out within a comprehensive framework, which includes:

- OGDC Health, Safety and Environmental Policy Statement;
- Operational controls and specific environmental procedures within the project Environmental Management Plan (EMP); and
- Implementation of Environmental Management and Monitoring Plan.

8.4. Structure of EMP

The environmental management plan is divided into the following core components:

- Organizational Structure and Roles and responsibilities;
- Implementation of EMP
- Mitigation matrix
- Environmental Monitoring Plan
- Waste management plan
- Emergency response plan;
- Site Restoration Plan
- Change Management Plan
- Flood Contingency Plan

8.5. Organizational Structure and Roles and Responsibilities

8.5.1. Organizational Structure

The proposed project includes the following organizations:

- OGDC as the project proponent and owner of the EMP
- Contractors and Subcontractors
- Punjab EPD as regulatory body
- Independent Monitoring Consultant (IMC)

The general roles and responsibilities of OGDC and the Contractors are detailed in the following sections.

8.5.2. Project Proponent-OGDC

For the proposed project, OGDC will appoint contractor(s) for the project activities. The contractor(s) will be responsible for implementation of, or adherence to, all provisions of the EIA and the EMP and with any environmental and other codes of conduct required by OGDC. However overall responsibility for implementation of EIA recommendation and the EMP will rest with the proponent. The responsibilities of project / site in-charge would be to;

- Maintain ongoing liaison with the personnel involved in the project;
- Ensure that requirements of EIA and EMP are met during project execution.
- Ensure that prior to commencing work in the project area; all field personnel receive a formal induction;
- Ensure that employees are adequately supervised so that the environmental objectives are achieved;
- Ensure that no pets, firearms, traps and nets are kept by the contractors and their employees whilst in the project license area; during project activities.
- Ensure that regulatory requirements, including any specific conditions contained in the approval, are complied with;

8.5.3. Contractors and Subcontractors

Contractor(s) will be responsible for implementation of, or adherence to, all provisions of the EIA and the EMP and with any environmental and other codes of conduct required by OGDC. Site Manager of the contractor(s) will be responsible for the effective implementation of the requirements of EIA and EMP. However overall responsibility for implementation of EIA recommendations and the EMP will rest with OGDC's concerned departments.

8.5.4. Environmental Protection Agency

Punjab EPD as regulatory body is to oversee compliance with compliance with local environmental laws. According to Punjab environmental protection act, Punjab EPD has the powers to conduct surprise inspections or visits of the project area to observe the status of environmental compliance of the project.

8.5.5. Independent Monitoring Consultant (IMC)

As independent third party, the IMC will be responsible to independently monitor the compliance of project activities with EMP, EIA and environmental approval conditions. The IMC will share its findings on compliance with OGDC for further submission to Punjab EPA as desired or obligated.

8.6. Communication and Documentation

For effective monitoring, management and documentation of the environmental performance during the operation, environmental matters will be discussed during daily meetings held on-site. Environmental concerns raised during the meetings will be mitigated after discussions between OGDC and the contractors. Any issues that require attention of OGDC higher management will be communicated to them for action. OGDC and its contractors will ensure that the communication and documentation requirements specified in the EMP are fulfilled during the project.

8.6.1. Trainings

The key objective of the training program is to ensure that the requirements of the EMP and EIA recommendations are clearly understood and followed throughout the project. The trainings to the staff will help in communicating environment related restrictions specified in the EIA and EMP.

Contractor's HSE Advisor in coordination with OGDC site in-charge will determine the training requirements necessary for understanding and effective implementation of the EMP and the EIA. Contractor(s) will be responsible to disseminate the necessary training to relevant personnel.

Project personnel will be trained on various aspects of job safety to ensure sound management of occupational safety issues. They will also be trained on practices of protection of environmental aspects likely to be found susceptible to project activities such as indigenous flora and fauna, wildlife, water bodies and ecological resources etc. It will make sure that employees / workers understand the issues associated with the proposed activities. Trainings will be arranged on regular basis with notification that it must be attended by all employees / workers.

Trainings identified in EMP are given below:

- Site orientation course
- Training for emergency response and preparedness
- Training for familiarization with site environmental controls.
- Specific environmental training for relevant employees

A firefighting system shall be installed which will include firefighting water, foam generators and portable fire extinguishers. The personnel shall be trained on the use and operation of these systems. Equipment such as firefighting equipment, medical

equipment, ambulances and environmental protection and spill control equipment shall also be provided so that they are available in the event of an emergency. The aim is to instruct all personnel on the operation of this equipment and on the procedure to be followed in the event of spills, fire or explosions.

8.7. Project Planning and Design

8.7.1. Design of the Operation

The project involves oil and gas exploration activities in the selected areas of Zindan II Block. The project activities are described in detail in Section 2. If there is any change in design of the project after obtaining environmental approval, it will be managed as per the Change Management Plan provided in the EMP.

8.7.2. Approvals

Obtaining NOC from EPA does not relieve the proponent of other obligations and hence OGDC and its Contractors will obtain all relevant clearances and necessary approvals required by the government prior to commencing the operations.

8.7.3. Contractual Provisions

The requirements of this EIA in terms of environmental mitigation will be incorporated into the operational plans and procedures with contractors.

8.7.4. Coordination with Stakeholders

OGDC will ensure that coordination required with the project stakeholders on environmental and social matters as required by the EMP is maintained throughout the operation.

8.7.5. Environmental Management Systems

OGDC and the contractors will ensure that the mitigation measures mentioned in the EIA are adhered to and HSE Management System are implemented during the proposed project. The contractors will abide by the relevant contractual provisions relating to the environment.

8.7.6. Monitoring

OGDC and its contractors will ensure that monitoring of the project activities is carried out according to the monitoring program given in the EMP.

8.7.7. Emergency Procedures

OGDC will prepare contingency plans to deal with any emergency situation that may arise during the operation e.g. fire, major oil spills, medical evacuation, natural disasters and communicate these to the regulatory agencies if required by these agencies.

8.7.8. Restoration

OGDC will ensure that the restoration of the site after the end of seismic activities is carried out according to the requirements of the EMP.

8.7.9. Minimum Distances

Implementation of minimum distance criteria provides safety by preventing impact on the environment, community health safety and local infrastructure. The minimum distances are provided in table below which may be maintained from environmental features including communities, water sources etc. The contractor will ensure that these minimum distances are adhered to during the project operations and are monitored for compliance.

Table 8.1: Recommended Distances from Environmental Features	
Item	Distance
New access tracks	50m from all surface water sources 100m from cultural sites (including graveyard and shrines) 100m from villages
Campsite	500m from communities 500m from cultural sites (including graveyard and shrines) 500m from surface water bodies - Min. 500m from the protected area
Soak pits	300m from all surface/groundwater sources
Up-holes	30m from water wells 50-100m from houses 100m from Canals 50m from reptile hole (with soft start approach) 50m from bird nest (with soft start approach)
Shot holes	50m from water wells 50m from houses 100m from Canals
Sensitive habitats	500 meters

8.8. Proposed EMP reporting and reviewing procedures

For effective implementation of Environmental Management Plan, HSE matters will be discussed during daily meetings held on-site. Environmental concerns raised during the meetings will be mitigated after discussions between the OGDC Site In-charge, and relevant staff of contractor(s). Any issues that require attention of OGDC's higher management will be communicated for concurrence. The contractor will also prepare a weekly HSE report.

8.8.1. Weekly Reports

The purpose of these reports will be to review the performance of the operation by reviewing the number of non-conformances and the environmental incidents that occurred during the reporting period, progress on daily action items and to list recommendations for additional controls, mitigation measures or monitoring requirements. The main contents of weekly report will include the incident details, resource use, environmental non-compliances, H&S records, socioeconomic issues (if any), photographic records, inspection and audits, change managements (if any) and trainings etc.

8.8.2. Social Complaints Register

The OGDC site representatives will maintain a register of complaints received from local communities and measures taken to mitigate these concerns. Liaisons with community members including particularly the land owners/occupiers will be maintained throughout the project to identify and address the concerns of locals. Appropriate compensations will be provided to the grieved residents of the project area.

8.9. Mitigation Management Matrix

Mitigation Management Matrixes are provided in Table blow. The Mitigation Management Matrix will be used as a management and monitoring tool for implementation of the mitigation measures.

It is highlighted that although responsibilities for executing and monitoring mitigation measures have been delegated to contractors/ sub-contractors. OGDC will hold the primary and overall responsibility for ensuring full implementation of the EMP.

8.10. Environmental Monitoring

The Monitoring of different activities will be required to assess the impacts of activities on the environment. For this purpose;

- Follow the monitoring frequency of selected parameters as per the monitoring plan given in the Table below.
- Record all non-conformities observed and report them.
- Report any impact anticipated along with recommendations for further action.

Contractor(s) shall take note of the recommendations relating to issues arising during monitoring of proposed activities.

Table 8.2: Mitigation Management Matrix for Seismic Activities

No.	Impact and Mitigation Measures	Responsibility	Action/Monitoring Parameter/Monitoring Method	Timing
Impacts on Land Use				
1.1	Land uptake for the project will be kept to minimum.	OGDC / SC	Check land requirement for the project	Before land clearing
1.2	Need of construction will be reduced by considering use of pre-fabricated materials and portable units e.g. cabins, etc.	OGDC / SC	Consider pre-fabricated materials and portable units where possible	During Construction
1.3	Site restoration plan will be implemented upon project completion.	OGDC / SC	Monitor site restoration plan	After project completion
1.4	Dense patches of vegetation will be avoided by adjusting the location of campsites, base camps, fly camps and access tracks etc.	OGDC / SC	Monitor land clearing activities	During land clearing
1.5	Total land uptake by the camps and access tracks will be kept to the minimum required.	OGDC / SC	Approve camps and access tracks	Prior to track preparation
1.6	Clearing of vegetation will be kept to a minimum. Cutting of trees will be avoided.	OGDC / SC	Monitor land clearing activities	During land clearing
1.7	The preparation of tracks will be carefully planned and done. Where an access track can be prepared through compaction alone, it be considered accordingly. Otherwise, graveled surface will be prepared.	OGDC / SC	Approve access tracks	Prior to track preparation
1.8	It will be ensured that the selected route does not affect any habitats and cause habitat fragmentation or damage.	OGDC / SC	Ensure habitat protection	During route preparation
1.9	During the project, movement of survey vehicle/equipment will be restricted to work areas only to avoid unnecessary disturbance of soils in the project area.	OGDC / SC	Check compliance	During entire project
1.10	Preparation of new access tracks will be minimized and use of existing routes will be preferred as much as possible. Where improvement of existing tracks or development of short lengths of new tracks is unavoidable the width of the access track will not exceed 5 m.	OGDC / SC	Approve access tracks	Prior to track preparation
1.11	Vehicle speed will be regulated and monitored to avoid excessive dust emissions.	OGDC / SC	Speed limit boards and monitor vehicle speed	During entire project

1.12	Seismic camps will be located in existing clearing and levelled land, if possible. If this is unavoidable then the campsites will be located where minimum, land clearing is required.	OGDC / SC	Identify location of the campsite to the SC and CC	At the time of site selection for camp site
1.13	While travelling on banks of streams and watercourses slow speeds (not exceeding 20 km per hour or even lesser) will be maintained to avoid damage to the banks.	OGDC / SC	Check compliance	During entire project
1.14	Photographs will be taken before any activity to record the conditions of campsite, roads and seismic lines at locations that are likely to undergo soil erosion. Similar photographs will be taken at intervals throughout the survey to monitor any changes and soil conditions.	OGDC / SC	Supervise and ensure compliance	During the entire operation
1.15	Good engineering practices will be adopted during construction activities to ensure that unnecessary clearing of vegetation and disturbance to soils outside work areas are avoided.	OGDC / SC	Adopt good engineering practices	During construction
1.16	Seismic lines in undulating areas will be planned such a way to minimize disturbance to natural topography.	OGDC / SC	Avoid disturbance to natural topography	During entire project activities
1.17	During the construction phase, a single track shall be identified and approved along sections of the main track on which work is in progress. Vehicles shall be allowed to travel only on the approved track.	OGDC / SC	Approve access tracks	During construction
1.18	During construction stage, gravel should not be dumped on or close to the access track being improved or constructed such that it causes a hindrance in the movement of local vehicles (if any) and pedestrians.	OGDC / SC	Check compliance	During construction
Sensitive Areas/Protected areas				
2.1	Avoid seismic lines within protected areas wherever technically feasible.	OGDC / SC	Check compliance	During seismic survey
2.2	Maintain adequate buffer distances from wildlife sanctuaries and reserved forests in consultation with Forest and Wildlife Departments.	OGDC / SC	Check compliance	During entire project activities
2.3	Utilize existing roads and trails to minimize new land disturbance.	OGDC / SC	Approve access tracks	During entire project activities

2.4	Minimize vegetation clearance; prefer manual cutting over mechanical methods.	OGDC / SC	Check compliance	During entire project activities
2.5	Avoid cutting mature trees unless explicitly approved by the Forest Department.	OGDC / SC	Avoid tree cutting	During entire project activities
2.6	Separate and reuse excavated soil during restoration.	OGDC / SC	Check compliance	During restoration
2.7	Conduct pre-survey ecological walkthroughs to identify sensitive habitats and wildlife presence.	OGDC / SC	Baseline survey	Before project execution
2.8	Schedule operations during daytime hours to reduce disturbance to nocturnal species.	OGDC / SC	Avoid late night operations	During entire project
2.9	Restrict vehicle speed and movement within forest areas.	OGDC / SC	Speed limit signs and monitoring	During entire project
2.10	Prohibit hunting, trapping, or harassment of wildlife by project personnel.	OGDC / SC	Avoid wildlife hunting	During entire project
2.11	Use controlled, low-energy seismic sources near sensitive habitats.	OGDC / SC	Check compliance	During entire project
2.12	Avoid operations during wildlife breeding or sensitive seasons, where applicable.	OGDC / SC	Check compliance	During entire project
2.13	Limit workforce access to essential personnel only.	OGDC / SC	Check compliance	During entire project
2.14	Provide environmental awareness training to all workers regarding forest and wildlife protection.	OGDC / SC	Check compliance	Pre-construction
2.15	Install clear signage to mark protected and sensitive areas.	OGDC / SC	Check compliance	During entire project
2.16	Restore all disturbed areas immediately after survey activities.	OGDC / SC	Restoration and Rehabilitation of project area	After completion of project
2.17	Re-grade access tracks, refill shot holes, and stabilize soil to prevent erosion.	OGDC / SC	Restoration and Rehabilitation of project area	After completion of project

2.18	Re-vegetate disturbed areas using native plant species where necessary.	OGDC / SC	Plantation of native species	After completion of project
2.19	Implement regular environmental monitoring during seismic operations	OGDC / SC	Check compliance	During seismic operations
2.20	Coordinate closely with Forest and Wildlife Departments throughout the project.	OGDC / SC	Consultation with local forest and wildlife departments	During entire project
2.21	Ensure compliance with all applicable environmental and wildlife protection regulations.	OGDC / SC	Check compliance	During entire project
Soil & Water Contamination				
3.1	All vehicles will be inspected before clearing them for use during the project. Only fit and well-tuned equipment and machinery will be used during the project.	OGDC / SC	Check all the vehicles	Before the project
3.2	Fuel storage areas (if provided) will be built with secondary containment. All fuel containers will have adequate capacity and provided with liner sheets at the bottom.	OGDC / SC	Check compliance	During the construction of the fuel storage area
3.3	Regular monitoring of all fueling activities including fuel storage.	OGDC / SC	Monitoring of fuel storage and handling etc.	During the entire project
3.4	Any leakage will be immediately repaired and vehicle will be retained until the issues is rectified.	OGDC / SC	Check compliance	During the entire project
3.5	All fuel tanks will be properly marked to highlight their contents.	OGDC / SC	Check signs	During the entire Operation
3.6	Fuel and oil storage areas shall have secondary containment in the form of cemented or brick masonry bunds with plastered to prevent soil contamination in case of leaks or spills. The volume of the containment area will be equal to at least 110% of the total volume of fuel/oil stored or 110% of the volume of one largest tank. Secondary containment shall also have sump pit for collection of spillage material.	OGDC / SC	Check containment volume of the banded area	At the time of construction

3.7	Fuels tanks will be regularly checked for leaks and all such leaks will be plugged immediately.	OGDC / SC	Inspect fuel tanks for leaks	During the entire Operation
3.8	The soil contaminated from spills will be collected and handed over to Punjab EPD approved waste contractor for disposal.	OGDC / SC	Check compliance	During the entire operation
3.9	A spill prevention and contingency plan will be prepared to deal with moderate and major spills.	OGDC / SC	Spill control plan	Before construction
3.10	Shovels, plastic bags, and absorbent material should be present near fuel and oil storage or handling areas to attend spills and leaks.	OGDC / SC	Check compliance	During the entire operation
3.11	During fuel and oil transfer operations such as refueling bulldozers through a dedicated fuel vehicle, drips and spills will be avoided and drip pans will be used.	OGDC / SC	Ensure provision of drip pans provides training on safe refueling practices, monitor oil or fuel stains	During the entire Operation
3.12	Vehicles will only be serviced in designated cemented paved washing areas within campsites.	OGDC / SC	Designated washing area for vehicles	During entire project
3.13	Bentonite mud used for the purpose of up-hole and deep-hole drilling will be prepared in earthen pits. The used mud will be disposed of in the same pit and left to dry. After the mud has dried the pit will be backfilled.	OGDC / SC	Monitoring preparation and disposal	During deep hole and uphole drilling
Ambient Air Quality				
4.1	Dust emissions during construction activities should be minimized by good management practices such as locating stock piles out of the wind direction, keeping the height of the stock piles to a minimum, keeping earthwork areas damp, etc.	OGDC / SC	Check compliance	During construction
4.2	During construction, levelling or widening (for the access road) will be done in sections, immediately followed by sprinkling of water and also preferably compaction (where required).	SC/ OGDC Exploration	Monitor sprinkling of access track	During construction
4.3	During operation dust emissions due to road travel will be minimized by regulating vehicle speeds and watering of the access track (where required).	OGDC / SC	Set and monitor speed limits. Monitor sprinkling of access track	During the entire operation

4.4	Minimize the amount of disturbance and areas cleared of vegetation.	OGDC / SC	Check compliance	During entire project
4.5	Burning of waste and combustible material at the project site will be strictly prohibited.	OGDC / SC	Don't burn any kind of waste and combustible materials	During entire project
4.6	Generators, compressors and vehicles used during the operations will be maintained in a good condition to ensure that emissions are kept to a minimum level (compliant with PEQS standards).	OGDC / SC	Check maintenance logs	During the entire operation
4.7	Cover construction materials and stockpiled soils if they are a source of fugitive dust.	OGDC / SC	Check compliance	During construction
4.8	During seismic operations vehicle speeds will be regulated and monitored to minimize dust emissions.	OGDC / SC	Set and monitor speed limits	During seismic operations
4.9	Keep soil loads below the freeboard of the truck.	OGDC / SC	Check compliance	During entire project
4.10	Minimize drop heights when loaders dump soil into trucks.	OGDC / SC	Check compliance	During entire project
4.11	Campsites will be located at 500 m away from major residential communities.	OGDC / SC	Check distances of camp site from communities	Prior to construction of camp sites
4.12	Keep soil moist, if it is a source of fugitive dust, while loading into dump trucks and cover it with tarpaulin during transportation.	OGDC / SC	Soil should be moist and covered during transportation	During entire project
4.13	During operation phase, emissions from all point sources should also be monitored to check compliance with PEQS.	OGDC / SC	Check compliance	During operation phase
Noise pollution				
5.1	Camp site will be located at 500m away from the major residential community.	OGDC / SC	Check compliance	During entire project
5.2	The use of horns by project vehicles shall be minimized. The use of pressure horns shall not be allowed.	OGDC / SC	Do not use pressure horns	During entire project
5.3	Generators will be kept within enclosures to minimize dispersion of noise.	OGDC / SC	Check compliance	During entire project

5.4	During all operations generators, vehicles and other equipment and machinery will be maintained in good condition to ensure that noise from them is kept to a minimum level.	OGDC / SC	Maintenance of all equipment's, vehicles, generators and machinery	During entire project
5.5	Position all stationary sound-generating equipment (i.e. pumps and generators) as far as possible from nearby residences and other sensitive receptors.	OGDC / SC	Check compliance	During entire project
5.6	Whenever feasible, schedule diverse noisy activities (e.g. excavation, earthmoving) to occur at the same time, since less-frequent noisy activities would be less irritating than frequent less noisy activities.	OGDC / SC	Check compliance	During entire project
5.7	All equipment should have sound-control devices.	OGDC / SC	Check compliance	During entire project
5.8	Route heavy truck traffic away from residences and other sensitive receptors.	OGDC / SC	Avoid heavy trucks into residential area and other sensitive areas	During routing
5.9	It shall be assured that generators, vehicles and other potentially noisy equipment used will be in good condition.	OGDC / SC	Check and monitor generators, and vehicles	During entire project
5.10	In areas with higher noise levels or longer shifts, use of ear plugs and earmuffs will be ensured among the workers.	OGDC / SC	Ensure the provision of PPEs to workers	During entire project
5.11	Noise levels at communities nearest to the campsites and access tracks shall be monitored by contractor. In case these are found to exceed safe acceptable limits appropriate mitigation shall be taken.	OGDC / SC	Monitor the noise level at communities	During construction and operation
5.12	Movement of all project and personnel vehicles shall be restricted within work areas.	OGDC / SC	Check compliance	During entire project
Wastewater				
6.1	All wastewater streams (greywater and Blackwater) from campsite will be collected onsite in septic tank system comprising of septic tanks and soak pits.	OGDC / SC	Establishment of septic tanks and soak pits for wastewater streams	During entire project
6.2	The collected storm water can be used for activities e.g. dust suppression.	OGDC / SC	Rainwater harvesting and using for water sprinkling	During construction and seismic exploration

6.3	If not contaminated, the runoff may be released from site.	OGDC / SC	Check compliance	During entire project
6.4	Black water shall be stored in the septic tanks and excess wastewater shall be disposed of after treatment in septic tank/ soak pit (within permissible limits as per PEQs) in the local drains after taking approval from concerned TMA.	OGDC / SC	Wastewater treatment and disposal after approval from concerned TMA	During entire project
Use of Water				
7.1	Water from a local well will only be used after ensuring that the available capacity at the tube well (safe yield minus local demand) is at least 50% greater than the project demand. Discharge from the tube wells will be regularly monitored to supervise any changes in the yield of the wells. If a single well fails to meet this requirement, water will be obtained from multiple wells such that each well meets the above-mentioned requirement.	OGDC / SC	Check local demand and water abstraction	During entire operation
7.2	For all water obtained from local wells, the owner will be paid for water abstracted at the market rate.	OGDC / SC	Check compliance	During entire operation
7.3	A complete record of water consumption during seismic and construction of camps will be maintained.	OGDC / SC	Check compliance	During the entire Operation
7.4	The use of new water wells installed or to be installed by OGDC for community benefits will be allowed.	OGDC / SC	Check compliance	Before the start of the operation
7.5	The quantity of water used during seismic and camp construction operation will be kept to the minimum required by taking prudent water conservation measures on site.	OGDC / SC	Monitor water consumption and advise water conservation measures	During the entire operation
7.6	Contamination of surface and groundwater resources will be avoided.	OGDC / SC	Check compliance	During the entire project
Occupational Health and Safety Hazards				
8.1	All operations will be conducted in compliance with OGDC HSE policy as well as industry best practices.	OGDC / SC	Ensure OGDC HSE policy and best industry practices	During the entire project

8.2	Appropriate and well-stocked first aid kits and firefighting equipment will be available to all crew, and specific crew members should be trained on first aid administration and handling of firefighting equipment.	OGDC / SC	Provision of first aid kit and training of first aid and firefighting	Before the project
8.3	Risk Assessment/ JSAs will be carried out for each activity.	OGDC / SC	Check compliance	Before any activity
8.4	Job-specific personal protective equipment to be provided to the workers, training should be given, and their use made mandatory in designated areas.	OGDC / SC	Provision of PPEs, and trainings to the workers	Before the construction and exploration activities
8.5	A Base Camp Clinic will be provided, manned by suitably qualified field medical staff equipped with equipment and medication as appropriate, including ambulance vehicle(s).	OGDC / SC	Establishment of fully equipped clinic	During pre-construction
8.6	Adequate warning or cautionary signage will be posted as required.	OGDC / SC	Warning sign boards	Before the construction and exploration activities
8.7	All electrical equipment shall be properly installed, earthed and regularly inspected.	OGDC / SC	Check compliance	During electrical works
8.8	Only properly trained and authorized employees shall operate equipment or machinery.	OGDC / SC	Assigned well trained employees for equipment's and machinery handling	During construction and exploration activities
8.9	Provision of an Emergency Response Plan, Evacuation Plan, Medevac Plan, and Flood Management Plan will be implemented in all concerned situations.	OGDC / SC	Emergency Response Plan Evacuation Plan Medevac Plan Flood Management Plan	During all project activities
8.10	Personnel on seismic survey operations and those on transit around the project area will be provided armed escort.	OGDC / SC	Check compliance	During all project activities

8.11	Adequate site induction of all new personnel shall be done before starting with project.	OGDC / SC	Check compliance	Before starting the project
Cultural Resources/Sites of Archaeological Significance				
9.1	All contractors and field staff will receive training on the importance of cultural heritage and the procedures to follow if artifacts or historical sites are encountered.	OGDC / SC	Trainings to all contractors and field staff	Before starting the project
9.2	Regular field inspections will be conducted to ensure that seismic operations do not encroach upon or disturb known heritage areas.	OGDC / SC	Conduct field inspection	During the entire construction and operation
9.3	If any archaeological or cultural artifacts, structures, or sites are discovered during survey activities, contractors must immediately report to OGDC and halt work in the immediate vicinity.	OGDC / SC	Check compliance	During the entire construction and operation
9.4	Relevant heritage authorities, such as the Department of Archaeology and Museums, Punjab, will be notified to evaluate the significance of the findings and guide further action.	OGDC / SC	Consultation with the relevant heritage authorities	Before the project
9.5	Temporary barriers or fencing may be installed around newly discovered sites to prevent damage or disturbance until formal assessment is completed.	OGDC / SC	Check compliance	During entire project
9.6	All discovered artifacts or sites should be documented through photographs, GPS coordinates, and brief descriptions before any intervention, in coordination with heritage authorities.	OGDC / SC	Check compliance	During entire project
9.7	Seismic operations in the affected area can only resume once the heritage authorities have completed their assessment and provided clearance.	OGDC / SC	Check compliance	During entire project
Site Restoration				
10.1	Demobilization of all equipment and machinery.	OGDC / SC	Check compliance	During site restoration
10.2	Disposal of any waste material remaining at the time of completion of the operation.	OGDC / SC	Check compliance	During site restoration
10.3	Restoration of seismic lines will include removal of all cables, geophones, station units, flags, stakes and wastes from the lines and back filling of all mud pits.	OGDC / SC	Check compliance	During site restoration

10.4	All the fencing or barriers surrounding the seismic base camp area will be removed, and the area will be levelled. The concrete structures if desired by the land owner will be left intact. If not, the concrete will be broken up and disposed or reused for backfilling of pits / septic tank (below main rooting zone, 1 - 1.5 m) or provided to locals for re-use.	OGDC / SC	Check compliance	During site restoration
10.5	Dispose the waste water of septic tanks in environmentally friendly manner and restore it after dismantling in place (top roof and at least 1 meter wall or more if easily possible) and backfilling with at least 1 meter of native soil cover. Dispose sludge from septic tank in an environment-friendly manner.	OGDC / SC	Check compliance	During restoration
10.6	Restore soak pit after removing / handling of wastewater & cover and backfilling it with at least 1 meter of native soil cover. Dispose wastewater of soak pit in an environment-friendly manner.	OGDC / SC	Check compliance	During restoration
10.7	Contaminated bricks of black / grey water pits and others shall not be given to locals for any purpose.	OGDC / SC	Check compliance	During restoration

Note: SC: Seismic Contractor

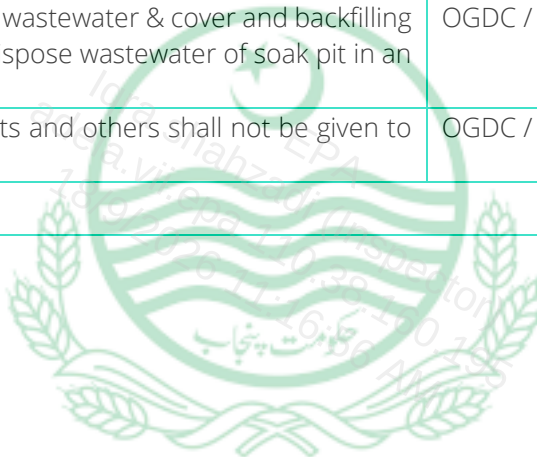


Table 8.3: Environmental Monitoring Plan for Seismic Activities

S. No.	Monitoring Aspects	Monitoring locations	Parameters	Frequency	Responsibility	Documentation
1	Exhaust and Emissions Monitoring	Vehicles, Generators & Fuel operated Machinery	CO, Smoke and Noise for Vehicles CO, NO _x , SO ₂ and PM for engine / generator.	Annually	OGDC / SC	Laboratory test Reports
2	Effluent/ Wastewater	Campsite	Effluent Flow, Temperature, pH, COD, BOD5, TSS, TDS, Oil & Grease, Chloride & Phenolic Compounds	Quarterly (if wastewater discharged into any nullah)	OGDC / SC	Laboratory test Reports
3	Noise level	Boundaries of the camp sites	Noise level (dBA)	Quarterly	OGDC / SC	Internally / externally
4	Solid Waste	Project site	Solid waste collection, storage, transportation and disposal	Daily	OGDC / SC	Complete record waste generation record, waste disposal record & disposal certificate)
5	Occupational Safety	Campsite, project roads	HSE Records, Incidents and injuries	Daily	OGDC / SC	Record of observations.

8.11. Water Management Plan

All water demanding activities will be diligently planned and reviewed for efficacy keeping in view the water stress in project area. All water sourcing and consumption activities will be done in an environmentally sustainable manner such that local water supplies are not compromised. All water sourcing will be registered and record of water consumption and disposal shall be maintained.

Where new wells are required, the site will be selected in a way that acquirers under community use are not affected. Deep acquirers will be tapped and flow meters installed to monitor the water abstraction from the well. Develop procedures for water abstraction to avoid adverse impacts on aquatic ecosystems or other water users. Procedures for water abstraction will be developed and adopted to avoid adverse impacts on aquatic ecosystems or other water users. Alternate water sources will be utilized to the best e.g. rainwater harvesting, use of grey water and AC condensate etc. Activities like washing of vehicles will be scheduled and criteria will be set for all such activities to prevent water usage where possible.

8.12. Change Management Plan

8.12.1. Change in Operations

Any change in the project design or project operation if required will be made in relevance to the EMP and all the impacts associated with changed process will be either similar to the existing impacts and if different will be assessed and included in the mitigation management plan.

8.12.2. Change in Record Register

A record register will be maintained at the project site at the start of project activities. All the changes to be made will be recorded in this register. This will assist in the step-by-step environmental monitoring and decision-making. Record register will be the responsibility of concerned department. and will be used internally.

8.12.3. Change in EMP

Changes in project design necessitate changes in the EMP. In this case, following actions will be taken:

- A meeting will be held between Site OGDC Incharge and staff of the contractor, to discuss and agree upon the proposed change to the EMP.
- Based on the discussion during the meeting, a report will be produced, which will include the additional EMP clauses.
- Additional EMP clauses will be added to the original EMP as a second volume which will be distributed to the relevant staff of OGDC and contractor.

8.13. Grievance Redressal Mechanism

For local community grievances, three modes of communication and outreach will be available:

1. Public Hearings

2. Outreach programs
3. Grievance Mechanisms

All grievances are addressed in accordance with company policy and legal requirements. Regular stakeholder engagement will be done to test and strengthen the protocols. The focal person details for dispute resolution will be displayed prominently at the project operational sites to enable ease of access and contact for the local communities to approach the concerned person for dispute resolution.

8.14. Site Restoration Plan

- After completion of the proposed geophysical investigation survey activities, the campsite, up-holes etc. will be restored to as similar to original condition as possible.
- For reference purpose a photographic record of the campsite prior to the set-up will be taken.
- Demobilization of all equipment and machinery.
- Disposal of any waste material remaining at the time of completion of the operation.
- Restoration of seismic lines will include removal of all cables, geophones, station units, flags, stakes and wastes from the lines and back filling of all mud pits.
- All the fencing or barriers surrounding the base camp area will be removed, and the area will be levelled. The concrete structures if desired by the landowner will be left intact. If not, the concrete will be broken up and disposed, reused for backfilling of pits/septic tank (below main rooting zone, 1 - 1.5 m) or provided to locals for re-use.
- Remove wastewater from septic tank and restore it after dismantling in place (top roof and at least 1 meter wall or more if easily possible) and backfilling with at least 1 meter of native soil cover.
- Restore soak pit after removing / handling of wastewater & cover and backfilling it with at least 1 meter of native soil cover.
- Contaminated bricks of black/grey water pits and others will not be given to locals for any purpose.

8.15. Emergency Response Plan

Contingency planning requires those emergency plans and procedures that can be put into action quickly as soon as unexpected events occur. Poor contingency planning can result in delayed or ineffective response to unexpected events. In turn, this delay could result in short-term and long-term environmental impacts and threats to public safety and convenience. Possible emergency situations during proposed activities include:

Possible risks arising from operational conditions or human error that could result in accidents, such as:

- Uncontrolled material leak into the atmosphere.
- Fire/explosions.
- Occupational accidents (serious or fatal), due failure to comply with operating rules and procedures, negligence of the personnel, falls, onsite accidents caused by equipment, burns, inappropriate use of equipment and personal protection items.
- Environmental Contamination (due to material leaks/spill into the environment). Spillage of fuel, oil, gas, chemicals and hazardous materials.

- Natural Risks that may affect the facilities and their resulting damage to property and the person (Earthquake, Typhoon/Cyclone, Lightening, Flash flooding etc.)
- External Risks arising from delinquent actions, terrorism, or vandalism.

Emergency situations are possible even with proper planning, design and implementation of correct procedures and personnel training. Project contractors will develop a site-specific emergency response plan and submit it to OGDC for review.



9. CONCLUSION

The project proposed by Oil and Gas Development Company includes 2D seismic activities to explore the presence of new hydrocarbon reserves in Zindan II Block. The total area of the block is 951 km², of which 534 km² falls within the administrative jurisdiction of Tehsil Piplan, District Mianwali, and 417 km² falls within Tehsil Kalur Kot, District Bhakkar. Approximately 400-line km of seismic surveys will be carried out by OGDC for the identification and exploration of oil and gas resources within the block.

Pakistan is striving through a severe energy crisis that has directly and indirectly affected all sectors of the economy over the past decade. Pakistan generates its power from an energy mix that includes oil, gas (natural gas and liquefied natural gas, LNG), coal, renewable sources (solar, wind and hydro energy), nuclear, and biomass. Pakistan's energy sector is heavily dependent on imported fuel (oil and LNG). Pakistan meets about 80% of its gas and 15% of its oil demand from local sources. In the 2022-23 fiscal year, oil production was 69,513 barrels per day, while gas production reached 3,259 million cubic feet per day. The remaining demand has been met through imports, which puts pressure on the balance of payments⁹.

In order to assist the economic development and reduce the import bills, there is a dire need to explore and increase the domestic production of oil and gas. The proposed exploration activities would help to achieve this goal besides having a positive impact on socioeconomic conditions as it would provide more job opportunities to the local people and generate opportunities for more business.

In order to assess the environmental and socioeconomic impacts of the proposed project activity the EIA study has been conducted to evaluate the impacts and propose mitigation measures. The findings from the study conducted have been categorically recorded and presented in this report.

A baseline survey of the project area conducted by the EIA study team provides the basis of establishing profiles of natural, socioeconomic and cultural environments which might be impacted by project activities. The proposed exploration activities will not be conducted in any protected area unless approval from the concerned department has been obtained. All the requirements have been addressed in this EIA, which has covered the following:

- The proposed project activities;
- Alternatives considered in finalizing the project description;
- Environmental conditions of the project area;
- Legislative requirements related to the project;
- Potential environmental impacts of the proposed project activities on the physical, natural and socio-economic receptors;
- Mitigation and monitoring measures that will help in avoiding or minimizing these impacts.

All activities associated with the proposed project have been reviewed and their possible impacts methodically analyzed. A comprehensive Environmental Management Plan has

⁹ <https://ppisonline.com/wp-content/uploads/2023/09/Investment-Brochure-2023.pdf>

been put together and provided in the report for adherence which will ensure the evasion of environmental degradation or contamination.

Screening of potential impacts from the project activities finds that:

- The project's impacts on the ambient environment will be short term and mostly localized.
- The project location (location of seismic lines) is safely away from key sensitive receptors e.g. settlements, infrastructure, water bodies etc.
- Vegetation density of the site and surroundings is moderate to low. The predominant vegetation type of the area includes scrub forest. Project activities will not significantly affect the vegetation density of the area.
- Animal density in the project area is moderate and contains some endangered and vulnerable species and the faunal density is low near the settlement/ agricultural lands.
- Impact from project related transportation activities can occur in areas falling close to communities. Adoption of safe driving practices and careful scheduling of activities will be required near these areas.
- The project is not water intensive, the impact on area's water availability is not expected from project's water consumption. However, water conservation measures will still be adopted to prevent any unanticipated impact.
- Socioeconomic impacts on micro-scale would be insignificant if any. Social issues like removal of existing business, property and resettlement are not anticipated from any project activity.

Based on the risk assessment carried out for the project, it is recommended that:

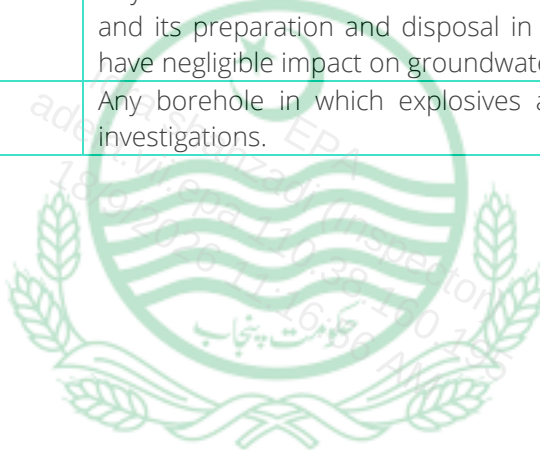
- The impact on animal life can be prevented by careful clearance, excavation works and adopting a "No Hunting, No trapping" Policy.
- Temporary inconveniences due to construction works are minimized through planning and coordination with local population and organizations in the neighborhood.
- Environmental Performance Monitoring is made an integral part of the Project to ensure environmental safeguards.
- Water conservation practices may be adopted at all stages of project.

A series of mitigation and monitoring measures have been included to address the concerns for these measures. Assuming effective implementation of the mitigation measures and monitoring requirements as outlined in the Environmental Management Plan, the adverse environmental and social impacts of the proposed Project activities are likely to be within the acceptable limits. The project is not expected to have long-term significant or irreversible negative environmental impacts neither at the construction, nor at operation phases.

It is thus recommended that the EIA for the proposed project be approved with the condition that all corrective and mitigation measures proposed in this report will be implemented with diligence. The provided EMP in the report will provide guidelines and measures to ensure sustainable and eco-responsible execution of the project activities.

APPENDIX-I: GLOSSARY & DEFINITION

Client /Proponent: Oil and Gas Development Company Limited	
Proposed Project:	Oil & Gas Exploration Activities in Zindan-II Block (EL 3271-9), Punjab Province
Environmental Consultant:	EMC Pakistan Private Limited
Project Site/Area:	District Bhakkar and Mianwali, Punjab
EPD	Environment Protection Department
Study	Environmental Impact Assessment (EIA)
Seismic Vibrator:	A seismic vibrator is a truck-mounted or buggy-mounted device that is capable of injecting low-frequency vibrations into the earth
Geophones:	A device used in surface seismic acquisition, that detects ground velocity produced by seismic waves and transforms the motion into electrical impulses.
Bentonite mud:	Bentonite mud will be used during seismic operations for drilling of up holes and deep holes to avoid the holes from collapsing. The mud and the cuttings will be disposed of into earthen pits backfilled after drying the mud and cuttings. This mud is prepared by mixing bentonite with water. Bentonite is a natural clay material and non-hazardous in nature. The use of the mud and its preparation and disposal in earthen pits will therefore have negligible impact on groundwater or soil quality.
Shot hole	Any borehole in which explosives are detonated for seismic investigations.



APPENDIX-II: ABBREVIATIONS

Abbreviation	Explanation
API	American Petroleum Institute
BOD	Biological Oxygen Demand
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species
CMS	Convention on Migratory Species
COD	Chemical Oxygen Demand
CSR	Corporate Social Responsibility
DGPC	Directorate General of Petroleum Concessions
E&P	Exploration and Production
EHS	Environment, Health & Safety
EIA	Environmental Impact Assessment
EL	Exploration License
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
ERP	Emergency Response Plan
ESG	Environmental, Social & Governance
GOP	Government of Pakistan
GPS	Global Positioning System
HAWS	Hand-Arm Vibration Syndrome
HSD	High Speed Diesel
HSE	Health, Safety and Environment
IFC	International Finance Corporation
ISO	International Organization for Standardization
IUCN	International Union for Conservation of Nature
LSO	Louisiana Statewide Order
NCS	National Conservation Strategy
NDC	Nationally Determined Contribution
NEAP	National Environmental Action Plan
NFPA	National Fire Protection Association
NGOs	Non-Government Organizations
O&G	Oil and Grease
OGDC	Oil & Gas Development Company Limited
PCA	Petroleum Concession Agreement
PEPA	Pakistan Environmental Protection Agency
PEQS	Punjab Environmental Quality Standards
PPC	Pakistan Penal Code
PPE	Personal Protective Equipment
PPEPCA	Pakistan Petroleum Exploration and Production Companies Association
PPIS	Pakistan Petroleum Information Service
SC	Seismic Contractor
SDGs	Sustainable Development Goals
SOE	State Owned Enterprise
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UFCCC	United Nations Framework Convention on Climate Change

APPENDIX-III: LIST OF INDIVIDUALS AND ORGANIZATIONS CONSULTED ALONG WITH THEIR WRITTEN FEEDBACK

S. No.	Stakeholder Groups	Department	Name and Designation
1	Government Departments	Environmental Protection Agency, Bhakkar	Mr. Hafiz Ghulam Abbas Assistant Director
		Environmental Protection Agency, Mianwali	Mr. Muhammad Ikram UDC
		Forest Department, District Bhakkar	Watchers
		Forest Department, District Mianwali	Muhammad Aqib Khan Forester
		Wildlife Department, District Bhakkar	Mr. Ghulam Muhammad Shahid Incharge Manager
		Wildlife Department, District Mianwali	Mr. Amjad Hussain Naib Qasid
2	Environment practitioners and experts	NUST Islamabad	Professor, Department of Environmental Sciences, NUST, Islamabad

Written Feedback Form: Consultation with Local People
Project: Oil & Gas Exploration Activities in Zindan-II Block (EL 3271-9), Punjab Province

Sr No	Name	Occupation	Area/Residence	Feedback	Signature
1.	M. Ashim	Farmer	Ghangra	اگر منصوبہ سے متعلق کوئی اور اثر ہو گا تو اس سے ہم کو کوئی نقص نہیں پہنچے گا۔	Ashim
2.	Abdul Rehman	Shopkeeper	Ghangra	جیسے کہ میں نے آج کے دوران کوئی اور اثر نہیں دیکھا ہے۔	Abdul Rehman
3.	Bashir Ahmad	Farmer	Harnoli	مقامی لوگوں کو کوئی اور اثر نہیں پہنچے گا۔	Bashir Ahmad
4.	M. Younis	Teacher	Harnoli	اگر ماحولیات کو کوئی اور اثر ہو گا تو اس سے ہم کو کوئی نقص نہیں پہنچے گا۔	M. Younis
5.	Ghulam Mustafa	Farmer	Hayfawala	کمیٹی کو چاہیے کہ پانی کے وسائل کو آلودہ نہ کرے۔	Ghulam Mustafa
6.	M. Iqbal	Laborer	Hayfawala	اس منصوبہ سے (وزارت کے مطابق) کوئی اور اثر نہیں پہنچے گا۔	M. Iqbal
7.	Khalid Mahmood	Shopkeeper	Piplan	ہم زمین اور فلاحی و تعلیمی فن کے لیے اس منصوبہ سے کوئی اور اثر نہیں دیکھ رہے ہیں۔	Khalid Mahmood
8.	M. Tariq	Farmer	Piplan	کمیٹی کو چاہیے کہ چٹائی مشینوں اور مشینوں کو سولیاں توڑنے سے روک دے۔	M. Tariq
9.	Sajid Hussain	Driver	Kallurkot	منصوبہ کے دوران شریف اور سولہ کو کنٹرول کیا جائے گا۔	Sajid Hussain

10.	M. Nawaz	Farmer	Kallari Kot	مقامی نوجوانوں کو لکڑی میں شریک دیا جائے۔	Nawaz
11.	Shoukat Ali	Laborer	Akram Wala	اگر کہیں مقامی شریکائی کام ہی کرے تو علاقے کے لوگ اس منصوبے کی حمایت کریں گے۔	Shoukat Ali
12.	Ghulam Haider	Farmer	Akram Wala	کام کے دوران ماحولیات کے اصولوں پر عمل کرنا ضروری ہے۔	Ghulam Haider
13.	M. Ramzan	Shopkeeper	Rodi	منصوبے میں علاقے کی مقامی حالت بہتر ہونے کی امید ہے۔	M. Ramzan
14.	Liakat Ali	Farmer	Rodi	کہیں کو چاہیے زمین اور پانی کے تحفظ کو یقینی بنائے۔	Liakat Ali
15.	M. Shahid	Teacher	Chandni Chowk	اگر مقامی آبادی کو اعتماد میں لیا جائے تو منصوبہ کامیاب ہو سکتا ہے۔	M. Shahid
16.	M. Asif	Laborer	Chandni Chowk	دروازے کے مواقع فراہم ہوں تو یہ منصوبہ علاقے کے لیے مفید ہوگا۔	M. Asif
17.	Imran Khan	Farmer	Mahmood Wala	کہیں کو چاہیے کہ کام کے دوران دھواں اور شور کم کریں۔	Imran Khan
18.	Nasir Ahmad	Shopkeeper	Mahmood Wala	مقامی لوگوں کو ملازمتوں میں شریک دینا چاہیے۔	Nasir Ahmad
19.	M. Bilal	Student	Piplan	اگر ماحولیات کے تحفظ کو یقینی بنایا جائے تو منصوبہ قابل عمل ہوگا۔	M. Bilal
20.	Abdul Qader	Farmer	Aarnoli	کہیں کو چاہیے کہ مقامی مسائل کو مدنظر رکھ کر منصوبہ رابطہ بہتر کر دے۔	Abdul Qader

21.	M. Saleem	Driver	Kallari Kot	منصوبہ علاقے کی ترقی اور دروازے کے مسائل کو حل کرے۔	M. Saleem
22.	Shabbir Ahmad	Farmer	Ghanjra	فجروں اور زمین کے تحفظ کو یقینی بنایا جائے۔	Shabbir Ahmad
23.	Asif Ali	Shopkeeper	Piplan	کہیں کو چاہیے کہ مقامی مسائل کو مدنظر رکھ کر منصوبہ رابطہ بہتر کر دے۔	Asif Ali
24.	M. Akram	Laborer	Akram Wala	دروازے کے مواقع میں تو یہ اس منصوبے کی حمایت کریں گے۔	M. Akram
25.	M. Zubair	Teacher	Rodi	ماحولیات کے اصولوں پر سختی سے عمل کرنا چاہیے۔	M. Zubair
26.	Tariq Mahmood	Farmer	Hafiz Wala	پانی کے وسائل کو محفوظ رکھا جائے۔	Tariq Mahmood
27.					
28.					
29.					
30.					

APPENDIX IV: SOURCES OF DATA AND REFERENCE MATERIAL

- Geological Survey of Pakistan
- Pakistan Meteorological Department
- Field Surveys Conducted in Project Area
- Environmental Monitoring Conducted in Project Area
- Pakistan Social and Living Standards Measurement Survey
- Pakistan Bureau of Statistics
- Punjab Bureau of Statistics
- Punjab Agriculture Department
- Revenue Department, Government of the Punjab
- OGDC's Annual & ESG Reports available online (<http://www.ogdcl.com/>)



APPENDIX V: TERMS OF REFERENCE

Title: Oil & Gas Exploration Activities in Zindan-II Block (EL 3271-9), Punjab Province

Location: District Bhakkar and Mianwali

Project Proponent: Oil and Gas Development Company Limited

Project Description:

This document presents the findings of an Environmental Impact Assessment (EIA) carried out by EMC Pakistan (Pvt.) Limited for the project "Oil & Gas Exploration Activities in Zindan-II Block (EL 3271-9), Punjab Province" proposed by Oil & Gas Development Company limited (OGDC). The proposed project includes 2D Seismic Survey to acquire seismic data for the exploration of hydrocarbon in Zindan-II Block. The total area of Zindan-II Block is over an area of 400 L. km approx. The proposed 2D seismic survey will be carried out in districts Bhakkar and Mianwali of Punjab.

The objective of proposed project is to collect stratigraphic information of subsurface structures which can be analyzed to identify potential oil & gas reservoirs and to enhance the production of fossil-fuels to reduce energy deficiencies of the Pakistan.

The project involves various activities associated with 2D seismic survey; scope of the project involves:

- Temporary land acquisition (on rent)
- Construction of access road
- Development of camp-sites (base-camp and fly-camp if required)
- Mobilization of seismic crew
- 2D Seismic Survey/ Data Acquisition
- Restoration and rehabilitation of disturbed land

EIA Requirement:

- Section 12 of Punjab Environmental Protection Act, 2012 (amended 2017)
- Punjab Environmental Protection Agency (Review of IEE and EIA) Regulations, 2022

Objectives:

To obtain environmental approval as required under Section 12 of Punjab Environmental Protection Act, 2012 (amended 2017)

Scope of EIA:

- Complete description of the project
- Collection, analysis and presentation of baseline data
- Identification of significant environmental issues
- Assessment of direct, indirect impacts on environment
- Mitigation measures to minimize predicted adverse impacts
- Review of the relevant Policies, Legislations and Regulations
- Environmental Management and Monitoring plan
- Conclusion & Recommendations

APPENDIX-VI: LIST OF NAMES, QUALIFICATIONS AND ROLES OF TEAM MEMBERS CARRYING OUT THE IEE/EIA STUDY

S#	Name of Experts	Position in EIA Study Team	Role and Responsibility
1.	Asif Shuja Khan	Team leader	Overall Management of Project
2.	Ms. Farhat Shaheen	Senior Environmentalist	Technical Review of Report
3.	Dr. Muhammad Mohiuddin	Senior Environmentalist	Overall team coordination Technical Review of Report
4.	Mr. Owais Ahmad	Environmentalist	Baseline survey and monitoring Risk Assessment Development of EMP Assistance to senior team members in data collection Reporting
5.	Ms. Ayesha Noor	Environmentalist	Assistance to senior team members in report writing Secondary data collection



APPENDIX-VII: APPROVALS FROM CONCERNED DEPARTMENTS

- Approval from EPD has been applied.





Annexure I: OGDC HSE Policy





OIL AND GAS DEVELOPMENT COMPANY LIMITED

Occupational Health, Safety, and Environment Policy Statement and Commitment

As a responsible oil and gas E&P company, we are committed to embrace Health, Safety and Environment (HSE) in all our activities. The emphasis on HSE management is crucial to our operational requirement and to maintain market reputation. In carrying out our multidimensional activities, we also ensure welfare of indigenous communities, protection of ecosystems and environment. As we continue to avail exploration and production opportunities on a sound foundation of technical and financial prudence, we intend to:

- Exhibit visible leadership at each level and ensure necessary resources, trainings and infrastructure are in place for aiming HSE excellence.
- Identify hazards and ensure effective controls to manage operational risks.
- Ensure that our entities meet or exceed applicable HSE laws, regulations, standards and other requirements.
- Set objectives and targets to safeguard humans & assets, protect environment and conserve energy & natural resources.
- Ensure that Contingency Plans are in place for business continuity.
- Provide employees with self-assured methods & practices, authority to stop unsafe work & motivation through rewards and recognition.
- Employ contractors and service companies who aspire to the high HSE standards at all times, and recognize that HSE is everyone's responsibility.
- Improve HSE system by continually focusing on Leading Indicators and disseminating lessons learned from Lagging Indicators.
- Assess HSE KPIs regularly & share performance accordingly.

Through observance of this policy, we aim to assist in protecting the environment and the overall wellbeing of our stakeholders, specifically our employees, clients, shareholders, partners, contractors, subcontractors, service companies and communities.

Managing Director / CEO



Annexure II: Environmental Monitoring Reports



ENVIRONMENTAL MONITORING & ANALYSIS REPORT

OGDC

- Ambient Air Monitoring
- Ground Water Analysis

Report Reference No: AES-FMO-EM-37/2026

Dated: 13th March, 2026

Page 1 of 2

Page 1 of 2

Asian Environmental Services (Pvt.) Ltd.

has prepared this report as per prerequisites of Customer.

Any other individual using the content of this document shall do so at their own liability.

The customer is responsible for lawful usage of this reported data.

Document No. AES/LMS/FRM-I 10. Date of Issue 01 April, 2022. Revision No. 01



AMBIENT AIR MONITORING

RODI

Bhakkar



AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No	AES-FMO-EM-37-2026-AA-01	Monitoring Point	Rodi
Date of Monitoring	02-03-2026 to 03-03-2026	Monitoring Coordinates	32°10'37" N 71°25'46" E

Sr. No.	Time	CO (mg/m ³)	NO (µg/m ³)	NO ₂ (µg/m ³)	NO _x (µg/m ³)	SO ₂ (µg/m ³)
1	14:00	1.25	10.64	18.51	29.15	29.02
2	15:00	1.15	10.10	18.19	28.30	26.96
3	16:00	0.99	9.97	17.72	27.69	26.44
4	17:00	0.87	9.86	16.28	26.14	26.07
5	18:00	0.81	9.64	15.47	25.11	25.21
6	19:00	0.78	9.04	14.14	23.18	24.11
7	20:00	0.73	8.66	13.97	22.63	23.17
8	21:00	0.69	8.18	13.67	21.85	22.31
9	22:00	0.63	7.79	13.35	21.14	21.21
10	23:00	0.58	7.52	13.18	20.70	23.25
11	00:00	0.54	7.18	12.69	19.87	22.31
12	01:00	0.47	6.56	10.44	17.00	21.50
13	02:00	0.43	5.99	9.84	15.83	21.73
14	03:00	0.49	6.44	9.65	16.09	20.32
15	04:00	0.55	7.05	12.84	19.90	18.60
16	05:00	0.62	7.52	11.92	19.44	19.77
17	06:00	0.67	8.39	13.46	21.85	23.46
18	07:00	0.72	8.83	14.72	23.55	23.82
19	08:00	0.78	9.42	14.42	23.84	27.30
20	09:00	0.83	8.41	13.59	22.01	28.39
21	10:00	0.99	9.12	16.47	25.59	29.57
22	11:00	1.04	9.69	17.48	27.17	30.22
23	12:00	1.12	9.86	17.31	27.17	32.47
24	13:00	1.21	10.21	17.29	27.51	31.06
Average Concentration		0.79	8.59	14.4	23.03	24.93

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AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No	AES-FMO-EM-37-2026-AA-01	Monitoring Point	Rodli
Date of Monitoring	02-03-2026 to 03-03-2026	Monitoring Coordinates	32°10'37" N 71°25'46" E

Parameters	Method of Measurement	Monitoring Duration	LDL	Average Obtained Concentration	PEQS	Remarks
Nitrogen Dioxide (NO ₂) *	Gas Phase Chemiluminescence	24 Hours	1.00	14.4	80.0 µg/m ³	Optimal
Nitrogen Oxide (NO)*	Gas Phase Chemiluminescence	24 Hours	1.00	8.59	40.0 µg/m ³	Optimal
NO _x *	Gas Phase Chemiluminescence	24 Hours	1.00	23.03	NGVS µg/m ³	-
Sulphur Dioxide (SO ₂) *	Ultraviolet Fluorescence method	24 Hours	1.00	24.93	120.0 µg/m ³	Optimal
Carbon Monoxide (CO)*	Non-Dispersive Infra-Red (NDIR)	24 Hours	0.01	0.79	05.0 mg/m ³	Optimal
Ozone (O ₃) *	Non-Dispersive Ultra-Violet Absorption Method	01 Hour	1.00	26	130	Optimal
Particulate Matter (PM ₁₀) *	β Ray absorption method	24 Hours	1.00	57	150.0 µg/m ³	Optimal
Particulate Matter (PM _{2.5}) *	β Ray absorption method	24 Hours	1.00	21	35.0 µg/m ³	Optimal
Total Particulate Matter (TSP)	Gravimetric Sampling	24 Hours	1.00	93	500.0 µg/m ³	Optimal

*Parameters are approved from Punjab Environmental Protection Agency.

Note: The standard for CO monitoring is for 05 Hours, however the Average Obtained Concentration is of 24 Hours

Abbreviations:

LDL= Lower Detection Limit
mg/m³ = Mill Gram per Meter Cube

Remarks:

Optimal = Compliance with Permissible Range
Low = Less Than Permissible Range

PEQS= Punjab Environmental Quality Standards
NGVS= No Guideline Value Set

Marginal = Close to Extreme Edge

µg/m³ = Micro Gram per Meter Cube

High = Exceeds from Permissible Range

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AMBIENT AIR MONITORING REPORT

Monitoring Details

Report Reference No	AES-FMO-EM-37-2026-AA-01	Monitoring Point	Rodi
Date of Monitoring	02-03-2026 to 03-03-2026	Monitoring Coordinates	32°10'37" N 71°25'46" E

Sr. No.	Time	Ambient Temperature °C	Wind Direction	Wind Velocity m/s	Humidity %	Pressure (mm of Hg)
1	14:00	30	W	2.4	28	758
2	15:00	30	N	2.36	29	758
3	16:00	31	S	2.74	30	759
4	17:00	31	NE	1.28	30	759
5	18:00	30	N	2.64	33	759
6	19:00	28	S	1.97	38	760
7	20:00	26	W	2.41	49	758
8	21:00	25	N	1.11	53	757
9	22:00	23	NE	2.24	58	758
10	23:00	22	N	1.38	66	757
11	00:00	21	NE	0.64	67	758
12	01:00	21	SE	1.82	68	758
13	02:00	20	SW	2.37	69	758
14	03:00	20	S	1.41	72	759
15	04:00	20	N	2.28	77	758
16	05:00	19	W	2.94	82	759
17	06:00	19	SW	1.64	80	758
18	07:00	18	N	2.38	79	758
19	08:00	18	NW	1.78	81	758
20	09:00	20	S	2.64	72	759
21	10:00	24	NE	1.9	63	758
22	11:00	28	N	2.56	49	757
23	12:00	28	S	1.28	46	758
24	13:00	29	NE	2.64	41	759

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Document No. AES/LMS/FRM-110, Date of Issue 01 April, 2022, Revision No. 01



NOISE MONITORING REPORT

Monitoring Details

Report Reference No: AES-FMO-EM-37-2026-AA-01 Monitoring Point: Rodi
Date of Monitoring: 02-03-2026 to 03-03-2026 Monitoring Coordinates: 32°10'37" N 71°25'46" E

Sr. No.	Time	Noise dB (A)	
1	14:00	51	
2	15:00	52	
3	16:00	53	
4	17:00	52	
5	18:00	51	Day Time
6	19:00	50	
7	20:00	49	
8	21:00	48	
9	22:00	47	
10	23:00	46	
11	00:00	45	Night Time
12	01:00	44	
13	02:00	45	
14	03:00	44	
15	04:00	43	
16	05:00	44	
17	06:00	45	
18	07:00	46	
19	08:00	47	
20	09:00	47	Day Time
21	10:00	48	
22	11:00	49	
23	12:00	50	
24	13:00	50	

Time	PEQS	Average Values	Remarks
Day Time	65	49	Optimal
Night Time	55	45	Optimal

Abbreviations:

Remarks:

Optimal = Compliance with Permissible Range
Low = Less Than Permissible Range

dB (A) = Decibel (Relatable to human hearing)

Marginal = Close to Extreme Edge

PEQS = Punjab Environmental Quality Standards

High = Exceeds from Permissible Range

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GROUND WATER ANALYSIS REPORT

Sample Details

Report Reference No.	AES-FMO-EM-37/2026 GW-16	Report Issue Date	13-03-2026
Nature of Sample	Ground Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	02-03-2026	Sample Receiving Date	04-03-2026
Analysis Completion Date	06-03-2026	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			28 °C & 39 %
Sample ID	AES-FMO-GW-16/2026	Sample Location	Hamoli
Project Details	Oil & Gas Exploration Activities in Zindan-II		



Ground Water Analysis Results					
Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Laboratory Analysis					
Color*	SMWW 2120 C	≤ 15 TCU	0	N.A.	Optimal
Taste*	SMWW 2160 C	Non-Objectionable	Non-Objectionable	N.A.	Optimal
Odor*	SMWW 2150 B	Non-Objectionable	Non-Objectionable	N.A.	Optimal
Turbidity*	SMWW 2130 B	< 5 NTU	0	N.A.	Optimal
Total Hardness (as CaCO ₃) **	SMWW 2340 C	< 500 mg/L	104	± 1.40	Optimal
Total Dissolved Solids (TDS)**	SMWW 2540 C	< 1000 mg/L	393	± 2.77	Optimal
pH**	SMWW 4500 H* B	6.5 - 8.5	7.93	± 0.04	Optimal
Aluminum (Al)	SMWW 3111 B	≤ 0.2 mg/L	BDL	N.A.	Optimal
Antimony (Sb)	SMWW 3114 B	≤ 0.005 mg/L	BDL	N.A.	Optimal
Arsenic (As)	SMWW 3114 B	≤ 0.05 mg/L	BDL	N.A.	Optimal
Barium (Ba)	SMWW 3113 B	0.7 mg/L	BDL	N.A.	Optimal
Boron (B)	SMWW 3113 B	0.3 mg/L	BDL	N.A.	Optimal
Cadmium (Cd)	SMWW 3113 B	0.01 mg/L	BDL	N.A.	Optimal
Chloride (Cl) **	SMWW 4500-Cl B	< 250 mg/L	112	± 1.59	Optimal
Chromium (Cr)	SMWW 3113 B	≤ 0.05 mg/L	BDL	N.A.	Optimal
Copper (Cu)	SMWW 3111 B	2.0 mg/L	0.164	N.A.	Optimal
Cyanide (CN)*	SMWW 4500-CN F	≤ 0.05 mg/L	0	N.A.	Optimal
Fluoride (F)**	SMWW 4500-F C	≤ 1.5 mg/L	0.71	± 0.06	Optimal
Lead (Pb)	SMWW 3114 B	≤ 0.05 mg/L	BDL	N.A.	Optimal
Manganese (Mn)	SMWW 3113 B	≤ 0.5 mg/L	BDL	N.A.	Optimal
Mercury (Hg)	SMWW 3114 B	≤ 0.001 mg/L	BDL	N.A.	Optimal
Nickel (Ni)	SMWW 3113 B	≤ 0.02 mg/L	BDL	N.A.	Optimal
Nitrate (NO ₃) **	SMWW 4500-NO ₃ D	≤ 50 mg/L	1.25	± 0.02	Optimal
Nitrite (NO ₂) *	SMWW 4500-NO ₂ B	≤ 3.0 mg/L	0	N.A.	Optimal
Selenium (Se)	SMWW 3114 B	0.01 mg/L	BDL	N.A.	Optimal
Residual Chlorine (Cl ₂) *	SMWW 4500-Cl B	0.2-0.5 at consumer end	0	N.A.	Optimal

Signature
13/3/26



GROUND WATER ANALYSIS REPORT

Sample Details

Report Reference No.	AES-FMO-EM-37/2026 GW-16	Report Issue Date	13-03-2026
Nature of Sample	Ground Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	02-03-2026	Sample Receiving Date	04-03-2026
Analysis Completion Date	06-03-2026	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			28 °C & 39 %
Sample ID	AES-FMO-GW-16/2026	Sample Location	Hamoli
Project Details	Oil & Gas Exploration Activities in Zindan-II		



Ground Water Analysis Results					
Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
		0.5-1.5 at source/1.0 mg/L			
Phenolic Compounds (as Phenols) *	SMWW 5530 D	NGVS mg/L	0	N.A.	
Zinc (Zn)	SMWW 3113 B	5.0 mg/L	0.038	N.A.	Optimal
Microbiological Analysis					
Total Coliforms*	SMWW 9222 B	0 CFU / 100 mL	0	N.A.	Optimal
Fecal Coliforms *	SMWW 9222 D	0 CFU / 100 mL	0	N.A.	Optimal

*Parameters are approved from Punjab Environmental Protection Agency (EPA).

**Parameters are accredited from Pakistan National Accreditation Council & approved from EPA.

The reported expanded uncertainty is based on combined standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

Abbreviations:

PEQS = Punjab Environmental Quality Standards

TCU = True Color Unit

NTU = Nephelometric Turbidity Unit

Remarks:

Optimal = Compliance with Permissible Range

Low = Less Than Permissible Range

SMWW 24th Edition = Standard Methods for the examination of Water and Wastewater

N.A. = Not Available

MU = Measurement Uncertainty

CFU = Colony Forming Unit

BDL = Below detection limit

NGVS = No Guideline Value Set

Marginal = Close to Extreme Edge

High = Exceeds from Permissible Range

Report Disclaimer

- If provided in the report, the statement of conformity is based on a binary decision rule of simple acceptance (shared risk).
- The decision rule will be provided upon request.
- The remaining portion of the sample (s) will be disposed off after 25 days after the issuance date of report from the laboratory unless otherwise instructed (Condition Apply).
- This report shall not be reproduced in part/parties.
- This report is not intended to be used legally.
- The provided results relate only to the sample provided/collected.
- Values reflect the testing results; decision for usage of report totally depends on Customer.

Analyzed By



Reviewed By

(TM) 13/03/26

Approved By

(QM)

-----End of Report-----

GROUND WATER ANALYSIS REPORT

Sample Details

Report Reference No. AES-FMO-EM-37/2026 GW-17
Nature of Sample Ground Water
Grab/Composite Grab
Sample Collection Date 02-03-2026
Analysis Completion Date 06-03-2026

Report Issue Date 13-03-2026
Sample Collection Reference AES/LMS/QSP-014
Sample Collected/Sent by AES
Sample Receiving Date 04-03-2026
Laboratory Temperature & Humidity (25 ± 5) °C & (55 ± 15) %

13-03-2026
AES/LMS/QSP-014
AES
04-03-2026
(25 ± 5) °C & (55 ± 15) %



Ambient Temperature & Humidity at the Time of Sample collected 28 °C & 39 %

Sample ID AES-FMO-GW-17/2026

Sample Location Government Model High School Kallarkot

Project Details Oil & Gas Exploration Activities in Zindan-II

Ground Water Analysis Results					
Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
Laboratory Analysis					
Color*	SMWW 2120 C	≤ 15 TCU	0	N.A.	Optimal
Taste*	SMWW 2160 C	Non-Objectionable	Non-Objectionable	N.A.	Optimal
Odor*	SMWW 2150 B	Non-Objectionable	Non-Objectionable	N.A.	Optimal
Turbidity*	SMWW 2130 B	< 5 NTU	0	N.A.	Optimal
Total Hardness (as CaCO ₃) **	SMWW 2340 C	< 500 mg/L	300	± 1.40	Optimal
Total Dissolved Solids (TDS) **	SMWW 2540 C	< 1000 mg/L	516	± 8.78	Optimal
pH**	SMWW 4500 H* B	6.5-8.5	7.82	± 0.04	Optimal
Aluminum (Al)	SMWW 3111 B	≤ 0.2 mg/L	BDL	N.A.	Optimal
Antimony (Sb)	SMWW 3114 B	≤ 0.005 mg/L	BDL	N.A.	Optimal
Arsenic (As)	SMWW 3114 B	≤ 0.05 mg/L	BDL	N.A.	Optimal
Barium (Ba)	SMWW 3113 B	0.7 mg/L	BDL	N.A.	Optimal
Boron (B)	SMWW 3113 B	0.3 mg/L	BDL	N.A.	Optimal
Cadmium (Cd)	SMWW 3113 B	0.01 mg/L	BDL	N.A.	Optimal
Chloride (Cl) **	SMWW 4500-Cl B	< 250 mg/L	94	± 1.59	Optimal
Chromium (Cr)	SMWW 3113 B	≤ 0.05 mg/L	BDL	N.A.	Optimal
Copper (Cu)	SMWW 3111 B	2.0 mg/L	BDL	N.A.	Optimal
Cyanide (CN)*	SMWW 4500-CN F	≤ 0.05 mg/L	0	N.A.	Optimal
Fluoride (F)**	SMWW 4500-F C	≤ 1.5 mg/L	0.57	± 0.06	Optimal
Lead (Pb)	SMWW 3114 B	≤ 0.05 mg/L	BDL	N.A.	Optimal
Manganese (Mn)	SMWW 3113 B	≤ 0.5 mg/L	BDL	N.A.	Optimal
Mercury (Hg)	SMWW 3114 B	≤ 0.001 mg/L	BDL	N.A.	Optimal
Nickel (Ni)	SMWW 3113 B	≤ 0.02 mg/L	BDL	N.A.	Optimal
Nitrate (NO ₃) **	SMWW 4500-NO ₃ D	≤ 50 mg/L	2.47	± 0.02	Optimal
Nitrite (NO ₂) *	SMWW 4500-NO ₂ B	≤ 3.0 mg/L	0	N.A.	Optimal
Selenium (Se)	SMWW 3114 B	0.01 mg/L	BDL	N.A.	Optimal
Residual Chlorine (Cl ₂) *	SMWW 4500-Cl B	0.2-0.5 at consumer end	0	N.A.	Optimal

[Signature]
13/03/21



Document No. AES/LMS/FRM-110; Date of Issue 01 April, 2022; Revision No. 01

GROUND WATER ANALYSIS REPORT

Sample Details

Report Reference No.	AES-FMO-EM-37/2026 GW-17	Report Issue Date	13-03-2026
Nature of Sample	Ground Water	Sample Collection Reference	AES/LMS/QSP-014
Grab/Composite	Grab	Sample Collected/Sent by	AES
Sample Collection Date	02-03-2026	Sample Receiving Date	04-03-2026
Analysis Completion Date	06-03-2026	Laboratory Temperature & Humidity	(25 ± 5) °C & (55 ± 15) %
Ambient Temperature & Humidity at the Time of Sample collected			28 °C & 39 %
Sample ID	AES-FMO-GW-17/2026	Sample Location	Government Model High School Kallorkot
Project Details	Oil & Gas Exploration Activities in Zindan-II		



Ground Water Analysis Results					
Parameter	Analysis Method	PEQS	Result	MU (CL95%)	Remarks
		0.5-1.5 at source/1.0 mg/L			
Phenolic Compounds (as Phenols) *	SMWW 5530 D	NGVS mg/L	0	N.A.	-
Zinc (Zn)	SMWW 3113 B	5.0 mg/L	0.044	N.A.	Optimal
Microbiological Analysis					
Total Coliforms*	SMWW 9222 B	0 CFU / 100 mL	0	N.A.	Optimal
Fecal Coliforms *	SMWW 9222 D	0 CFU / 100 mL	0	N.A.	Optimal

*Parameters are approved from Punjab Environmental Protection Agency (EPA).

**Parameters are accredited from Pakistan National Accreditation Council & approved from EPA.

The reported expanded uncertainty is based on combined standard uncertainty multiplied by a coverage factor $k=2$, providing a coverage probability of approximately 95%.

Abbreviations:

PEQS = Punjab Environmental Quality Standards

TCU = True Color Unit

NTU = Nephelometric Turbidity Unit

Remarks:

Optimal = Compliance with Permissible Range

Low = Less Than Permissible Range

SMWW 24th Edition = Standard Methods for the examination of Water and Wastewater

N.A. = Not Available

MU = Measurement Uncertainty

CFU = Colony Forming Unit

BDL = Below detection limit

NGVS = No Guideline Value Set

Marginal = Close to Extreme Edge

High = Exceeds from Permissible Range

Report Disclaimer

- If provided in the report, the statement of conformity is based on a binary decision rule of simple acceptance (shared risk).
- The decision rule will be provided upon request.
- The remaining portion of the sample (s) will be disposed off after 15 days after the issuance date of report from the laboratory unless otherwise instructed (Condition Apply).
- This report shall not be reproduced in part/parties.
- This report is not intended to be used legally.
- The provided results relate only to the sample provided/collected.
- Values reflect the testing results; decision for usage of report totally depends on Customer.

Analysed By



Reviewed By

(TM)

13/3/26

Approved By

(QM)

-----End of Report-----

Annexure III: Emergency Response Plan



Contingency/ Emergency Response Plan

Scenario -1 (Fire)

Burning smell and/or smoke is an indication of the outbreak of fire.

Actions

The person who first detects fire will shout Fire... Fire. .and tries to put off the fire by using appropriate type of portable fire extinguisher.

If the fire cannot be extinguished, switch off the power supply, close doors and windows

On hearing the fire alarm all occupants shall come out of the cabins/offices/workplace and proceed to assembly point.

Leading Fireman

Wear RED fire jacket and proceed to the site of incident.

Instruct all personnel to evacuate immediately and safely.

Ensure rooms and vacate; windows and doors are closed but not locked.

When the area has been fully evacuated, proceed to assembly point.

Ensure no one re-enter the room until advised.

Ensure evacuated personnel are assembled in an orderly manner away of fire, medical and other traffic, and report to the Emergency Coordinator at assembled point regarding the evacuation of their Zone. If personnel are trapped or missing, then report the findings to the emergency coordinator and emergency services.

First Aider

Wear yellow first aiders vest and administer first aid and assistance.

Assist fire warden in the execution of his duties.

Provide first aid at assembly point.

Scenario -2 Road Traffic Accident (RTA)

In a traffic accident, if the driver is not injured or has sustained minor injuries, he will:

Switch off the engine and come out of the cabin.

Assess the condition of passengers, if any.

Provide the help to prevent deterioration of the condition.

Help them to get out of the vehicle.

Do not move seriously injured victims.

Contact Emergency Numbers

Do not leave the accident spot till emergency aid reaches the spot.

Do not move vehicle.

Note: While calling emergency, all the relevant details (exact location, nature of accident,

Contingency/ Emergency Response Plan

type of assistance needed, phone number for the further contract and the name of the caller) should be communicated.

Scenario - 3 (Man Lost)

If confirms that a man is lost the following actions shall be taken:

Start Man Lost procedure when person has not arrived within 2 Hrs of planned time.

Collect man lost information as per checklist details below:

DATA

Name of the man:

Vehicle details:

Destination and intended route:

Any known medical problem:

Other information which may help

Checks

Accommodation

Mess & Recreation

Camp

Clinic

Fuel Station

Local shops

Mosque

Neighboring camps

Communicate to Location IC / HSE Officials.

Organize a search team with emergency resources like vehicle, First Aider etc.

Call emergency (15) and intimate relevant details.

Try to find out whether the missing person has been involved in any accident or is in under detection.

Contact local hospital to ascertain whether the missing person has been involved in accident.

TPT should remain at telephone to receive and give details as and when called for.

If the lost man found out by search team inform all details to Local Emergency.



Contingency/ Emergency Response Plan

Scenario -4 (Heat Stroke)

Heatstroke happens when body temperature rises quickly and a person can't cool down. It can be life-threatening by causing damage to the brain and other vital organs. It may be caused by doing tiring activity in the heat or remaining in a hot place for long. Heatstroke can happen without having any previous heat-related condition, such as heat exhaustion.

When to Seek Emergency Help

If you suspect someone has suffered heatstroke, call your immediate IC. Move the person out of the heat right away.

Symptom:

- Fever of 104 degrees Fahrenheit (40 degrees Celsius) or greater.
- Changes in mental status or behavior, such as confusion, agitation and inaudible speech
- Hot, dry skin or heavy sweating
- Nausea and vomiting
- Flushed skin
- Rapid pulse
- Rapid breathing
- Headache
- Fainting
- Seizure
- Coma

Treatment

Cool the person through whatever means available. For example:

- Put the person in a cool tub of water or a cool shower.
- Spray the person with a garden hose.
- Sponge the person with cool water.
- Fan the person while misting with cool water.
- Place ice packs or cool, wet towels on the neck, armpits and groin.
- Cover the person with cool, damp sheets.
- If the person is conscious, offer cold water.
- Begin CPR if the person loses consciousness and shows no signs of circulation, such as breathing, coughing or movement.



Annexure IV: EIA Checklist



CHECKLIST (EIA)PAK EPA GUIDELINES FOR PREPARATION AND REVIEW OF ENVIRONMENTAL REPORTS, 1997

Required Content	EIA Report		
	PAGE NO.	REMARKS (If Any)	LACKING
Executive summary:			
1. Title and location of project			
2. Name of the proponent	i		
3. Name of the organization preparing the report	i		
4. A brief outline of the proposal (type, process, technology and land requirement)	i		
5. The major impacts	iv		
6. Recommendations for mitigation measures	iv		
7. Proposed monitoring	vi		
Introduction:			
1. Purpose of report	1		
2. Identification of project and proponent	1		
3. Details of consultant	1		
4. Brief description of nature, size, and location of project	1		
Screening: Whether the Project requires IEE or EIA as per Regulations	4		
Scoping	5		
1. Spatial and Temporal Boundaries of Environmental Assessment	5		
2. Important issues and concerns raised during consultation	5		
3. Significant impacts and factors to be determined	6		
Consideration of Alternatives	25		
1. Site alternatives, their selection and rejection criteria	25		
2. Design/Technology alternatives, their selection and rejection criteria	25		
3. Environmental Alternatives, their selection and rejection criteria	26		

Required Content	EIA Report		
	PAGE NO.	REMARKS (If Any)	LACKING
4. Economic Alternatives, their selection and rejection criteria	26		
Description of the project:	10		
1. Objectives of Project	10		
2. Location and Site Layout of the project (May be annexed at the end of report)	10		
3. Land use on the site	13		
4. Road access	15		
5. Vegetation features of the site	15		
6. Cost and Magnitude of operation	23		
7. Schedule of implementation	23		
8. Description of the project (Process flow chart/steps, Technology, Raw material and products, by-products)	17		
9. Restoration and rehabilitation plans	24		
Description of Environment: Clear-cut picture of existing environmental resources:	42		
1. Baseline Physical Environment	44		
2. Baseline Ecological Environment	65		
3. Baseline Socioeconomic Environment	74		
4. Lab reports of environmental analyses (along with soil tests, geo-investigation in case of building projects and industries)	60, 64	Also attached as Annex II.	
5. Suitability of the site (not prohibited, environmentally sensitive, incompatible to surroundings and unsuitable)	44		
Impact Assessment			
1. Methodologies for impact identifications (One/more)	94		
✓ Checklists	94		
✓ Matrices			

Required Content	EIA Report		
	PAGE NO.	REMARKS (If Any)	LACKING
✓ Networks			
✓ Overlays			
✓ GIS and Computer expert systems			
2. Characteristics of impacts (nature, magnitude, extent and location, timing, duration, reversibility, risk)	95		
Screening of potential Environmental Impacts and mitigation measures on/during:	97		
1. Project location	97		
2. Design	99		
3. Construction phase	100		
4. Operational phase	103		
5. Potential Environmental Enhancement Measures	112		
Environmental management and monitoring program	114		
i. Description of proposed mitigation actions along with:	120		
ii. Schedule for implementation and Environmental budget	120		
iii. Environmental Management Team along with their Roles and responsibilities (by name or position)	115		
iv. Proposed monitoring program to assess performance or output of EMP	120, 131		
v. Proposed EMP reporting and reviewing procedures	118		
vi. Any training needs required to ensure implementation of EMP and Monitoring plans	116		

Required Content	EIA Report		
	PAGE NO.	REMARKS (If Any)	LACKING
Stakeholders Consultation: Communicate the possible impacts and concerns to the following to assist further analysis and decision making:	84		
i. Proponent's Environment Management Team	84		
ii. The responsible authority	84		
iii. Other departments and agencies	85		
iv. Environmental practitioners and experts	85		
v. Affected and wider community	84		
Appendices			
1. Glossary	136		
2. List of abbreviations	137		
3. Lists of individuals and organizations consulted along with their written feedback	138		
4. Sources of data and a full list of all reference material used	140		
5. Terms of references of environmental reports and those given to individual specialists	141		
6. List of names, qualifications and roles of team members carrying out the IEE/EIA study	142		
7. Approvals from other concerned departments	143		