

Environmental Impact Assessment (EIA) 2D/3D Seismic Survey in GAMBAT-II BLOCK, SINDH

MAY- 2025



**EMC Pakistan
Private Limited**





Environmental Impact Assessment (EIA)

***2D/3D seismic survey in
Gambat-II Block Sindh***

Final Report

May, 2025

Ref: EIA/13/05/25



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EXECUTIVE SUMMARY

Pakistan Petroleum Limited (PPL) plans to conduct 2D and 3D seismic surveys in the Gambat-II Block to explore hydrocarbon potential of the awarded area. The Gambat-II Block has been awarded to PPL by the Government of Pakistan for oil and gas exploration activities. The block covers a total area of 1,697.56 square kilometers, spanning in the districts Khairpur and Sukkur in Sindh Province.

The proposed project involves conducting both 2D and 3D seismic survey in Gambat-II block. The proposed activity will primarily take place in district Khairpur with smaller portion extending into Sukkur district. The 3D seismic survey will cover approximately 696 square kilometers, while the 2D survey will span 330-line kilometers (refer to Tables ES-01 and ES-02).

A section of the 3D survey lies within the Takkar Wildlife Sanctuary, a designated Protected Area under the Sindh Wildlife Protection, Preservation, Conservation, and Management Rules, 2022. Another ecologically sensitive area, Mehrano Wildlife Refuge, is also located within the proposed 3D seismic zone. Additionally, Khat Dhoro Wildlife Sanctuary, another Protected Area under the same legislation, is located near one of the 2D seismic lines. However, a safe buffer of 900 meters has been maintained to avoid any impact on the sanctuary (refer to Figures ES-1 and ES-2).

The proposed project area encompasses several key settlements, including Shadi Shaheed, Gambat City, Tando Masti Khan, Kot Diji, and the Khairpur Special Economic Zone. Access to the project site is conveniently available via National Highway N-5 (Indus Highway) and National Highway 55 (Mehran Highway), along with adjoining roads such as Nara Road, Thari Road, and Thari-Naro Road.

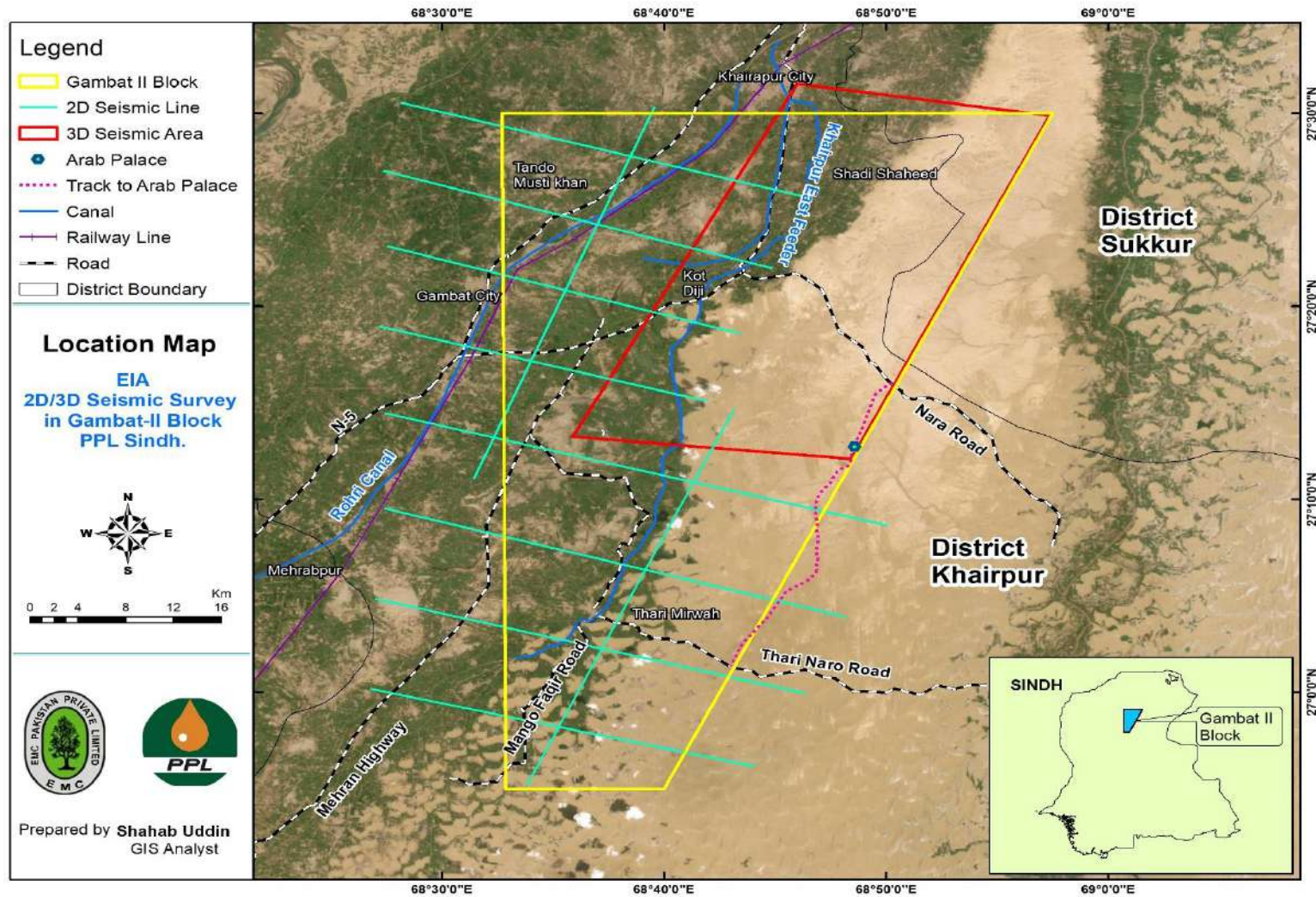
To support seismic activity, base and fly camps will be established. The base camp will serve as the central hub for operations and logistics, while the fly camp will be secondary camp which will be located closer to the active survey's areas for more efficient data acquisition. An explosive storage camp will also be constructed to store the explosives used in dynamite shot holes during seismic activities.

Table ES-1: 2D Seismic lines at Gambat-II Block

Line_ID	Start_X	Start_Y	End_X	End_Y	Line_Km
PPL25-GAMII-01	456652.8342	2977617.5567	472168.1011	3013552.3067	39.00
PPL25-GAMII-02	445060.9768	2986891.0567	473683.9570	2979400.8848	30.00
PPL25-GAMII-03	452818.6038	3006953.8848	466372.1680	3042531.9629	38.00
PPL25-GAMII-04	445417.6487	2995540.3692	477429.0220	2986356.0098	33.00
PPL25-GAMII-06	446130.9964	3004189.6817	480460.7395	2993667.8067	36.00
PPL25-GAMII-08	446220.1643	3013284.8379	483581.6292	3002406.2910	39.00
PPL25-GAMII-10	445863.4905	3021577.4785	470117.2351	3014354.8379	25.00
PPL25-GAMII-12	446487.6682	3029245.9473	472703.1106	3020774.9473	28.00
PPL25-GAMII-14	446220.1624	3036468.5723	475110.6502	3027016.7285	30.00
PPL25-GAMII-16	447557.6858	3042977.8535	478053.1995	3033704.3379	32.00
Total Line Km					330.00

Table ES-02: Surface coordinates of Gambat-II planned 3D seismic survey (696 Sq. Kms)

ID	X	Y
A	476933.7659	3044649.1348
B	495647.5315	3041609.1035
C	480893.7024	3008806.5098
D	460184.4710	3010982.1504



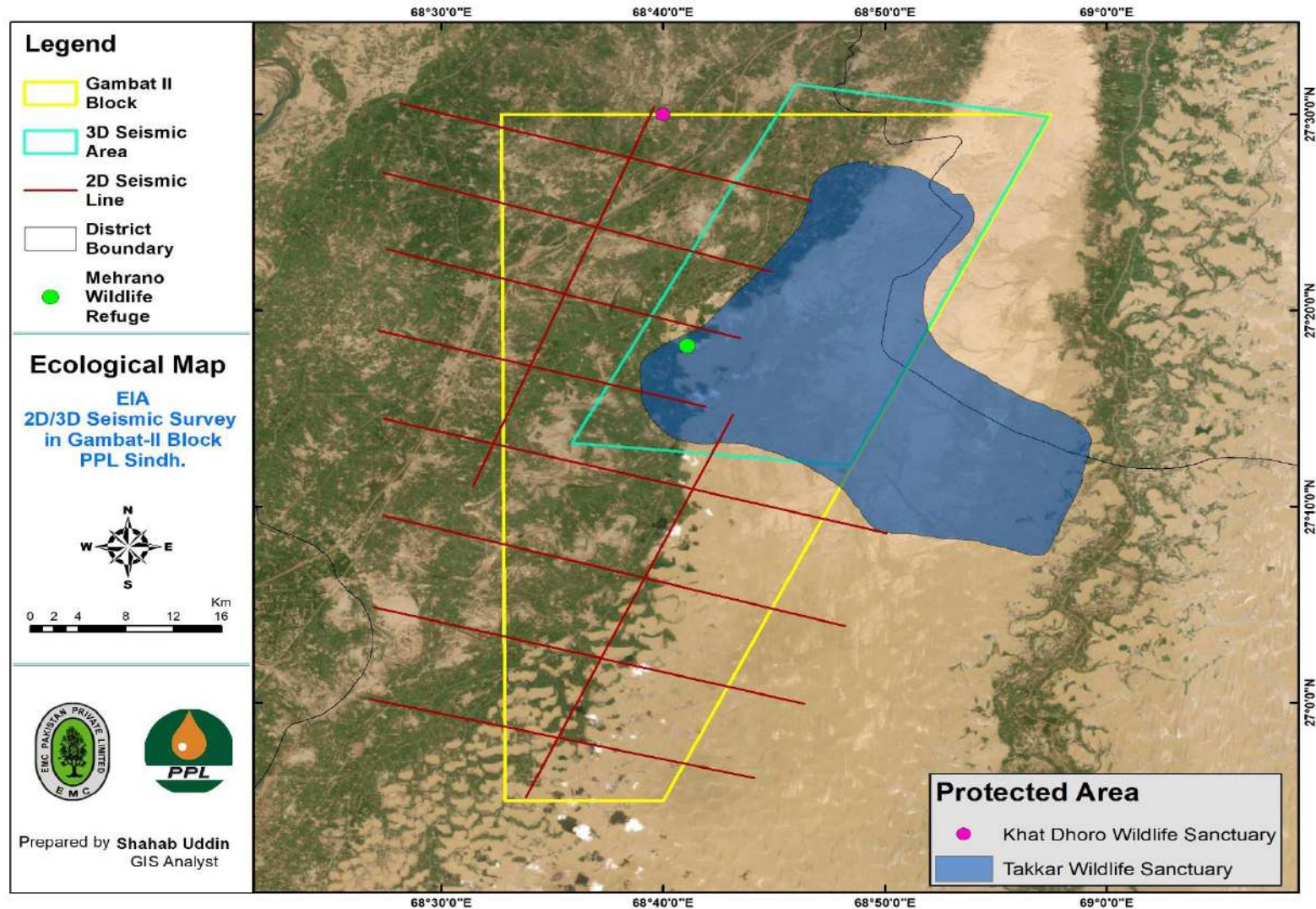


Fig ES-2: Location of Protected areas in Gambat-II

Based on the nature and scope of the project, it has been classified under Schedule-III of the Sindh Environmental Protection Agency (SEPA) Environmental Assessment Regulations, 2021, specifically falling under **Category J—"Environmentally Sensitive Areas."** This category includes all projects located in ecologically sensitive zones designated by the Agency, necessitating the submission of an Environmental Impact Assessment (EIA).

The scope of work under the project are:

- Land acquisition
- Construction of access track
- Development of campsites (Base Camp and Fly Camps (if required))
- Crew mobilization
- 2D Seismic Surveying
- 3D Seismic Surveying
- Restoration and rehabilitation.

The project will employ seismic surveying, a geophysical technique used to map subsurface structures without drilling. This involves generating seismic waves—either by vibroseis trucks (vehicle-mounted vibrators) or dynamite shot holes—that reflect off underground rock layers and are recorded by geophones. The collected data helps create 2D or 3D images of geological formations, enabling the identification of potential hydrocarbon reservoirs, faults, and other subsurface features.

2D surveys produce cross-sectional views of subsurface formations, while 3D surveys, conducted based on promising 2D results, provide more detailed, three-dimensional images over smaller areas.

To evaluate the ecological conditions of the project area, especially the zones overlapping with protected areas, a multidisciplinary team from EMC Pakistan Pvt. Ltd comprising wildlife experts, SEPA-certified lab personnel, and a sociologist, conducted an extensive field survey. The team assessed the entire project area, documenting physical features, flora and fauna, habitats, potential threats from proposed activities, and recommended mitigation measures. The survey also included assessments of Takkar and Khat Dhoro Wildlife Sanctuary which are designated wildlife sanctuary and a Protected area within the Sindh Wildlife, Protection, Preservation, Conservation and Management Rules, 2022.

In addition to this, the ecological survey also covered the Mehrano Wildlife Refuge which is a privately owned sanctuary located in the project area. The wildlife Refuge is managed by the Talpur family for generations, this refuge was established to protect the region's native wildlife, particularly endangered species such as the blackbuck and hog deer. While parts of the refuge are fenced to protect wildlife and control access, much of the area remains open and undisturbed, preserving its natural state. Despite its ecological value, the refuge is not officially recognized under any national or provincial wildlife protection laws.



EIA team observing the wildlife foot prints



Noise monitoring



Social consultation in the project area



Ambient Air monitoring



Assessment of sensitive ecological habitats

Figure ES 3: EIA field survey team

Environmental monitoring was conducted at multiple sites to assess ambient air quality, noise levels, and surface and groundwater conditions. Community consultations were also held to capture local residents' views, concerns, and expectations. These engagements provided insights into the social dynamics of the area and helped identify local priorities.

The report includes a detailed analysis of the natural and socio-economic environment, covering geomorphology, water resources, air quality, vegetation, wildlife, and habitats. The socio-economic profile addresses population demographics, education, health, gender issues, agriculture, transportation, communications, and sources of income.

Potential impacts of seismic survey on the physical, biological, ecological environment of the project area specially the sanctuaries and socio-economic and cultural environment of area have been assessed through this study and mitigation measures have been proposed which shall be adopted to alleviate the impacts on the environment.

The Environmental Impact Assessment study ensures that:

- All aspects of the existing project area are examined and data is collected to form a comprehensive environmental and socioeconomic baseline.
- All major and minor positive or negative impacts on the environment (physical, social and ecological) during the different stages of project are identified.
- A list of mitigation measures covering all possible impacts is included along with their implementation procedures and guidelines.
- A detailed Environmental Management Plan (EMP) is provided for sustainable operation of the project and forms an essential part of the EIA document.

For the effective implementation and management of mitigation measures, an Environmental Management Plan (EMP) has been prepared which meets the requirements of Sindh Environmental Protection Act 2014.

The EMP provides a mitigation measures to address potential impacts of project activities, to enhance project benefits and to introduce standards of best practice in all project activities. It defines the legislative requirements, guidelines and best industry practice that apply to the project. Furthermore, it formulates roles and responsibilities of the project proponent in terms of safeguarding the environmental and social well-being of the area and its inhabitants.

The EIA concludes that the proposed project of 2D/3D seismic survey will not lead to significant adverse environmental impacts and careful implementation of the EMP will ensure that potential impacts are managed and minimized and the project proponents meet all statutory requirements.

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Annex – I	PPL QHSE Policy
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1.0 INTRODUCTION

1.1 Brief Description of the project

This study presents the findings of the Environmental Impact Assessment (EIA) conducted by EMC Pakistan Private Limited for the proposed 2D/3D Seismic Survey in Gambat-II Block, Sindh. The geographical extent of Gambat-II block predominantly lies within the district Khairpur, while northeastern portion extends into the district Sukkur of Sindh province. The block covers an area of approximately 1,679.56 sq.km.

The proposed project involves conducting both 2D and 3D seismic survey in Gambat-II block. The proposed activity will primarily occur in district Khairpur, with smaller portion extending into Sukkur district. The 3D seismic survey will cover an area of approximately 696 square kilometers, while the 2D seismic survey will span 330-line kilometers.

A section of the 3D seismic activity falls within the Takkar Wildlife Sanctuary, a designated Protected Area under the Sindh Wildlife Protection, Preservation, Conservation, and Management Rules, 2022. Additionally, Khat Dharo, another wildlife sanctuary and Protected Area under the same legislation, is located near one of the 2D seismic lines. However, a safe buffer distance of 900 meters has been maintained to avoid any impact on the sanctuary. The project area is also in proximity to the Mehrano Wildlife Refuge, which, although not legally recognized as a protected area, serves as a privately managed conservation zone and breeding farm. The refuge is actively preserved for its biodiversity.

The 2D/3D seismic activity project aim to explore the hydrocarbon reserves in the block. The survey will use a combination of seismic methods, including the Dynamite Method and Vibroseis (using heavy vehicles to generate seismic waves). These waves will be captured by geophones placed on the land surface. The method selected will depend on the terrain characteristics, such as flat land, undulating dunes, or desert areas.

The EIA study has been prepared in compliance with the mandatory requirement of the Section 17 of Sindh Environmental Protection Act (SEPA) 2014.

Compliance with provisions of SEPA 2014, Section 17 requires that

“No proponent of a project will commence construction or operation unless he has filed with the Agency an environmental impact assessment, and has obtained from the Agency approval in respect thereof”.

For this EIA, field surveys were conducted in the study area by EMC Pakistan Pvt. Limited team which included an environmentalist, sociologist, ecologist and a wildlife specialist. Field data collection comprised observational surveys; consultations and meetings with government departments, NGOs and local communities; and on-site verification of existing secondary information.

Secondary data was collected from the project proponent, in-house databases, Government Departments and NGOs. Additionally, relevant international guidelines, conventions, and environmental assessment procedures developed by the Pakistan Environmental Protection Agency (EPA) were reviewed in the preparation of this document.

1.2 Project Proponent contact

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1.4 The Proponent-Pakistan Petroleum Limited¹

The company's history can be traced back to the establishment of a public limited company in June 1950, with major shareholding by Burmah Oil Company (BOC) of the United Kingdom for exploration, prospecting, development and production of oil and natural gas resources. In September 1997, BOC disinvested from the Exploration and Production (E&P) sector worldwide and sold its equity in PPL to the Government of Pakistan (GoP). Subsequently, the government reduced its holding through an initial public offer in June 2004, which was further decreased with the initiation of the Benazir Employees Stock Option Scheme (BESOS) in August 2009 when PPL employees were allotted 12 percent shares from the government's equity. More recently, GoP further disinvested its 5 percent shares, around 3.55 percent of the total paid-up capital, in PPL through Secondary Public Offering in 2014. Currently, the company's shareholding is divided between the government, which owns about 67.51 percent, PPL Employees Empowerment Trust that has approximately 7.35 percent — being shares transferred to employees under BESOS — and private investors, who hold nearly 25.14 percent.

PPL has acquired 100 percent shareholding of MND E&P Limited, a company incorporated in England and Wales. The name of the subsidiary has been changed to PPL Europe E&P Limited.

¹ <https://www.ppl.com.pk/content/corporate-profile-overview>

The company has also established a wholly-owned subsidiary, PPL Asia E&P B.V. with corporate seat in Amsterdam, Kingdom of Netherlands. The subsidiary will focus on exploration and production of oil and gas in the region.

In August 2021, a PPL-led consortium was awarded Offshore Block 5 in Abu Dhabi's second competitive exploration block bid round. Offshore Block 5 covers an area of 6,223 square kilometers and is located 100 kilometers north east of Abu Dhabi city. The consortium includes four leading national E&P companies, PPL as operator, Oil and Gas Development Company Limited (ODGCL), Mari Petroleum Company Limited and Government Holdings (Private) Limited (GHPL) with an equal shareholding of 25 percent. To this end, a new company Pakistan International Oil Limited (PIOL) was incorporated in the UAE with PPL as the management shareholder and has entered into the concession agreement with Abu Dhabi National Oil Company.

PPL operates 16 producing fields across the country at Sui (Pakistan's largest gas field), Adhi, Kandhkot, Chachar, Mazarani, Adam, Adam West, Shadadpur, Shahdadpur West, Shahdadpur East, Zafir, Fazal, Kabir, Hadaf, Dhok Sultan and Shahpur Chakar North and holds working interest in 24 partner-operated producing fields, including Qadirpur the country's second largest gas field.

As a major stakeholder in securing a safe energy future for the country, PPL pursues an aggressive exploration agenda aimed at enhancing hydrocarbon recovery and replenish reserves. PPL together with its subsidiaries has a portfolio of 50 exploration assets of which the company operates 28, including an offshore Block 5 in Abu Dhabi, UAE and a local offshore lease in Pakistan, while 22 blocks, comprising an onshore concession in Yemen, are operated by joint venture partners.

As part of its diversification strategy, PPL has strengthened its mining operations through Bolan Mining Enterprises (BME), established in 1974 with an equal shareholding of 50 percent each between PPL and Government of Balochistan (GoB). To this end, PPL signed a mining lease (ML) deed for Lead and Zinc in District Khuzdar with GoB in December, 2021. According to the ML deed, PPL has been granted a large-scale mining lease over an area of 30 square kilometers for establishment of bayrite, lead and zinc (BLZ) processing/ beneficiation plant in District Khuzdar, Balochistan. The estimated recoverable reserves of BLZ are 69 million tonnes along with 32 years of life after commencement of production.

More recently, PPL in collaboration with Oil & Gas Development Company Limited and Government Holdings (Private) Limited (collectively, the SOEs), entered into agreements for the reconstitution of the Reko Diq project with Barrick Gold Corporation, Balochistan Mineral Resources Limited and Government of Balochistan in December 2022. The project is managed through Pakistan Minerals (Private) Limited, a special purpose entity equally owned by the SOEs, which holds a 25 percent equity stake in the project.

Over the years, PPL has developed a reliable foundation and infrastructure for providing clean and safe energy through sustainable exploitation of indigenous natural resources while adhering to best practices of corporate governance and employee health and safety and constraining the ecological footprint of its operations. As a result, Sui, Kandhkot, Adhi and Hala, Gambat South and Mazarani assets, Purification Plant, Sui, Sui Field Gas Compressor Station, Sui Production, Sui Field utility, Sui Stores, Sui Field Hospital and Quality, Health, Safety and Environment, Drilling & Well Engineering, Construction, Projects, Production Technology and Medical Services departments stand certified for ISO 9001 Quality Management System.

Similarly, Kandhkot, Adhi and Hala, Gambat South, Mazarani assets, Sui Field Gas Compressor Station, Sui Production, Sui Field utility, Sui Stores, Sui Field Hospital and Exploration, Quality, Health, Safety and Environment, Drilling & Well Engineering, Construction and Projects departments have been certified for ISO 14001 Environmental Management System and ISO 45001 Occupational Health & Safety Management System. Purification Plant, Sui, is also certified for ISO 45001 Occupational Health & Safety Management System.

PPL has played a significant role as a responsible corporate citizen since the inception of its commercial activities in Sui by establishing the Sui Model School in 1957 for children of workers and local communities. In order to ensure geographical and thematic diversity, the company's CSR programme focuses on education, health, infrastructure development and socio-economic uplift of disadvantaged communities living in and around its operating areas as well as other parts of the country. The company also initiated Corporate Donations programme to reach deserving population in urban areas. To this end, PPL has earmarked at least 1.5 percent of its annual pre-tax profit for CSR initiatives with actual spending crosses Rs. 3-billion-rupee mark.

Vision

To achieve energy self-sufficiency for Pakistan by becoming the most successful and efficient discoverer and producer of oil and gas.

Mission

To serve the people of Pakistan in an area critical to their economic development by employing, training and developing the best people available and empowering them to deliver extraordinary results while insisting that they conform to the highest standards of professional and ethical conduct.

Corporate Social Responsibility (CSR) activities²

Pakistan Petroleum Limited (PPL)'s Corporate Social Responsibility (CSR) programme dates back to the start of PPL's commercial operations in Sui in the 1950s when the

^{2 2} <https://www.ppl.com.pk/content/CommunityAtAGlance>

company established a school for children of workers and local communities. Since then, CSR has been the centerpiece of PPL's corporate ethos.

In 2001, the PPL Welfare Trust (PPLWT) was founded to provide geographic and thematic diversity to the company's CSR programme, which includes education, health, infrastructure development, socio-economic uplift of disadvantaged communities, particularly those living in and around its operating areas, and post-disaster rehabilitation.

Need analysis, scoping, planning and execution of CSR projects is carried out through strategic local partnerships. To ensure swift delivery, maximum on-ground impact and sustainability of its social investments, all interventions occur after due consultation and mutual agreement with stakeholders, including community representatives, local governments and non-governmental organizations.

To further strengthen PPL's CSR portfolio and access the underserved in non-operational urban areas, the company has initiated Corporate Donations Programme in 2016-2017.

As one of the leading corporate providers of social development and welfare services in some of the most remote swathes of the country, PPL has received Pakistan Corporate Philanthropy Award for 14 consecutive years from 2004 to 2017.

It will be nearly impossible to highlight all the CSR / social welfare activities carried out by PPL in province of Sindh. However, few notable ones are as under:

Corporate Social Responsibility in Sindh

Health

- Operating 03 Medical Mobile Units (MMU) for local community living around Kandhkot, Gambat South and Mazarani fields.
- Annually holds Surgical Eye Camps for the community living round Kandhkot, Gambat South and Mazarani fields
- Constructed and furnished 20 bedded Maternity Home at Shahdadpur Institute of Medical Sciences Shahdadpur, District Sanghar
- Extended Emergency Department of Shahdadpur institute of Medical Sciences Shahdadpur, District Sanghar
- Constructed and furnished 8 Govt dispensaries at Tehsil Bhirya, District Naushahro Feroz and Tehsil Kashmore at District Kashmore
- Renovated and furnished building for establishment of NICVD Kashmore
- Constructed and furnished building for establishment of Thalassemia Centre Badin
- Established ophthalmic operation centre at Dr. Ruth Pfau health centre Kandhkot

Corporate Social Responsibility in Sindh

	• Provided 07 fully equipped Ambulances to Govt Hospitals at Tehsil Kashmore, Khipro, Thana Bola Khan, Bhirya and Daur • Rehabilitated and furnished operation theater of THQ Kandhkot • Donated Rs 10 million to SIUT for purchase of Lithoclast machine for surgeries of stone in Kidney • Donated Rs 5 million to The Kidney Centre for purchase of 03 Dialysis machines. • 13- During Covid-19, PPL vaccinated 150,000 individuals mostly living around the fields.
Education	• Constructed 65 school buildings at Tehsil Shahdadpur, Tando Adam, Khipro, Kashmore, Kandhkot, Hala, Jati, Naushahro Feroz, Rohri and Jamshoro. • Providing 12 Higher Professional scholarships annually to the students of District Sanghar and Matiari • Providing 10 Higher Professional scholarships annually to the students of District Kashmore • Providing 25 scholarships annually to local students of District Sanghar and Matiari to pursue Technical Education at The Hunnar Foundation (THF) Rashidabad, Tando Allahyar • Providing 30 scholarships to Deaf and Dumb students of District Sanghar and Matiari to pursue education at Deaf Reach School and Training Centre Tando Allahyar • Distributed 1000 school bags among students of Govt schools around Hala and Gambat South fields in 2023. • Provided furniture to Govt schools of District Sanghar, Kashmore, Matiari, Naushahro Feroz, Sujawal and Shaheed Benazirabad.
Water	Installed 7 Solar based RO Plant at Different Districts such as Naushahro feroze, Shaheed Benazirabad and Hyderabad • 3 RO plants at village Lakha Road, Bhirya road and Fateh Muhammad Araen at District Naushahro feroze. • 3 RO plants at Jam Sahib Town, Ghanwar Chandio and village Muhammad Shah at District Shaheed Benazirabad. • 1 RO plant at village Qasim Panhwar at District Hyderabad.

Corporate Social Responsibility in Sindh

Installed 15 Solar based RO Plants at following villages of Tehsil Shahdadpur District Sanghar

- Pir Moladad street Shahdadpu
- Haji lal Muhammad Waso
- Khudad kapri
- Stiyaryoon
- Masoonda Rindh
- Moa Chora
- Baqir Nizamani
- Ghulam Haider Bagrani
- Lundo
- Karimdad Khichi

Installed 10 Solar based RO Plants at following villages of Tehsil Tando Adam District Sanghar

- Nau Wah
- Ghulam Ali Nizamani
- Malik Allahyar
- Syed Hassan Jamil
- Allah Dino Khaskheli
- Ismail Abro
- Alam Baloch
- Syed Nobut Ali Shah

Water Supply schemes at different Districts of Sindh

- Constructed 03 Solar based water supply schemes at village Sardaroo Khoso, Imamdin malik and Abdul Rehman Chachar at Tehsil Kashmore District Kashmore
- Constructed 02 Solar based water supply schemes at village Ranahu and Rablao at Tehsil Khipro District Sanghar
- Constructed 04 water supply schemes at village Abdul Wahab Suhandro, Asghar Chachar, Ghulam Muhammad Mazari and Theriri & Mandho Malik at Tehsil Kashmore District Kashmore
- Constructed 02 water supply schemes at village Thana bola khan at District Jamshoro

Corporate Social Responsibility in Sindh

	- Constructed water supply scheme at village Soomer Karani at Tehsil Thana Bola khan at District Jamshoro - Constructed 02 water supply schemes at village Budhapur and Manjhand at District Jamshoro - Constructed 5 water storage tanks and laid water distribution line at village Noor Thahemore, Tayyat Dero, Luqman Shaikro, Haji Muhammad Rahim and Ramzan Pathan Taluka Jati District Sujawal. - Supply of water to the community living around Mazarani field through Bowser on daily basis.
Infrastructure	- Constructed 32 Km Road from Indus Highway to village Akram Bajkani and Haibat Bajkani District Kashmore - Constructed 2 Km Road from Bhit Shah – Shahdadpur road to village Ally Faqir Dero District Sanghar - Constructed 3 Km Road Shahdadpur – Nawabshah Road to village Muhammad Khoso District Sanghar - Constructed 2.1 Km dual Shahdadpur bye pass road at Shahdadpur, District Sanghar - Constructed 0.4 Km Road and water coarse at village Khudadad Kapri District Sanghar - SOS Children’s Villages Jamshoro: With a covered area of approximately 50,000 sq. ft. The facility consists of 15 family homes, five staff residences, administrative block, library and computer center, play area, auditorium, mosque, clinic, workshop, store, shop and a community center, catering to about 150 children. - As part of Mother and Child Health’s extension, PPL has constructed a new ward, operation theatre and recovery room in MCH Kandhkot. - For provision of effective maternal and child healthcare services to local communities in Hala, District Matiari, a separate obstetrics and gynecology center was established by PPL at Taluka Hospital, Matiari. 10.6 km road from Indus to village Punhal Khan Golo, near Kandhkot Field. (Vol) - Shahdadpur bye-pass road at District Sujawal. (Vol) - Constructed Haibat bridge on Beghari Sindh Feeder canal at Kandhkot, Dist. Kashmore. (Vol)

Corporate Social Responsibility in Sindh

	20 Kms road in the surrounding of Kandhkot and Shahbandar fields. (Vol)
Vocational Training & Skill Development	- Women Vocational & Skill Development Centre, Kotri, Dist. Jamshoro. (Vol) - Scholarship to Pursue Internationally Recognized Technical Diploma over 185 male youth of District Matiari, Dera Bugti and Kashmore have been awarded scholarship to pursue City and Guilds, UK recognized technical diploma in the fields of welding, plumbing, motor mechanic, refrigeration, electronics and mechanical.
Post Disaster Rehabilitation	The company continued its support for affectees of natural disaster.



Constructed Thalassemia Diagnostic, Treatment & Research Centre, Badin



Gifted Ambulance to BHU at Budhapur, District Jamshoro



Free surgical eye medical camps at Kandhkot



Constructed & Furnished Women Vocational & Skill Development Centre at Kotri, District Jamshoro

	
SOS Children Village	Relief Consignments sent to flood-affected areas

1.4.1 Quality, Health, Safety and Environment³

Pakistan Petroleum Limited (PPL) strives to maintain international standards and best industry practices to ensure consistency in provision of safe energy from indigenous sources. The company recognizes that operational safety and health for staff and contractors, maintaining quality of processes and outputs and constricting the ecological footprint of operations promotes excellence and corporate responsibility.

Quality, Health, Safety and Environment (QHSE) department was established to provide integrated support for assurance and control of technical and administrative operations, work performance and asset integrity besides, inculcating safety awareness and adopting best operational practices in strict compliance with statutory Health, Safety and Environment standards.

For consistency in implementation of standard QHSE practices, staff capacity building sessions on emergency response, asset integrity and process safety are regularly held. Moreover, safety guidelines are provided to staff, contractors and guests visiting fields and office locations. QHSE practices and tools are integrated into the management and operational processes, including SAP audit management and quality modules, to obtain tangible benefits through efficient monitoring. On the conservation front, reporting to relevant provincial environmental protection agencies or EPAs is carried out through the Self-Monitoring and Reporting Tool for compliance with the National Environmental Quality Standards. Initial Environment Examination and Environment Impact Assessment studies are mandatory prior to initiating new projects/ development work.

As a result, 13 assets and departments are certified for ISO 14001 Environmental Management System (EMS) and 17 for ISO 9001 Quality Management System (QMS) and 14 for 45001 (OH&S).

^{3 3} <https://www.ppl.com.pk/content/health-safety-environment-overview>

In order to sustain and update compliances, all certified facilities and departments undergo regular internal and external surveillance audits, following which corrective measures are implemented (if required).

Employees from various technical departments are qualified lead auditors for ISO 9001 QMS, ISO 14001 EMS and ISO 45001 to assist in executing audits.

In recognition of its efforts to ensure operational health, safety and environmental conservation, PPL has received the Employers' Federation of Pakistan's prestigious Occupational Safety, Health and Environment Best Practices Awards in 2012 and 2014.

1.4.2 PPL's Policy and Commitment to Quality, Health, Safety and Environment

Pakistan Petroleum Limited (PPL) is a frontline oil and gas exploration and production company in the country. At PPL, management is committed to maintaining and continually improving Quality, Health, Safety and Environment (QHSE) standards in all spheres of business activities.

PPL firmly believe that implementation of QHSE Management System augment continual improvement in all business processes and add value to external stakeholders.

Function, Asset and Department Heads are accountable to ensure QHSE and legal compliance in their respective areas of responsibility and demonstrate pivotal leadership role in promoting QHSE culture within the organization. Whereas, all employees and contractor's staff are responsible to implement QHSE requirements in their own benefit as well as of colleagues, contractors, visitors and community.

To carry out this Policy, PPL shall:

- Define SMART QHSE objectives and targets aligned with organizational goals and monitor performance for continual improvement.
- Conduct risk assessments, incident reporting & investigations and occupational health surveillance to identify preventive measures and capture improvement opportunities.
- Fulfill its QHSE legal and other compliance obligations.
- Reward and recognize QHSE proactive efforts and initiatives of individuals.
- Protect environment and ensure minimum environmental footprint of its business activities.
- Ensure that seat belt is fastened on all seats of vehicle by employees, contractors, and visitors.
- Permit smoking in designated areas only at PPL Fields and Locations.
- Continually improve QHSE standards by adopting new techniques, approaches and best industry practices addressing various business processes.
- Working safely is a condition of employment at PPL.

1.5 Scope and Objectives of EIA

The proposed project can have an adverse impact on the environment if proper mitigation measures are not in place. The potential impacts of the seismic survey include crop damage, disturbance to local communities and wildlife, soil erosion, water pollution, etc. However, through the identification of impacts, and the development and implementation of mitigation measures, such potential environmental impacts can be avoided or reduced, making the project social and environmentally friendly and economically feasible.

The EIA study is aimed at developing the environmental and social profile of the project area so as to evaluate the existing physical, biological and socioeconomic aspects leading to respective impacts due to construction and operation activities of the proposed project. Other objectives of the EIA study are to ensure that:

- Any major adverse impact on the environment (physical, ecological and social) during different phases of projects viz. siting, design, construction, and operation are identified.
- Adverse impacts are appropriately addressed and adequate mitigation measures are incorporated in the siting, design, construction, and operation phases of project.
- Socioeconomic aspects are identified, and mitigated.
- Alternatives to achieve the objectives are analyzed.
- Environmental Management Plan (EMP) for sustainable development and operation of the project is developed for implementation and monitoring of the project activities.

This EIA report has been prepared after identifying the environmental aspects and screening the potential impacts to ensure that the pertaining proposed project activities in the Gambat-II Block are environmentally conducive and compliant to local environmental laws most important the Sindh Environmental Protection Act, 2014. Scope of EIA study included:

- Description of project activities
- Review of legislative framework for the project
- Description of environmental and social baseline of project area
- Stakeholder Consultation
- Analysis of project alternatives
- Impact Assessment and Mitigation measures
- Development of Environmental Management and Monitoring Plan

1.6 Project Categorization

The EIA study is a mandatory requirement under the provisions of Sindh Environmental Protection Act 2014 and the rules made thereunder. Sindh Environmental Protection Act, 2014 under section 17 (1) mandatorily requires proponent of project to file an IEE or EIA, as the case may be, and obtain approval from the SEPA before commencing construction or operation of the project.

Section 17 (1) of the 2014 Act is reproduced herein under for reference:

“17. (1) No proponent of a project shall commence construction or operation unless he has filed with the agency an initial environmental examination or environmental impact assessment and has obtained from the Agency.”

Sindh EPA Environmental Assessment Regulations, 2021 categorize projects into three separate schedules depending on whether a project requires an Environmental Checklist (Schedule-I) or an IEE (Schedule-II) or EIA (Schedule III). The Regulations also require that all projects located in environmentally sensitive areas need submission of an EIA.

The proposed 2D/3D seismic activities will be carried out inside the Environmentally Protected area (i.e. Takkar Wildlife Sanctuary and close to Khat Dhoro Wildlife Sanctuary), therefore project falls in Schedule III of SEPA regulation.

J. Environmentally Sensitive Areas

All projects situated in environmentally sensitive areas being identified by the agency.

Accordingly, this EIA study was conducted and its report is being filed with the Sindh Environmental Protection Agency for approval.

1.7 EIA Methodology

Brief description of the different steps taken during the EIA study are given below.

1.7.1 Collection and Review of Project activities

At the outset of EIA, necessary project information was collected from client to acquire an understanding of the project activities and to determine the extent and scope of field surveys and impact assessment.

1.7.2 Review of Applicable Legislations and Guidelines

National legislation, international agreements, environmental guidelines, and best industry practices were reviewed to identify the legal requirements and international applicable guidelines that PPL is required to meet during the project.

1.7.3 Secondary Data Collection

All available secondary data including previous studies in the area, case studies, baseline studies, census reports, and reports by geological survey of Pakistan etc. were gathered and reviewed. Previous studies conducted by EMC in the area were also reviewed during this task. The information collected from secondary sources included information related to physical, biological and socio-economic environment of the project area.

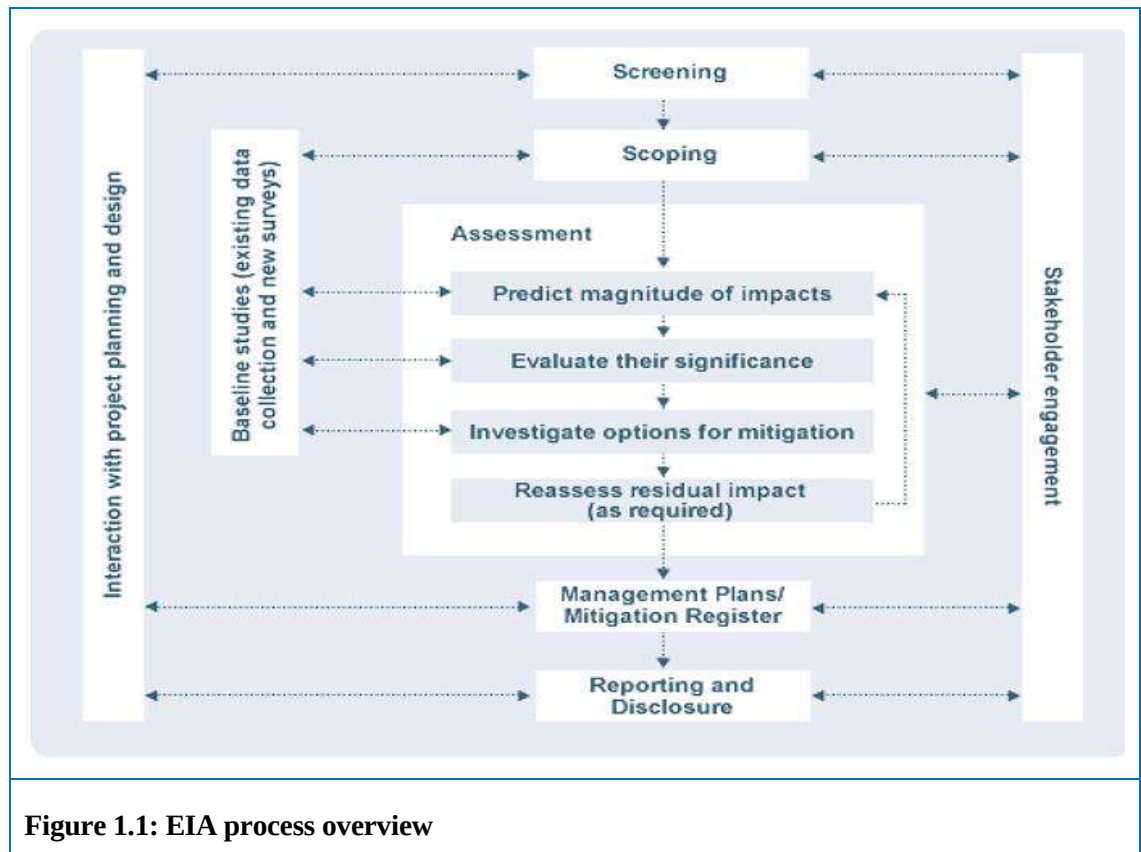


Figure 1.1: EIA process overview

1.7.4 Field Data Collection

Field surveys of the project area were conducted by the EMC team. During the site visit, primary data was collected on the physical, biological, and socio-economic conditions of the project area. Discussions were held with local community members to gather area-specific information, as well as their views and concerns regarding the project and its associated activities.

The survey team visited agricultural lands, historical sites, water bodies, desert regions, as well as schools and colleges within the Gambat-II Block. An ecological survey was also carried out in collaboration with a wildlife expert, focusing on the Takkar and Khat Dhoro Wildlife Sanctuaries, as well as the Mehrano Wildlife Refuge. The purpose of this visit was to obtain expert recommendations on mitigation measures to minimize and eliminate potential adverse impacts on local ecology and wildlife.

	
Observing fauna foot prints	Noise Monitoring
	
Assesment of fauna and flora	Social & wildlife consultation with local people
	
Group photo with villagers	Social consulation
	
Air monitoirng	Following the Houbara bustard foot prints
Figure 1.2: EIA field survey team	

1.7.5 Impact Identification and Assessment

Following collection of field data during surveys, potential impacts which may arise from proposed activities were identified. These include effects on physical, biological, socio-economic, archaeological and cultural environment. Impacts were identified in particular on the biodiversity and assessed on the basis of field data collected from project area, secondary data, expert's opinion, and monitoring results of previous oil and gas exploration projects in Pakistan.

1.7.6 Recommendations to Mitigate Impacts

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

1.7.7 Framework of Environmental Management Plan (EMP)

Environmental Management Plan (EMP) was developed for effective implementation of the recommended mitigation measures. EMP includes controls to minimize the identified impacts, and monitoring program to monitor residual impacts, if any, during the operation. The EMP has laid down procedures to be followed during the seismic survey and drilling operation and has identified roles and responsibilities for all concerned personnel during the operation, including post project reporting.

1.7.8 Reporting

The Report has been prepared according to Sindh Environmental Protection Agency (SEPA) guidelines for environmental assessment. This report includes the findings of the assessment, the project impacts, and the mitigation measures to be implemented during the execution of the proposed activities.

1.8 Organization of this Report

This report consists of eight sections including this introductory section. Sequence wise sectional brief is given as follows:

- **Section 1** gives introduction of project and overview of process
- **Section 2** describes the proposed project activities;
- **Section 3** contains an overview of applicable national regulatory requirements as well as international conventions, guidelines which are relevant to Oil & Gas industry and applicable in the scenario of Pakistan;
- **Section 4** describes baseline of project area that includes existing environmental conditions such as natural and socioeconomic environment as well as biodiversity.

- **Section 5** details on stakeholder & public consultation that was carried out during field visits for this study. It further contains the responses received from representatives of concerned departments and local inhabitants respective to proposed project;
- **Section 6** presents assessment of potential impacts of proposed seismic operations along with appropriate mitigation measures for mitigation of these impacts;
- **Section 7** provides a comprehensive Environmental Management Plan (EMP) and defines the changes in management criteria for the environmental assessment and identifies the steps that need to be taken if there is a change in project activities or in the area where the seismic survey would be conducted;
- **Section 8** concludes the EIA study and its outcome.

1.9 EIA Study Team

Table 1-1: EIA Study Team

S. No.	Name	Position in Project
1	Mr. Syed Nadeem Arif	Project Manager
2	Mr. Ahmed Zohair Siddiqui	Team Leader
3	Mr. Imran Khan	Environmentalism
4	Mr. Muhammad Shayan Ansari	Environmental Engineer
5	Mr. Ghulam Sarwar Jamali	Wildlife Expert
6	Ms. Areesha Muntaha	Environmental Scientist
7	Mr. Mudassir	Environmental Engineer
8	Mr. Shahzaib Shamim	Environmentalism
9	Mr. Raja Nizakat	Sociologist
10	Mr. Hassan Ali	Field Officer
11	Mr. Shahab Uddin	GIS Analyst
12	Mr. Zain Rafi	Cad/Graphics

2.0 DESCRIPTION OF PROJECT

2.1 The Project

PPL intends to conduct 2D and 3D seismic survey in the Gambat-II Block to explore the hydrocarbon reserves. The total area of block is 1,697.56 sq.km which span into the districts of Khairpur and Sukkur in Sindh Province. The 3D seismic survey will cover an area of approximately 696 square kilometers, while the 2D seismic survey will span 330-line kilometers

The proposed 3D seismic activity covers an area of approximately 696.00 sq. km, predominantly spanning in ecologically sensitive zones, such as Takkar and Khat Dhoro Wildlife Sanctuary. In contrast, 2D seismic lines span on approx. 330 L.km across the entire Gambat-II Block. To support this activity, base and fly camps will be established. The camp will serve as the central hub for operations and logistics while, fly camp will be secondary camp which will be located closer to the active survey's areas for more efficient data acquisition. The designated explosive storage camp will be also constructed to store the explosive which will be used in dynamite shot holes during seismic activity.

Table 2.1: 2D Seismic lines at Gambat-II Block

Line_ID	Start_X	Start_Y	End_X	End_Y	Line_Km
PPL25-GAMII-01	456652.8342	2977617.5567	472168.1011	3013552.3067	39.00
PPL25-GAMII-02	445060.9768	2986891.0567	473683.9570	2979400.8848	30.00
PPL25-GAMII-03	452818.6038	3006953.8848	466372.1680	3042531.9629	38.00
PPL25-GAMII-04	445417.6487	2995540.3692	477429.0220	2986356.0098	33.00
PPL25-GAMII-06	446130.9964	3004189.6817	480460.7395	2993667.8067	36.00
PPL25-GAMII-08	446220.1643	3013284.8379	483581.6292	3002406.2910	39.00
PPL25-GAMII-10	445863.4905	3021577.4785	470117.2351	3014354.8379	25.00
PPL25-GAMII-12	446487.6682	3029245.9473	472703.1106	3020774.9473	28.00

PPL25- GAMII-14	446220.1624	3036468.5723	475110.6502	3027016.7285	30.00
PPL25- GAMII-16	447557.6858	3042977.8535	478053.1995	3033704.3379	32.00
Total Line Km					330.00

Table 2.2: Surface coordinates of Gambat-II planned 3D seismic survey

ID	X	Y
A	476933.7659	3044649.1348
B	495647.5315	3041609.1035
C	480893.7024	3008806.5098
D	460184.4710	3010982.1504

2.2 Project location

The Gambat-II Block is geographically located predominantly within Khairpur District, while its northeastern portion extends into Sukkur District of Sindh Province. The proposed project area (fig 2.1) includes several key settlements, such as Shadi Shaheed, Gambat City, Tando Masti Khan, Kot Diji, and the Khairpur Special Economic Zone. Access to the project site is facilitated via National Highway N-5 (Indus Highway) and National Highway 55 (Mehran Highway), as well as adjoining roads like Nara Road, Thari Road, and Thari-Naro Road. Within the project area, the Rohri canal and Khairpur East Feeder originate downstream of the left zone of the Sukkur Barrage. Both canals run from north to south, dissecting the project area.

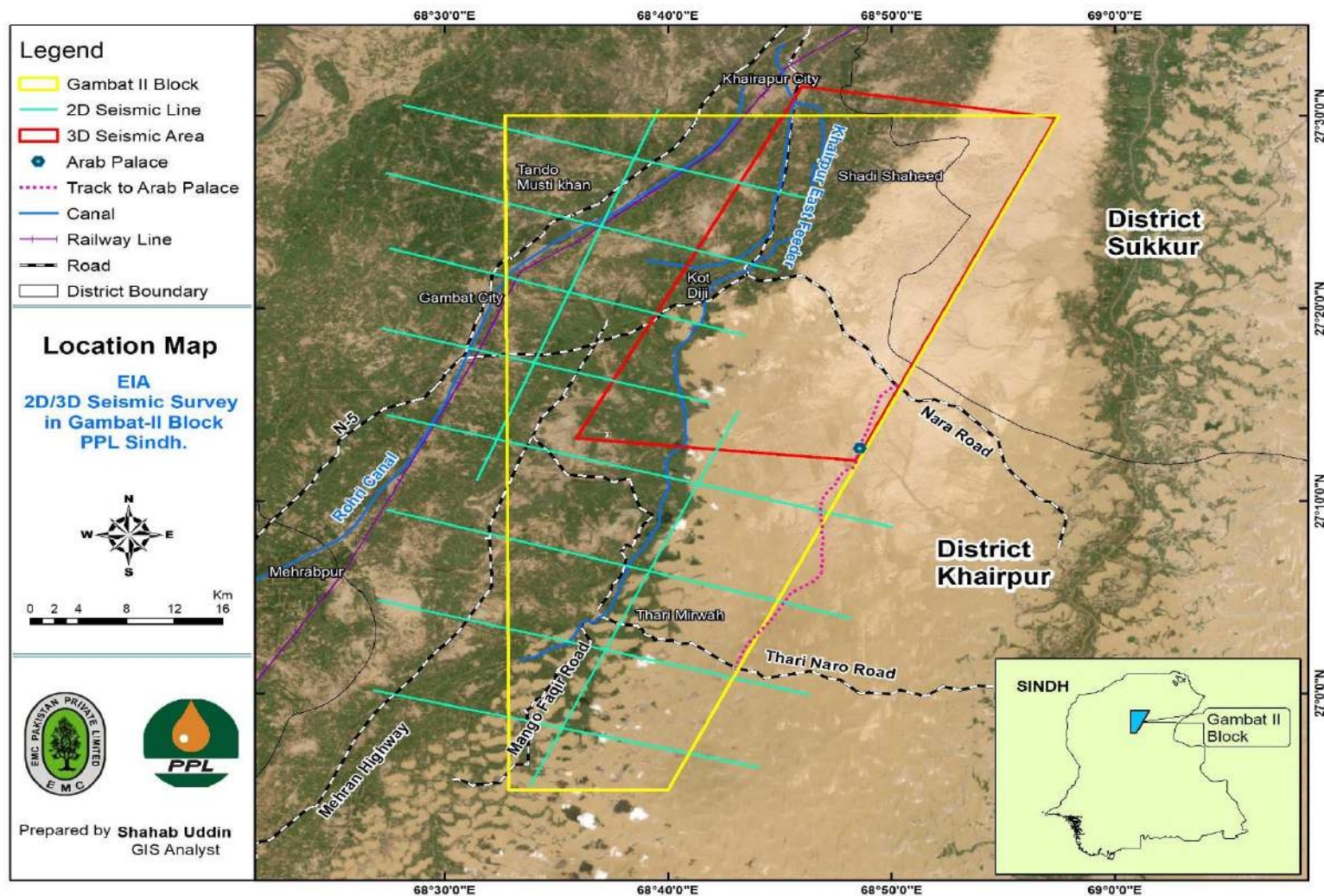


Fig. 2.1: Location map of the Gambat-II Block PPL

Figure 2.2: Physical feature of the Project Area



A view of arid shrub land ecosystem



Lizard borrow area



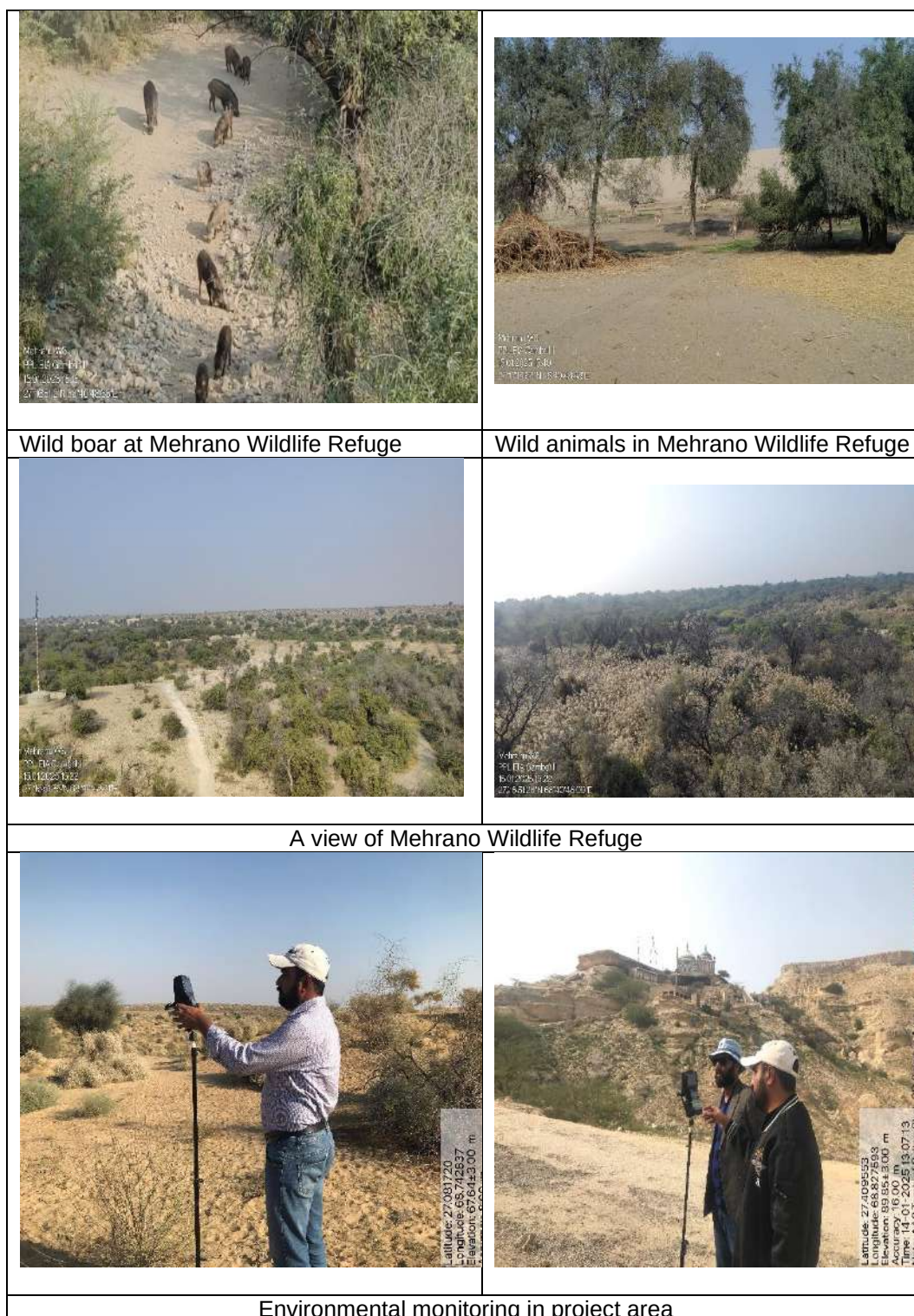
Agricultural field



Flora in Takkar Wildlife Sanctuary



Consultations with locals



2.3 Project Need

Energy, being lifeline of socio-economic development of a country, occupies a dominant position in the development plan as ensuring energy security is one of the important themes of the Vision along with water and food. Pakistan is facing a formidable challenge of energy shortage with the demand outweighing its supply. The energy shortage has adversely affected all sectors of the economy.

Pakistan's existing energy mix is highly dependent on expensive fuels, like oil and gas, instead of coal and hydel. At the moment, the country is termed as an energy deficient nation and relies heavily on imported fossil fuels⁴. It's estimated that over 60% of Pakistan's foreign exchange is spent on importing these fuels⁵. The fluctuating prices of crude oil in the international market have significant repercussions on Pakistan's economy. The discovery of new potential oil and gas reserves could help Pakistan in balancing its export and import bills, thereby bolstering the economy and reducing dependency on expensive fuel imports⁶.

2.4 Project objectives

Pakistan Petroleum Limited aims to achieve following objective from the proposed project.

- Exploration of new hydrocarbon reserves through seismic survey on the basis of promising geological features.
- To boost domestic fossil fuel production, helping alleviating Pakistan's energy deficit and support sustainable economic development.

By achieving these goals, PPL aims to strengthen the country's energy supply, mitigate power shortages, and contribute to long term economic stability.

2.5 Scope of Work

The main proposed project activities comprise following:

- Land acquisition
- Construction of access track
- Development of campsites (Base Camp and Fly Camps (if required))
- Crew mobilization
- 2D Seismic Surveying
- 3D Seismic Surveying
- Restoration and rehabilitation.

2.6 Seismic Survey

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 receives sound signals generated either by a controlled impulsive source such as seismic explosive or by vehicle mounted vibrator trucks.

⁴ Rehman, S.A et. al.; The Future of Sustainable Energy Production in Pakistan: A System Dynamics-Based Approach for Estimating Hubbert Peaks, 2017

⁵ <https://tribune.com.pk/story/2384887/66-of-forex-spent-on-fuel-imports>.

⁶ ibid

Two basic types of seismic data acquisition techniques are being used in Pakistan: two-dimensional (2D) and three-dimensional (3D). The seismic operation proposed by PPL comprise of 2D and 3D seismic data acquisition within the project area. A three-dimensional seismic survey utilizes multiple points of observation. This is accomplished by deploying a grid of geophones and seismic source impact points along the surface of the area being studied. The result is a volume or cube of seismic data sampled from a range of different angles and distances. A 3D survey is used when a 2D survey reveal a geological structure or element that are suspected to contain oil or gas. It yields a more detailed picture by providing information about a smaller area in 3 dimensions.

Seismic surveys can be conducted using a number of methods, including deep holes, shallow holes (also referred to as the pop shot methods) or using vibroseis. Factors that influence the selection of a particular method include land type, economics and environmental concerns. Dynamite technology will be used as a source of energy at places where less clearing of agricultural lands is required and in hilly / mountainous terrain.

2.6.1 Survey Methodology

The main purpose of the proposed seismic operation is to investigate the hydrocarbon potential in the Gambat-II block area and to identify a suitable location for the drilling of the exploration/ appraisal/ development well. It is anticipated that the seismic survey of the Gambat-II block will be completed within 12 months after mobilization of the seismic crew.

Three techniques will be used for data acquisition; vibroseis in the desert area; dynamite within agricultural lands and all other areas where access or working of the vibroseis will be difficult; and Upholes that may be drilled at selected locations within the area of the seismic survey. Each seismic operation will involve housing a maximum of ~1000 people in a camp site and the use of water for domestic and operational purposes. Local labor will also be employed during the operation. In pursuance to the requirements of the exploration license with the Government of Pakistan, PPL intends to carry out 3D seismic activity over an area of 696.00 sq.km, predominantly spanning in ecologically sensitive zones, including the Takkar Wildlife Sanctuary and Mehrano Wildlife Refuge. In contrast, 2D seismic lines span on approx. 330 L.km across the entire Gambat-II Block.

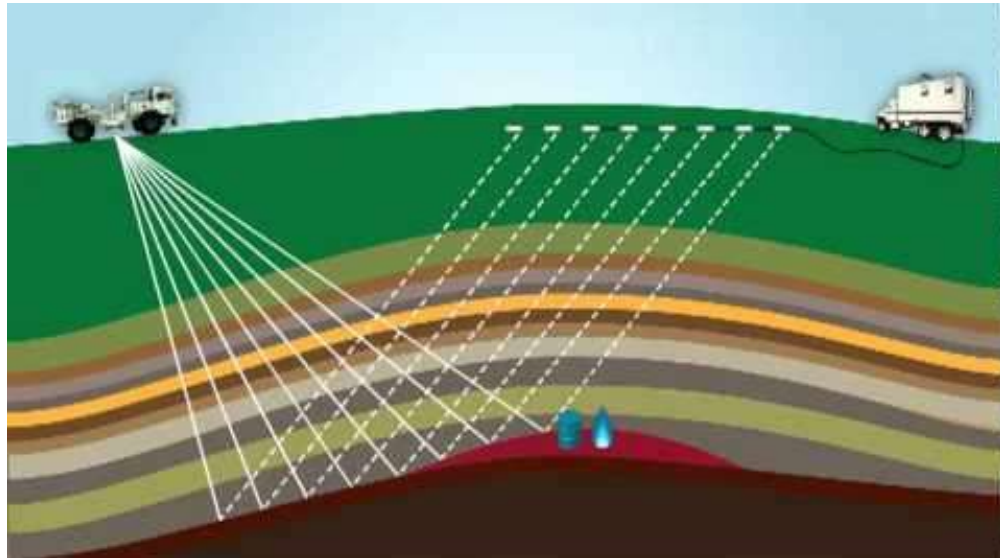


Figure 2.2: Seismic survey Procedure

The different activities that will be involved in conducting the seismic survey are:

- Land Permitting
- Line Survey & Preparation
- Drilling shot holes
- Cabling
- Shooting and recording
- Restoration and rehabilitation

A description of activities involved in seismic program is provided below.

2.6.2 Line Permitting

Before commencement of work, a permitting team headed by chief permit man will arrive in the area. The team's early arrival will facilitate activities such as liaising with local landowners and authorities to inform them of the operation and make necessary arrangements. The permitting team will identify the ownership of the land areas over which the seismic operation will be undertaken. In consultation with the district administration and following agreed rates, compensation will be given to the land owners. During the seismic survey, the chief permit man will be the focal point for communication between local inhabitants and seismic survey personnel.

2.6.3 Line Survey and 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 every 25/50m interval with whitewashed stones or wooden pegs.

Seismic lines lying in the desert will be cleared to a width of 4.5m and a depth of a few inches with a bulldozer. This will allow the movement of vibroseis over the cleared strip of land along the line. Clearing of trees and dense patches of vegetation will be avoided. The material that is removed will be pushed to either side of the line creating low windrows along the length of the line. Seismic lines lying in agricultural fields will not be cleared, as dynamite will be used as the energy source in these areas.

2.6.4 Data Acquisition- Dynamite

In this technique, shot holes will be drilled on the seismic lines passing through agricultural lands or areas where access or working of vibroseis will be difficult. These holes will be drilled using portable hand driven drills. Each drill will be operated by a team of 4 drillers headed by a foreman. A total of 5 to 10 drilling teams will be employed on each line. It is expected that each team will be able to drill 10 to 15 holes per day. If required, each drilled hole will be cased with a Polyvinyl Chloride (PVC) pipe to prevent the hole from collapsing. If a shot point cannot be drilled at a specified location because of any environmental restriction, a replacement point will be located as close to the original shot point as possible. Similarly cables and geophones will be laid across the surface water bodies (rivers, canal or dhands etc.) for data acquisition purposes.

Due to loose sandy material expected in the area, the holes during drilling will be flushed with bentonite mud. The bentonite mud will be prepared near the shot point in a 2m square and 0.5m deep earthen pit. Water required for the preparation of the mud will be transported by water tankers. These water tankers will travel only on existing tracks. In case an existing track does not reach to a shot point, the tanker will stop on the track at a position nearest to the shot point, from thereon water will be transported by means of hose pipes connected to the tanker. The spent drilling mud and cuttings will be stored inside a similar earthen pit. The spent mud and cuttings will be allowed to dry after which the pit will be backfilled with at least 15cm of top soil cover. The pits will be clearly marked until restored. Since bentonite is a type of clay and a non-hazardous material, burial of the mud and cuttings on site will not contaminate soil or groundwater.

After completion of drilling, each shot hole will be loaded with 0.5-8 kg of dynamite and 1 or 2 detonators. Explosives will be handled by a loading crew who will be specially trained in the handling, storage, transportation, charging, firing and safety of dynamite. The charges will be carefully inserted into each hole before the cylindrical PVC casing is removed. Each hole will then be backfilled with sand.

Different teams working on the seismic activity include front crew, back crew, shooting crew, recording crew and green crew, who will carry out shooting, recording and restoration along the seismic lines. These teams will operate several days behind the drilling team.

The front cable crew will layout the cables and plant geophones along the seismic line. The cables and geophones will be symmetrically laid out 4 to 4.5 km along the seismic line on either side of a shot point. The geophones connected together in groups of 24 or more will be planted along the line at intervals of 1m to 5m. Each string of geophones will be

connected to a cable, which will be connected to a station unit. The station units will be connected to a recording unit through the same cable. The points along which cables and geophones will be laid are termed receiver array.

The shooting crew will be responsible for the detonation of charges. Once the cables and geophones have been symmetrically laid out along the line, the charge is detonated by a crew comprising of 4 men. At the surface the sound of the detonation will be no more than a muffled thud. The process is repeated along the line; cables and geophones being removed from the back of the line and placed at the front of the line as the shooting crew progresses.

The recording crew will monitor the recording equipment and recording of the seismic data. The back cable crew will be responsible for picking up the cables, geophones and station units. The green crew will follow the back cable crew and remove all wastes from the seismic lines and restore the shot holes as close to their original condition as possible.

2.6.5 Data Acquisition- 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, 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. The arrangement of cables, geophones and station units will be similar to the arrangement adopted for dynamite. 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 5-8 km of line can be recorded each day.

2.6.6 Data Acquisition- Upholes

Upholes will be drilled with the help of truck mounted drilling rigs. These holes will be drilled to a depth of up to 100m and will be 150mm in diameter. To ensure stability of the borehole, a water-based bentonite mud will be circulated through the hole. It is estimated that for each hole approximately 8,000 liters of water will be required for the preparation of the bentonite mud. The mud will be prepared in an earthen pit near the hole. A similar pit will be used to store the used mud. After drying the pits along with their contents (bentonite mud and cuttings) will be backfilled. Data from upholes will be collected by a hammer source at the surface or blasting the detonators lowered in the hole and string of geophone suspended inside the hole in case of hammer or place on surface in a particular geometry.

Table 2.2: List of equipment for seismic survey

Recording Crew's Equipment

1. Seismic Recording System of 24 bit (SN-428/408 or equivalent/better) capable of not less than 10000 channels digital recording at 2 m.sec sample rate for 3D.
2. Oscillograph Camera with a minimum capacity of 10000 channels
3. Dual tape drive should be able to produce two original 3490 or 3590/3592 cartridges in SEG-D format and capable to copy a second set on 3490/3590/3592 or 3592 cartridges in SEG-Y format
4. Truck (4x4) with air-conditioned cabin housing the above system.
5. Color Printer
6. CD-R / DVD-R drive
7. Telemetry cables with 4 take out @ 60-65 meter intervals
8. Geophone strings of 12 geophones per string
9. FDU (At each channel)
10. LAUL (After 40 channels)
11. LAUX (For each line in the template)
12. Decoder Shot Pro
13. Encoder Shot Pro
14. Instrument Truck
15. Transportation Truck
16. Line Trouble Shooting Pick-up
17. Spare Part Kit
18. Marsh geophone string
19. Appropriate Personal protection equipment's (PPEs)

Survey Crew's Equipment

1. Trimble R8 or Leica 1230 & 530 with Dual Frequency Satellite Receiver
2. Handheld GPS receivers with dual frequency for positioning
3. Survey Data Processing System
4. Transportation Pick-up
5. Plotter 36"

Shot Hole Drilling Equipment for Dynamite Source

1. Portable Flushing Unit
2. Water Bowser
3. Transportation Truck
4. Transportation Pick-ups
5. Dynamite transportation vehicle
6. Detonators transportation vehicles
7. Vibrators
8. Dozer

Up-hole Crew Equipment

1. Truck mounted Drilling Rig should have capability to drill down to 120 meter plus
2. Down hole detonator harness
3. 48 channels Seismograph with complete accessories
4. Transportation vehicle
5. Water Bowser

Table 2.2: List of equipment for seismic survey

Recording Crew's Equipment

In-Field Processing Units

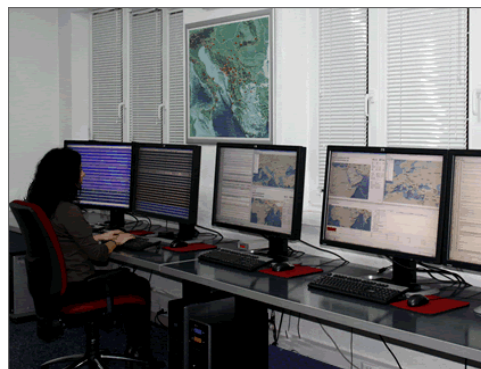
1.	Workstation with complete accessories
2.	Processing System, with complete range of seismic function modules for full 3D seismic data processing.
3.	Thermal plotter 24"
4.	HP 4000 Jet Printer
5.	CD/DVD-ROMs Driver DLT 8000
6.	Personal Computer with complete accessories



Seismic Recording Truck



Seismic Drilling Rig



Data Centre for data analysis



Survey Equipment

Figure 2.3: Machinery and equipment used in Seismic survey

2.6.7 Camp, Staffing & Supplies for seismic survey

One base camp and fly camps (if required) will be prepared to house a maximum of 1000 crew members. The Labor requirement in the following project will include skilled and unskilled labor to be employed for seismic, mobilization and activity. For seismic activity, the persons would be employed in different areas, including survey teams, geophysical experts, recording crew, data acquisition crew, camp crew, domestic staff and support staff. For unskilled jobs, priority will be given to locals. The camps will be located and constructed such that minimum clearing of vegetation or land is involved. The base camp will include accommodation area including tents and Porta cabins; senior and junior

kitchens 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 garbage pit. The camps will be fenced for security reasons. The base camp will be prepared by an advance party. Survey work will start only after satisfactory set up of the base camp. Most camp supplies will be transported from Hyderabad, Karachi and Sukkur. Water will be required during the operation for domestic and drilling purposes. The required quantity of water will be obtained from existing local tube wells in the area or through water bowzers. The contractor must obtain written permission from the relevant authority (such as the Irrigation Department) prior to extracting water from any surface water body or canal. A bulk stock of dynamite will be transported to the project area. This will be stored in a purpose-built explosive storage area located at a safe distance from communities and the seismic camps. The explosives will be stored in an excavated pit lined with concrete blocks and covered with tarpaulins. The area will be fenced and guarded for security reasons. Power required during operation of the base camp will be met through installation of diesel generators.

Table 2.3: List of communication and camp equipment

	Communication Equipment
1.	Field Base Camp and Field Units for data acquisition. Radio (25-40w) and walkie-talkies (5w)
2.	Satellite Phone
	Camp Equipment
1.	Medical Care Trailer
2.	Office Trailer for Survey and on-site Processor
3.	Drinking Water Supply Truck
4.	Fuel Tanker Truck
5.	Water Tanker
6.	Water Purification Facility
7.	Power Generator (base Camp)
8.	Battery Charger
9.	Photocopier
10.	Geo-phone String Tester
11.	Test Maintenance System
12.	Line Tester
13.	Grip Meter
14.	Mechanic & Elec. Maintenance Shop
15.	Spare Part Kit with complete accessories to repair all field equipment including geophone strings, FDU cables, LAUL, LAUX etc.
16.	Personal Computer with complete accessories including printer for company Representatives.

2.6.8 Access & Transportation of equipment to seismic lines

Access to seismic lines will mostly be through existing tracks. As four-wheel drive vehicles will be used by the project, these tracks can be used without any improvement. Short reaches of new tracks may have to be prepared in areas where there is no existing access, however, the preparation of new tracks will be minimized.

Table 2.4: List of transportation vehicle

1.	Ambulance
2.	4x4 Vehicle
3.	Logistics vehicle

2.6.9 Estimated quantity/volume of utilities to be consumed during seismic activities (Water, Fuel, etc.)

- Utility water: ~ 4,200 gallons per day
- Drinking water: ~ 2,400 gallons per day
- Electricity Required: ~ 500 KWh electricity per day
- Fuel Consumption: As per requirement

2.6.10 Restoration and Rehabilitation

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.

2.7 Schedule of activities

The 2D/3D seismic survey is scheduled to commence in the second quarter of FY 2025–26 and is expected to be completed by the second quarter of FY 2026–27.

2.8 Project cost

The total cost of the project is approx. USD 10 million

2.9 Effluents and Waste generation

The primary source of waste effluents during the camp site activities will be the domestic sewage generated at camps. Septic tanks of adequate size will be provided at camp for the treatment of sewage. Excess water from the septic tanks, as well as effluents from kitchen and washing areas, will be released into soaking pits. The solid residue from the septic tanks will be transported periodically to a municipal sewage treatment facility. Waste

lubrication oil from vehicles and machinery will be collected in drums and transported to recycling contractors.

During seismic activities, minimal waste is expected to be produced, as much of the process do not contain materials that produce. Seismic Operations will have minimal waste generation, mainly due to the residue that will be produced by the Dynamites. Furthermore, domestic waste will be produced. It is estimated that around 50 kg of solid waste will be generated per day.

2.9.1. Waste Management

The main concept for waste management will be that the environmental impacts associated with the disposal of project-generated waste are within acceptable limits. All waste water from kitchen and washing areas are to be collected into septic tank system.

Solid waste will be segregated. Most of the garbage plastic, glass and other non-combustible and recyclable waste will be segregated and supplied to vendors for recycling. The volatile combustible waste will be handed over to a certified waste contractor for disposal. Anything potentially dangerous such as batteries and aerosols will be placed in a separate container, appropriately marked, and disposed of with the proper authority.

Medical waste will be bagged and binned in a separate container appropriately labeled. This waste will be incinerated at nearby available facility through a certified waste contractor. A summary of waste management mechanism is presented in Table below.

Table 2.5: List of Different Type of Waste and Disposal Options		
Type of Waste	Description	Disposal Options
Food Waste (decayable waste)	Animal, fruit or vegetable residues	Buried in a pit safely or handed over to waste contractor.
Packaging Waste	Paper, plastic, textiles, cardboard, rubber, wood, glass, tin cans, aluminum cans	All Combustible material such as paper, plastic, textiles and non-combustible materials such as glass, tin and aluminum cans to be hauled away by contractor for recycling^(a)
Medical Waste	Syringes, glass bottles, soiled bandages, expired drugs, dressings	- Syringe needles to be cut with cutter and sent for incineration - Soiled bandages and dressings and needles to be sent for incineration - Expired drugs to be taken by contractor for disposal
Workshop Waste	Used oil, ferrous/non-ferrous materials, batteries, oil contaminated top-soil	- Handover vehicle related waste to local contractors for recycling⁷ - Used oil shall be provided to OGRA reclamation license holder Lubricating

⁷ PPEPCA Sectoral for Upstream Petroleum Sector – Onshore Volume 2 of 2

		Plant for reclamation or disposed of through EPA approved waste contractor. Batteries to be hauled away by contractor for recycling
Demolition Waste	Dirt, concrete, plaster, plumbing, heating and electrical parts	- Dirt, concrete and plaster to be buried at site; and - Plumbing, heating and electrical parts to be hauled away by contractor for recycling
Liquid Waste	Wastewater from kitchen and washing areas, sewerage	- Wastewater from kitchen and washing areas to be collected in septic tanks; and - Sewerage to be disposed of in a septic tank and soaking pit
Waste	Drill cuttings	Bentonite mud used for the purpose of up hole and shot hole drilling will be prepared in earthen pits. The used mud and drilling cuts will be disposed of in the same pit and left to dry. After the mud has dried the pit will be backfilled. Earthen pits for preparation and disposal of bentonite mud and drill cuttings will be located in an area where minimum vegetation clearing is involved.
Oil spills /soil contaminated by oil leakages or spills	Contaminated soil	- Oil spills will be contained and controlled using shovels, sands, and native soil. The equipment and materials will be made available at camp sites and during the operation. - The contaminated soil will be excavated and temporarily stored in a bounded area lined with an impermeable base. - Finally, the contaminated soil will be disposed of through EPA certified waste contractor
<i>a: Appropriate monitoring measures will be adopted to ensure that the material is actually recycled</i>		

2.10 Project alternatives

2.10.1 Introduction

The analysis of the project alternatives is a part of the EIA process to select the best among all the possible options. Alternatives to a project are defined as functionally different ways of achieving the same end result. The key criteria when identifying alternatives is that they should be feasible and reasonable.

The factors that govern the selection of potential alternative options and scenarios include: availability of alternate project sites, current technologies, design changes that need to be introduced, operational situation, capital & recurrent costs, environmental & social issues, their potential impacts, and costs of mitigation.

The “No Project” option is taken into account to demonstrate the need of the Project. In consideration of the different drivers, potential alternatives within the Project are restricted to the following aspects:

1. No project option
2. Project site alternative
3. Survey design technologies alternative
4. Acoustic source alternative
5. Line cutting technologies
6. Access Road
7. Transport vehicle

2.10.2 Project Consideration- Project and No project option

The project involves geophysical 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 geophysical investigation.

2.10.3 Project site alternatives

One alternative to the project is to leave the assigned project area. The Government through previous exploration work by various companies has identified a number of ‘blocks’ with potential for oil and gas reserves. The site for oil and gas exploration is chosen after extensive geological and land surveying, and not every concession area necessarily shows promise. When a porous reservoir rock forms an anticline deep in the subsurface, it may trap migrating hydrocarbons. The presence of such a structure at depth is indicated by surface geological studies and confirmed by conducting seismic surveys.

The alignments of the seismic lines proposed by the proponent represent areas of highest potential. Given the low to medium significance of the impacts associated with the project, no change in alignment of the survey lines will be required.

2.10.4 Survey technologies alternative

The technology to be employed for the seismic survey is the latest state-of-the-art for activities of this nature. 2D and 3D Seismic data acquisition, of approximately 330. L. Kms and 696.00 square kilometers respectively, will be carried out in the project area. The proponent will acquire a number of seismic survey lines (track lines) along which seismic

data will be recorded. The seismic survey operations and related activities will be constrained to the seismic survey lines, and to the base camp, fly camps and access roads to these areas within the Gambat-II block. On an area-wide survey such as this, there is considerable scope to adjust line placements and program size to bypass habitations or areas of particular sensitivity. A detailed evaluation of each line will be carried out as work progresses and line placements will be adjusted to achieve the survey objectives with minimum disruption and impact to the environment and resident communities.

Two methods will be used to generate the seismic waves (1) Truck mounted Vibroseis units, and (2) dynamite charged shot-holes for seismic data acquisition.

2.10.5 Acoustic source alternatives

Vibroseis and dynamite are the technologies proposed by the proponent for carrying out the 2D and 3D seismic survey.

2.10.5.1 Vibroseis

In this case, truck-mounted “vibrators” provide the primary source.

Alternative Technologies

The Vibroseis technology is a state-of-the-art technology that is widely used to carry out seismic surveys around the world. The only other alternative to Vibroseis is using a dynamite shot-hole (discussed in above section). The commonly used type of vibrators generates a peak force of 282 KN (63,500 lbs.). Vibroseis is generally preferred over dynamite shot-holes for the reasons; lower cost than dynamite operations, vibrator settings can be adjusted in the field and hence can greatly improve the results of a survey; and Vibroseis source points can easily be recorded again if for some reason the reflected signals are not of the required quality.

Recommendations

Vibroseis units have the advantage of not requiring shot-hole drilling crews or explosives. However, in wooded areas these large vehicles require much wider lines to be cut or mulched and in water-logged soil the tires may cause surface damage. Vibroseis will accordingly be restricted to dry, sparsely vegetated areas. Given the semi-arid to cultivated conditions of the project area, besides the eastern and southeastern part of the Gambat-II block which has sand dunes and rough terrain, Vibroseis is the preferred option for seismic survey in the flat-lying or gently undulating areas, while dynamite shot-holes would be preferred in the more rugged areas.

2.10.5.2 Dynamite shot-holes

In this case, a small charge of explosive is placed in a narrow-diameter hole drilled 18-25 meters into the ground, before being detonated remotely. Depth of hole, charge size, and type of explosives can affect the final quality of seismic data.

Alternative Technologies

The only other alternative to dynamite shot-holes is Vibrioses. Dynamite shot-holes are normally used in cases where Vibrioses method cannot be utilized, such as areas with steep slopes or rough terrain. This method has some constraints. As earlier mentioned, shot-hole depth, charge size, and type of explosive must be predetermined prior to the actual survey: none of these variables can be easily adjusted to improve data recovery, while Vibrioses field testing is easily conducted to determine optimum sweep frequencies and sweep lengths.

Recommendations

This technique will be useful and effective in hilly, rugged and steep terrain, in dry or waterlogged terrain, as well as in sensitive areas such as archaeological sites.

Both hand-powered and machine-powered drill units will be used according to the hardness of the ground and depth of hole. There will be man-portable units in areas where access is very limited and a low-impact technique is required. In most areas, however, drill units will be mounted on wheeled or tracked vehicles as the terrain requires. The drilled “shot” holes are usually destroyed by the detonations and will be backfilled on the surface after use. With this form of acquisition, seismic lines need only to be around two meters wide and can be meandered to avoid mature vegetation.

2.10.6 Line cutting technologies alternate

Alternative Technologies

A few decades back, the lines used to be cut using bulldozers: this was not considered environmentally friendly because they removed vegetation entirely, as well as scraped off surface soils. The current state-of-the-art technology is the use of mulchers. The mulching units are self-powered vehicles mounted on low ground pressure tracks or wheels exerting only 3-3.75 psi pressure on the surface. These machines cut low-lying vegetation and leave behind fine, rapidly bio-degradable nutrient-rich mulch in their wake with seeds intact. Soil structures and root systems are also left intact. Regeneration of mulched vegetation is rapid and even in arid areas vegetation returns to its pre-cut state in one to two years. Some areas of the Gambat-II block, especially to the western portion where agricultural activities are undertaken will need mulching to protect the top soil and allow quick re-growth of vegetation.

Recommendations

Line cutting will not be necessary in some parts of the project area on account of the bare or sparsely vegetated surface with thin soil cover overlying hard rock beneath. In areas where line cutting will be necessary, the method used will range from bulldozers, to the use of mulchers to clear areas with relatively dense vegetation and areas where farming takes place. The mulchers will cut a track of 2.5 meters in width without disturbing the top mat of soil.

2.10.7 Alternative with respect to project schedule

The timing of the operation can be changed on finding of significant impacts associated with the timing of the operation e.g. disturbance to wildlife species during their breeding season. The proponent will carefully schedule the project activities with the ultimate objective to create least possible disturbance to the environment and the communities.

2.10.8 Access road technologies

As far as is practicable, existing routes will be used to reach the proposed seismic activity areas in the Gambat-II block. Where this is not possible, access roads may have to be constructed. These are typically done using a bulldozer and light hand-cutting of vegetation using machetes. Some lines may have to be bulldozed to allow access for the Vibrioses vehicles. Such routes should also be planned, so that such access roads can benefit the local communities once the project is over.

2.10.9 Transport equipment

This could include the following: normal saloon/station wagon 4WD cars, pickups, water tanker, fuel tanker, personnel carrier, Vibrioses service truck, recording truck, line equipment layout truck, food transport truck, heavy trucks and ambulances. Selection of the appropriate make and type of this equipment will be carried out later by the seismic contractor, based on a consideration of the environmental setting and challenges posed to vehicles.

2.10.10 Alternatives to Ancillary Operations

The ancillary operations like setting up of camp sites, camp operation etc. are necessary for conducting the operations and are assessed to have no significant impacts on the environment if the suggested mitigation measures are adopted and EMP is implemented in letter and spirit. The water requirements of the project activities will be fulfilled mainly by the groundwater found in the project area. Multi options are proposed for groundwater extraction; of these the location will be selected away from existing groundwater well in use by local community. Water will not be extracted from the community wells in the area.

2.10.11 Conclusion

Seismic surveys are the specialized technical area, and alternative methods and technologies are limited. The survey technique and equipment specifications for the proposed seismic program are considered to be necessary for the acquisition of quality data to allow geological evaluation and the safe and optimal development of the Block. Impacts that are associated with the seismic activities will be minimal and measures have been put in place in the EMP to mitigate any potential impact that may occur during the exercise.

3.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORKS

3.1 Introduction

This chapter provides synopsis of policies, legislation, and guidelines that may have relevance to the project. The proponent of this project will comprehensively follow the relevant requirements of the policy documents and legislative framework as well as those recommendations as described in the national and international guidelines. Many of those guidelines have been incorporated in the mitigation measures and the Environmental Management Plan (EMP) which has been formulated for the better environmental management.

The principal law in Sindh is the Sindh Environmental Protection Act, 2014 with the objective of “protection, conservation, rehabilitation and improvement of environment for the prevention and control of pollution, and promotion of sustainable development”

PPL shall ensure that the operation is conducted to conform to PPLs corporate commitment to the total integration of health safety and social responsibility to environmental excellence in all aspects of its operations to:

- Protect the environment, maintain sustainable development
- Execute all operations for disposal of all materials (hazardous and non-hazardous) safely and without causing any health, environment and safety risk
- Adopt appropriate industry and corporate standards where adequate regulations do not exist
- Discontinue any operation if the health, environment or safety is at risk
- Attain high level of preparedness to manage emergency situation.

PPL will adhere to its commitment in environmental policy, national legislation and relevant international conventions and will seek guidance from national and international guidelines. PPL shall also ensure that the key project management staff is aware of these legislations and guidelines.

3.2 Statutory Framework

The constitution of Pakistan contains provision for environmental protection and resource conservation. The constitution mentions environmental pollution and the ecology as a subject in the concurrent legislative list, meaning that both the provincial and federal government may initiate and make legislation for the purpose. Article 9 of the Constitution defines the right to life as a “fundamental right” in these words “No person shall be deprived of life or liberty save in accordance with law”.

Several laws exist for the protection of the environment. Some of these laws are Federal and the rest Provincial in character. The promulgation of the Environmental Protection Ordinance 1983 was the first codifying legislation on the issue of environmental protection. This was indeed a consolidated enactment to plug the gaps and remove defects/deficiencies in the legislation. The promulgation of this ordinance was followed, in 1984, by the

establishment of the Pakistan Environmental Protection Agency, the primary government institution dealing with environmental issues. Significant work on developing environmental policy was carried out in the late 1980s, which culminated in the drafting of the Pakistan National Conservation Strategy. Provincial environmental protection agencies were also established at about the same time. The National Environmental Quality Standards were established in 1993.

Prior to the 18th Amendment to the Constitution of Pakistan in 2010, the legislative powers were distributed between the federal and provincial governments through two 'lists' attached to the Constitution as Schedules. The Federal list covered the subjects over which the federal government had exclusive legislative power, while the 'Concurrent List' contained subjects regarding which both the federal and provincial governments could enact laws. The subject of 'environmental pollution and ecology' was included in the Concurrent List and hence allowed both the national and provincial governments to enact laws on the subject. However, as a result of the 18th Amendment this subject is now in the exclusive domain of the provincial government. The main consequences of this change are as follows: i) The Ministry of Environment at the federal level has been abolished. Its functions related to the national environmental management have been transferred to the provinces. The international obligations in the context of environment will be managed by various ministries and departments of the federal government, ii) The Pakistan Environmental Protection Act 1997 (PEPA 1997) is technically no longer applicable to the provinces. The provinces have enacted their own legislation for environmental protection.

3.3 National Laws, Policies and Regulations

3.3.1 National Conservation Strategy

The National Conservation Strategy (NCS) is the primary policy document of the Government of Pakistan (GoP) on national environmental issues. The policy was approved by the Federal Cabinet in March 1992. The Strategy also attained recognition by the international donor agencies, principally the World Bank. The NCS identifies 14 core areas including conservation of biodiversity, pollution prevention and abatement, soil and water conservation and preservation of cultural heritage and recommends immediate attention to these core areas in order to preserve the country's environment.

A mid-term review of the achievements of the NCS in 2000 concluded that achievements under the NCS have been primarily awareness raising and institutional building rather than actual improvement to environment and natural resources and that the NCS was not designed and is not adequately focused as a national sustainable strategy (GoP, November 2000). The need therefore arose for a more focused National Environmental Action Plan (NEAP) required to bring about actual improvements in the state of the national environment with greater emphasis on poverty reduction and economic development in addition to environmental sustainability.

The National Environmental Action Plan was approved by the Pakistan Environmental Protection Council under the chairmanship of the President/ Chief Executive of Pakistan in February 2001. NEAP also constitutes the national environmental agenda and its core objective is to initiate actions that safeguard public health, promote sustainable livelihoods, and enhance the quality of life of the people of Pakistan.

The Government of Pakistan and United Nations Development Program (UNDP) have jointly initiated an umbrella support program called the National Environmental Action

Plan-Support Program signed in October 2001 and implemented in 2002. The development objective supported by NEAP-SP is environmental sustainability and poverty reduction in the context of economic growth. The objective of new policy has total 171 guidelines on Sectoral and cross sectoral issues. The objectives of new policy include assurance of sustainable development and safeguard of natural wealth of country. The following are the approved Sectoral Guidelines:

- Water Supply and Management.
- Air Quality and Noise.
- Waste Management.
- Forestry.
- Biodiversity and Protected Areas.
- Climate Change and Ozone Depletion.
- Energy Efficiency and Renewable.
- Agriculture and Livestock.
- Multilateral Environmental Agreements.

3.3.2 National Environmental Policy, 2005

The National Environmental Policy aims to protect, conserve and restore Pakistan's environment in order to improve the quality of life for the citizens through sustainable development. It provides an overreaching framework for addressing the environmental issues facing Pakistan, particularly pollution of fresh water bodies and coastal waters, air pollution of fresh water bodies and coastal waters, air pollution, lack of proper waste management, deforestation, and loss of biodiversity, desertification, natural disasters and climate change.

It also gives direction for addressing the cross-sectional issues as well as the underlying causes of environmental degradation and meeting international obligations.

The National Environmental Policy, while recognizing the goals and objectives of the National Conservation Strategy, National Environmental Action Plan and other existing environmental related national policies, strategies and action plans, provide broad guidelines to the Federal Government, Provincial Governments, Federally Administrated, Territories and Local Governments for addressing environmental concerns and ensuring effective management for their environmental resources.

The National Environmental Policy aims to protect, conserve and restore Pakistan's environment in order to improve the quality of life of the citizens through sustainable development.

3.3.3 Pakistan Environmental Protection Act 1997

Before 18th amendment in the Constitution of Pakistan, the Pakistan Environmental Protection Act, 1997 was the basic legislative tool empowering the government to frame regulations for the protection of the environment. After the said amendment, all provinces have constituted their own Environmental Acts.

3.3.4 National Sanitary Policy, 2006

The primary focus of sanitation is the purpose of National Sanitary Policy for the safe disposal of excreta away from the dwelling units and work places by using sanitary latrine and includes creation of an open defecation free environment along with the safe disposal of liquid and solid wastes; and the promotion of health and hygiene practices in the country.

The objectives of the policy are:

- To ensure an open defecation free environment; the safe disposal of liquid, solid, municipal, industrial and agricultural wastes; and the promotion of health and hygiene practices.
- To link and integrate sanitation programs with city and regional planning policies, health, environment, housing and education.
- To facilitate access of all citizens to basic level of services in sanitation including the installation of sanitary latrines in each house-hold, in rural and urban areas, schools, bus stations and important public places and also community latrines in densely populated areas.
- To promote Community, Lead Total Sanitations (CLTS).
- To develop guidelines for the evolution of an effective institutional and financial framework.
- To enhance capacity building of government agencies and other stakeholders at all levels for better sanitation, particularly avoiding incidents of water borne diseases.
- To develop and implement strategies for integrated management of municipal, industrial, hazardous and hospital and clinical wastes of national, provincial and local levels, and
- To meet international/regional obligations effectively in line with the national aspirations.
- To change the attitude and behavior on the use of sanitation.
- To increase mass awareness on sanitation and community mobilization.
- The proponent would provide best sanitary facilities to the workers and contractors at the project area in compliance to Policy

3.3.5 National Drinking Water Policy

The National Drinking Water Policy provides a framework for addressing the key issues and challenges facing Pakistan in the provision of safe drinking water to the people. The overall objectives of the policy are to provide guidelines that will allow consistency and conformity in the provision of the drinking water on sustainable basis, provide a financial framework within which the provision of water supply can be undertaken in a cost-effective, equitable and sustainable manner and gives key strategies that will help in enhancing access to safe drinking water supply.

Provision of safe drinking water is the constitutional responsibility of the provincial governments and the specific provision function has been developed to specially created agencies in cities and Town and Tehsil Municipal Administrations under the Local

Government Ordinance 2001 and the devolution framework for ensuring access to safe drinking water.

Provision of Safe Drinking Water for the workers will be ensured at the proposed project site during the seismic operation.

3.3.6 The Biodiversity Action Plan

The Biodiversity Action Plan, 2000 has been the most significant direct step towards addressing the issue of loss of biodiversity. It details the current status, trends, direct & indirect causes of loss of biodiversity; its principles, goals and aims; proposals for an 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 1912⁵, 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. Ecological survey was conducted by the team of ecologist and junior biologists to determine the ecological baseline of the area. This EIA study has addressed different aspects of conservation, including wildlife, and forest.

3.4 National Environmental Legislation & Guidelines

3.4.1 Pakistan Environmental Protection Act, 1997

Before 18th amendment in the Constitution of Pakistan, the Pakistan Environmental Protection Act, 1997 was the basic legislative tool empowering the government to frame regulations for the protection of the environment. After the said amendment, all provinces have constituted their own Environmental Acts.

3.4.2 Antiquities Act, 1975

The Act provides for protection of Pakistan's cultural resources. The Act defines "antiquities" as ancient products of human activity, historical sites or sites of anthropological or cultural interest, national monuments, etc. The Act is designed to protect these antiquities from destruction, theft, negligence, unlawful excavation, trade, and export. The law prohibits new construction in the proximity of a protected antiquity and empowers the GoP to prohibit excavation in any area that may contain articles of archaeological significance. Under the Act, the Project proponents are obligated to ensure that no activity is undertaken within 61 m (200 ft.) of a protected antiquity, and to report to the GoP's Department of Archaeology any archaeological discovery made during the course of the project.

The federal Department of Archaeology maintains a master register containing basic and vital information on the protected monuments and sites including full measurements of the protected area, description, location and Government Notification number with date of protection. The central directorate general of Archaeology has a separate list which is continuously updated as and when new sites are declared as protected.

In Pakistan at present there are 387 notified sites which are covered by Federal Antiquities Act. Up to date copies of this protected area list will be sought to avoid confusion at any later stage in development; as it is an on-going process to bring new sites within official

notification. For this reason, contact with the relevant Provincial or Federal Department of Archaeology should be sought by the proponent early during the feasibility/conceptual stage of project development.

3.4.3 The Forest Act, 1927

The Forest Act deals with the matters related with protection and conservation of natural vegetation/habitats. In that regard it empowers the concerned agency to declare protected and reserved forest areas and maintaining the same. In spite of the fact that it recognizes the right of people for access to the natural resources for their household use, it prohibits unlawful cutting of trees and other vegetation. The permission is required prior to undertaking any tree cutting from the area under the charge of Forest Department of Sindh.

3.4.4 Pakistan Penal Code, 1860

The Pakistan Penal Code deals with offences where public or private property and/or human lives are affected due to the intentional or accidental misconduct of an individual or body of people. In the context of environment, the Penal Code empowers the local authorities to control noise, noxious emissions and disposal of effluents. The environmental quality standards enforced by the EPAs supersede the application of this legislation on industries and municipalities. The Penal Code, however, can provide a basis for the client to coordinate its activities with the local authorities to ensure that its construction activities do not become a cause of public nuisance or inconvenience.

3.4.5 The Pakistan Environmental Assessment Procedures, 1997

The Pakistan Environmental Protection Agency prepared the Pakistan Environmental Assessment Procedures in 1997. The guidelines to the review process of EIA's have been given regulatory status in the Review of IEE and EIA Regulations 2000. The package of regulations prepared by PEPA includes:

- Policy and procedures for Filing, Review and Approval of Environmental Assessments;
- Guidelines for Preparation and Review of Environmental Reports;
- Guidelines for public Consultation;
- Guidelines for Sensitive and Critical Areas; and
- Sectorial Guidelines – Oil and Gas Exploration and Production.

The guidelines on policy and procedures define the policy context and the administrative procedures that will govern the environmental assessment process, from the project prefeasibility stage, to the approval of the environmental report. According to the procedures laid out in the policy guidelines, IEE's or EIAs are to be filed to the EPA of the province where the project is to be implemented. The Federal EPA 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.

Projects have been classified in the policy guidelines by expected degree of adverse environmental impacts. All projects proposed in environmentally sensitive areas (including Game Reserves and Wildlife Sanctuaries) require an EIA.

The Procedures required proponents to prepare terms of reference for the environmental assessment reports. They required all the studies should contain an assessment of the potential environmental impacts and the recommended mitigation measures.

The guidelines on public consultation deals with possible approaches to public consultation and techniques for designing and effective program of consultation that reaches out of all major stakeholders and ensure the incorporation of their concerns in any impact assessment study.

3.4.6 The Explosives Act, 1994

This Act has been formed to regulate the manufacture, possession, use, sale, transport and importation of explosives. An explosive has been defined (Section 4(a)) as the gunpowder, nitroglycerine, dynamite, gun-cotton, dinitro-toluene, trinitro toluene, picric acid, dinitrophenol, trinitro resorcinol (styphnic acid), cyclotrimethylence trinitramine, penta erythritol-tetranitrate, tetryl, nitroguanidine, lead azide, lead styphnate, blasting powders, fulminate of mercury or of other metals, diazo dinitro phenol, colored fires and any other substances, whether a single chemical compound or a mixture of substances, whether solid or liquid or gaseous, used or manufactured with a view to produce a practical effect by explosion, or a pyrotechnic effect.

Section 5: Government may make rules to regulate, prohibit, manufacture, possess, use, transport, import or export explosives or any specified class of explosives. The following matters may be provided for:

- a) the authority by which licenses may be granted,
- b) the fees to be charged,
- c) The manner in which application for licenses must be and the matters to be specified in such applications etc.

Section 6: Government may from time to time, either absolutely or subject to conditions, prohibit manufacture, possess, transport, import and export etc. any explosive.

Section 7: Government may make rules consistent with this Act authorizing any officer to enter, inspect, seize and examine etc. any place, carriage etc. in which an explosive is being used or sold etc.

Section 8: Any explosion by fire that causes loss of human life, serious injury to person or property etc. must be reported by the occupier or master etc. to Secretary Home Department and to the nearest police station.

Section 9: District Magistrate shall, in cases attended by loss of human life, or in any other case, direct a Magistrate Subordinate to hold an inquiry.

Sections 10 to 14: These sections deal with forfeiture of explosives by court; distress of aircraft or vessel; punishment for abetment and attempts; power to arrest without warrant persons committing dangerous offence; saving and power to exempt (to armed forces, person employed under the Government for enforcement of this Act or by notification etc.) respectively.

Section 19: Transportation of explosives by air shall be carried out in accordance with rules and regulations of International Civil Aviation Organization (ICAO), International Air Association (IATA) and Civil Aviation Authority of Pakistan (CAA).

3.4.7 The Land Acquisition Act, 1894

This Act provides law for the acquisition of land needed for public purposes and for companies and for determining the amount of compensation to be made on account of such acquisitions. The law provides details of various peculiarities involved in acquisition of land such as preliminary investigation, objection to acquisition, declaration of intended acquisition, enquiry. This Act provides law for the acquisition of land needed for public purposes and for companies and for determining the amount of compensation to be made on account of such acquisitions. The law provides details of various peculiarities involved in acquisition of land such as preliminary investigation, objection to acquisition, declaration of intended acquisition, enquiry into measurements, value & claims, taking possession, reference to court and procedure thereon, apportionment of compensation, payment, temporary occupation of land, acquisition of land for companies, disputes resolutions, penalties and exemptions etc. This Act has 55 sections addressing different areas. Such as section 4(2) mentions that it shall be lawful for any official authorized by the Collector to enter upon and survey, to dig or to do all other acts necessary to ascertain that whether the land is adapted for such purpose. The land in Gambat-II Block has been acquired as per Petroleum Concession Agreement (PCA) from Ministry of Energy (Petroleum Division). There is no land acquisition or involuntary settlement involved as part of project implementation.

3.4.8 Employment of Child Act, 1991

Article 11 (3) of the constitution of Pakistan prohibits employment of children below the age of 14 years in any factory, mines or any other hazardous employment. In accordance with this Article, the Employment of Child Act (ECA) 1991 disallows the child labour in the country. The ECA defines a child to mean a person who has not completed his/her fourteenth years of age. The ECA states that no child shall be employed or permitted to work in any of the occupation set forth in the ECA (such as transport sector, railways, construction and ports) or in any workshop wherein any of the processes defined in the Act is carried out. The processes defined in the Act include carpet weaving, bidi (kind of a cigarette) making, cement manufacturing, textile, construction and others). As part of its social responsibility, PPL always ensures to comply with provision of this Act at all of its project sites.

3.4.9 Pakistan Climate Change Act, 2016

Federal Cabinet of Government of Pakistan approved Pakistan Climate Change Act 2016 in November. It was enacted in 2017 after it was passed by the National Assembly. Consequent to the Act, three relevant institutions have been setup namely Pakistan Climate Change Council, Pakistan Climate Change Authority, and Pakistan Climate Change Fund.

Pakistan Climate Change Council: The institutional make-up of the council is highlighted under section 3, whereby it is provided that the council will have representations from the leadership of all avenues of the Federation. Section 4 highlights the functions and powers of the council which extends to supervising the enforcement of the CCA. Moreover, it has the following prerogatives: the international treaties Pakistan is a part of, giving strategic direction for the implementation of the United Nations Sustainable Development Goals ('SDGs'), giving guidelines for the protection of ecology, and considering the National Climate Change Report. To analyse these functions, while the

CCA gives the council the power to monitor the progress of climate change reports and policy outside the institution, there is a dearth of punitive measures with regards to the progress of climate change legislation.

PAKISTAN CLIMATE CHANGE AUTHORITY

Section 5(2) establishes the Pakistan Climate Change Authority ('PCCA'), with the prerogative of being a corporate body, which is capable of being sued and can pursue a suo moto case, acquire assets, loans, and can enter into contracts whenever required. Section 8 defines the function of the authority. The main ones include formulation of mitigation policies and programs, in order to curb the crisis of climate change in the country. The technical aspects of compliance to the Paris Agreement also fall within this body's ambit, as it is responsible for the submission of the Nationally Determined Contributions to the United Nations Framework Convention on Climate. This aspect raises a question of accountability, as upper Pakistan Climate Change Council members do not have a mandate to check the findings and technical aspects of the Nationally Determined Contributions as compiled by the PCCA.

PAKISTAN CLIMATE CHANGE FUND

Section 12 ordains the formation of a fund pertaining to climate change to be established, in order to provide a financial base by which the PCCA shall undertake its functioning. Section (12) (2) highlights that 'donations, endowments, grants and gifts' may be used as a pool for the fund to draw its funding. However, an important question to consider is section (12) (b)'s relationship with section (10) (2)(b), which requires permission from higher officials of the government before accepting any sort of foreign-based aid from organizations and governments. A key feature of the major revenue that comes for developmental projects is that they are foreign in nature, highlighting an issue with bureaucratic bottlenecks.

3.4.10 Guidelines for Sensitive and Critical Areas

The objective of the guideline is to provide guidance to project proponents and other stakeholders in the environmental assessment process, so that the proposed projects are planned and sited in a way that protects the values of sensitive and critical areas.

These guidelines will help proponents of projects requiring Environmental Reports:

- In identifying what are the officially notified protected areas in Pakistan. These may include critical ecosystems including wildlife reserves and forests, archaeological sites, monuments, buildings, antiquities, or cultural heritage sites;
- If a proposed development is on a notified protected area or within the vicinity of such an area, then the approach detailed in this guideline should be adopted.

The 3D seismic activity covers an area of approximately 696.00 sq. km, predominantly spanning in ecologically sensitive zones, including the Takkar and Mehrano Wildlife Sanctuaries. In contrast, 2D seismic lines span on approx. 330 L.km across the entire Gambat-II Block. Mitigation measures have been proposed in this EIA report to ensure that the seismic survey activities are carried out in safe and responsible manner.

3.5 National Legislation on Oil and Gas Exploration and Production

3.5.1 The Regulation of Mines and Oilfields and Mineral Development (Government Control) Act, 1948

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.

3.5.2 The Pakistan Petroleum (Exploration and Production) Rules, 1986

The 1986 Exploration and Production Rules address environmental concern, and required operators to “prevent pollution, avoid accumulation of trash and prevent damage to the environment and surroundings.”

3.5.3 The Model Petroleum Concession Agreement, 2013

As for safety, the Model Petroleum Concession Agreement (2013) 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 Fields Act also specifies penalties including imposition of fines and/or imprisonment.

3.5.4 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 2 describes the testing standards for the Petroleum products. Chapter 3 of this Act talk about the general penalties for the offenses under this Act, reports of accidents with petroleum and inquiries into serious accidents with petroleum.

The petroleum act deals with the transport of the petroleum. It specifies the nature and condition of pipelines in which the petroleum may be transported. The forms and conditions of licensing for the transport of petroleum products are prescribed in this act.

Pakistan has developed a comprehensive policy in the 1997 to promote the petroleum business in Pakistan. This policy elaborates the importance and view of Pakistan with regards to exploration, production, refining, marketing, distribution of petroleum products in Pakistan as well as procedural/regulatory measures, economic terms, infrastructure development, environmental and safety control, energy conservation, contingency plan, etc.

3.5.5 Mines Act, 1923

This Act relates to the regulation, inspection and occupational health and safety aspects of mines. The above Act has stipulations with respect to working hours, occupational diseases, periodic medical checkups, employment of female and children, employment of medical and welfare officers etc. Various provisions of this Act are discussed as under:

Section 4: A Chief Inspector (CI) and inspectors of mines are appointed.

Section 6: The Chief Inspector and Inspectors of mines have powers to enforce this Act and they may enter, inspect and examine any mine for ventilation, bye-laws, safety (health & welfare of staff) and may take any material and substance for analyses.

Section 12: Mining Board shall have powers of Civil Court for the purpose of deciding or reporting any matter referred to it.

Section 14, 15 & 16: Related to management of mining operations and fixes duties and responsibilities of managers, owners and agents of mines.

Section 17 to 22: Related to provisions of health and safety. These provisions require conservancy, canteens, shelters, medical appliances, first aid rooms etc. CI or Inspectors may give notice to mines if they find that any matter, thing or practice in or connected with mine is dangerous to human life, health or safety etc. and need to be remedied. Mine management is required to report any accident, loss of life or influx of inflammable or noxious gases etc. to appropriate authorities.

Section 22 (A&B): Limits the time of work for any person in a mine to a maximum of six days a week and not more than forty-eight hours in any week and not more than eight hours in a day.

Section 23-C: Bans the appointment of woman in any part of mine below ground. For above ground work, woman shall not work from 7 pm to 6 am.

Section 26: Prohibits child labor in a mine.

Section 34 to 44: Imposes penalties on any person who violates any of the provisions of this Act such as obstructs work of CI or Inspectors, falsifies records, omits to furnish plans, contravenes provisions regarding employment of labor, notice of accidents or disobeys orders etc. with imprisonment or fine or both. .

3.5.6 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.

3.5.7 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 sectoral guidelines; the Responsible Authority reserves the right to spot check field operations from time to time.

3.6 Provincial Laws and Regulations

3.6.1 Sindh Environmental Protection Act, 2014

Sindh Environmental Protection Act 2014 is the basic legislative tool which has been enacted to provide for the protection, conservation, rehabilitation and improvement of the environment, for the prevention and control of pollution, and promotion of sustainable development.

The Act is broadly applicable to air, water, soil, marine and noise pollution, as well as the handling of hazardous waste. Penalties have been prescribed for those who contravene the provisions of the Act. Powers of the Sindh Environmental Protection Agency (EPA) have been considerably enhanced under this legislation and they have been given the power to conduct inquiries into possible breaches of environmental laws either of their own accord, or upon registration of a complaint.

Environmental Protection Council (EPC): It has been formed consisting of Chief Minister as Chairman with Minister in charge of Environment Protection Department, Addl. Chief Secretary, Planning & Development Department, Government of Sindh and Secretaries of Environment, Finance, Public Health Engineering, Irrigation, Health, Agriculture, Local Government, Industries, Livestock & Fisheries Forest & Wildlife, Energy, Education Departments Government of Sindh and Divisional Commissioners of Sindh. Non-official members are also included (i.e. representatives of Chamber of Commerce & Industry and from medical or legal professions etc.) along with DG, EPA & two Members of Provincial Assembly also form part of EPC.

The functions and powers of EPC include coordination & supervision of provisions of Act, approving provincial environmental & sustainable development policies & SEQs, provide guidance for protection & conservation, consider annual Sindh Environmental Report, deal with interprovincial and federal provincial issues, provide guidance for bio safety and assist

Federal Government in implementation of various provisions of UN Convention on laws on Seas (UNCLOS).

Sindh Environmental Protection Agency (SEPA): SEPA would be headed by Director General (DG) with the aim to exercise the powers and perform the functions assigned to it under the provisions of this Act and the rules and regulations made there under. The Agency shall have technical and legal staff and may form advisory committees.

The Agency shall administer and implement the provisions of this Act and rules and regulations. It shall also prepare environmental policies, take measures for implementation of environmental policies, prepare Sindh Environment Report and prepare or revise Sindh Environmental Quality Standards. SEPA shall also establish systems and procedures for surveys, surveillance, monitoring, measurement, examination, investigation research, inspection and audit to prevent and control pollution and to estimate the costs of cleaning up pollution and rehabilitating the environment and sustainable development. SEPA would also take measures for protection of environment such as to promote research; issues licenses for dealing with hazardous substances, certify laboratories, identify need for or initiate legislation, specify safeguards etc. SEPA would also encourage public awareness and education regarding environmental issues.

SEPA would have powers to enter or inspect under a search warrant issued by Environmental Protection Tribunal or a Court search at any time, any land or building etc. where there are reasonable grounds to believe that an offence under this Act has been or is being or likely to be committed. SEPA may also take samples, arrange for testing or confiscate any article in discharge of their duties.

This act has also provided for Sindh Sustainable Fund derived from various sources such as voluntary contributions or fees generated etc. This fund is utilized for protection, conservation or improvement of environment.

Salient Features

Section-11: No person shall discharge or emit or allow the discharge or emission of any effluent waste, pollutant, noise or adverse environmental effects in an amount, concentration or level which is in excess to that specified in Sindh Environmental Quality Standards.

Section-12 & 13: No person shall import hazardous waste into Sindh province and handle hazardous substances except under licenses etc.

Section 14: No person shall undertake any action which adversely affects environment or which lead to pollute or impairment of or damage to biodiversity, ecosystem, aesthetics or any damage to environment etc.

Section 15: This section deals with regulation of motor vehicles banning emission of air or noise pollutants being emitted from them in excess of allowable standards.

Section 17: This section states that no proponent of a project shall commence construction or operation unless he has filed with the Agency an initial environmental examination or environmental impact assessment and has obtained from Agency approval in respect thereof. SEPA shall review the IEE & EIA and accord approval subject to such terms and conditions as it may prescribe or require. The agency shall communicate within four (04) months its approval or otherwise from the date EIA is filed failing which the EIA shall deemed to have been approved.

Section 21: Where agency is satisfied that the discharge or emission has occurred in violation of any provision of this act or rules etc. then it may, after giving an opportunity to person responsible, by order direct such person to take such measures within specified period. The agency under this section has been empowered to immediately stop, prevent or minimize emission, disposal etc. for remedying adverse environmental effects.

Section 22: The person who fails to comply with section 11, 17, 18 and 21 shall be punishable with a fine which may extend to five million rupees, to the damage caused to environment and in the case of a continuing contravention or failure, with an additional fine which may extend to one hundred thousand rupees for every day during which such contravention or failure continues. And, where a person convicted under sub-sections 1&2 had been previously convicted for any contravention of this Act, the Environmental Protection Tribunal (EPT) may, in addition to punishment, award imprisonment for a term that may extend up to three years, or order confiscation or closure of facility etc.

Section 23: Where any violation of this Act has been committed by any of employee of any corporate body, then, that employee shall be considered to be guilty of environmental pollution.

Section 25: This section allows for establishment of Environmental Protection Tribunals.

3.6.2 Sindh Environmental Protection Agency – (Environmental Assessment) Regulations, 2021

The EIA study is a mandatory requirement under the provisions of Sindh Environmental Protection Act 2014 and the rules made thereunder. Sindh Environmental Protection Act, 2014 under section 17 (1) mandatorily requires proponent of project to file an IEE or EIA, as the case may be, and obtain approval from the SEPA before commencing construction or operation of the project. Section 17 (1) of the 2014 Act is reproduced herein under for reference:

“17. (1) No proponent of a project shall commence construction or operation unless he has filed with the agency an initial environmental examination or environmental impact assessment and has obtained from the Agency.”

Sindh EPA Environmental Assessment Regulations, 2021 categorize projects into three separate schedules depending on whether a project requires an Environmental Checklist (Schedule-I) or an IEE (Schedule-II) or EIA (Schedule III). The Regulations also require that all projects located in environmentally sensitive areas need submission of an EIA.

On the basis of the nature and scope of project, it has been accordingly categorized into Schedule-III

J. Environmentally Sensitive Areas

All projects situated in environmentally sensitive areas being identified by the agency.

Therefore, an EIA study was conducted for the project in this respect and the EIA report was subsequently prepared to document the findings of the assessment.

3.6.3 Sindh Environmental Quality Standards (SEQS), 2016

The SEQS have so far provided standards about air quality only (9 parameters). The standard permissible levels of waste, noise, solid and land pollutants etc. have not been framed as yet. This study would thus use SEQS for describing permissible level for air

pollutants and SEQS would be used for mentioning permissible levels in case of other variables. PPL is committed to comply with the applicable SEQS.

3.6.4 Self-Monitoring & Reporting Rules, 2014

The official name of the Rule is, “Sindh Environmental Quality Standards (Self-Monitoring and Reporting by Industry) Rules, 2014”. The Government of Sindh in exercise of the powers conferred by Section 36 of the Sindh Environmental Protection Act, 2014 promulgated these rules in December, 2014. As per the rules set by this system, industries have to monitor effluents and emissions in compliance with the SEQS and report it to provincial Environmental Protection Agencies. This system classifies industry into three categories A, B and C each corresponding to a specified reporting frequency. By virtue of these Rules, all the industrial units are responsible for correct and timely submission of Environmental Monitoring Reports to the Federal Agency.

3.6.5 The Sindh Irrigation Act, (1879) and the Canal and Drainage Act, 1873

The Sindh Irrigation Act covers the construction, maintenance and regulation of canals for the supply of water and for the levy of rates of water supplied in the Province of Sindh. Canals are defined as channels, pipes and reservoirs constructed and maintained by the Government for the supply for the shortage of water. Under Section 27 of the Act a person desiring to have a supply of water from a canal for purposes other than irrigation shall submit a written application to a Canal Officer who may, with the sanction of the Provincial Government give permission under special conditions. The Act under Section 61 also prohibits the damaging, altering, enlarging or obstructing the canals without proper authority.

The Canal and Drainage Act (1873) prohibits corruption or fouling of water canals (defined to include channels, tube wells, reservoirs and watercourses), or obstruction of drainage.

3.6.6 Sindh wildlife Protection, Preservation, conservation and Management Act, 2020

This Act provides for the preservation, protection, and conservation of wildlife by the formation and management of protected areas and prohibition of hunting of wildlife species declared protected under the ordinance. The Act also specifies four broad classifications of the protected areas: National Parks, Wildlife Sanctuaries, Game reserves and Private Game Reserve. Activities such as hunting and breaking of land for mining are prohibited in the protected areas, as are removing vegetation or polluting water flowing through the park. Wildlife sanctuaries are areas that have been set aside as undisturbed breeding grounds and cultivation and grazing is prohibited in the demarcated areas. Nobody is allowed to reside in a wildlife sanctuary and entrance for the general public is by special dispensation. Game reserves are designated as areas where hunting or shooting is not allowed except under special permits.

3.6.7 Sindh wildlife Protection, Preservation, conservation and Management Rules, 2022

In exercise of the power conferred by Section 83 of the Sindh Wildlife Protection, Preservation, Conservation, and Management Act, 2020, the Government of Sindh has promulgated these rules.

As per Sindh Wildlife Protection, Preservation, Conservation and Management Rules, 2022, two protected areas are fall in Gambat-II Block.

Protected Areas within the Gambat-II Block

1. Takkar wildlife Sanctuary
2. Khat Dhor Wildlife Sanctuary

Therefore, it is suggested that, in line with the above-stated legislation pertaining to the wildlife protection and preservation in Sindh, the proponent should bring on board the relevant Sindh Wildlife Department for the implementation of the project activities in the protected areas.

3.6.8 The Sindh Cultural Heritage (Preservation) Act, 1994

The Sindh Cultural Heritage (Preservation) Act, 1994 is the provincial law for the protection of cultural heritage. Its objectives are similar to those of the Antiquity Act, 1975.

The historical background of the proposed Gambat-II block including some ancient cemeteries and the Satyaru village lies an ancient Hindu temple. Additionally, the historical Kot Diji Fort, a national heritage site, is located within the Gambat II block. The proposed seismic activities shall be carried out following the recommended mitigation measures to ensure that no harm or damage to the historical heritage of the area.

3.6.9 Hazardous Substances Rules, 2014

These Rules were notified in 2014 to streamline the procedures for issuance of licenses to industries/ businesses that generate hazardous waste and advises them about the methods for the removal of hazardous wastes in an environment friendly manner. The Rules also specify procedures to be adopted for disposal of hazardous waste and identify 242 hazardous substances and synthetic chemicals.

3.6.10 Sindh Sanitation Policy, 2016

The goal of the Provincial Sanitation policy is to ensure that the entire population of Sindh has access to a safely managed sanitation service and sanitary environment that is also nutrition- sensitive and hygienic. The motto of the policy was ‘Saaf Suthro Sindh’ (Neat and Clean Sindh). The Policy sets targets to achieve its motto. For instance, eradication of Open Defecation from Sindh Province by 2025, while 70% villages of 13 high priority districts achieve the status of open defecation free by 2020; create and develop wastewater treatment mechanisms to cover 75% of urban areas and 40% in rural areas by 2025, and implement integrated solid waste management with 100% coverage in urban areas and 60% in rural areas of Sindh by 2025. A WASH behavior changes and communication strategy has also been developed for sustainable and safe hygiene environment by 2025 to enhance the living standards of the people of Sindh.

3.6.11 Sindh Drinking Water Policy, 2017

Public Health Engineering & Rural Development Department, Government of Sindh, with the approval of Chief Minister Sindh issue the drinking water policy on 3rd May 2017.

Principles: The main principles of Sindh Drinking Water Policy, adopted from the National Drinking Water policy 2009, and aligned with the Sustainable Development Goals, are as follows:

- Access to safely managed drinking water is a fundamental right of every citizen and that it is the responsibility of the Government to ensure its provision to all citizens,
- Water allocation for drinking purpose shall be given priority over other uses,
- In order to ensure equitable access, special attention shall be given to removing the existing disparities in coverage of safe drinking water and for addressing the needs of the poor and the vulnerable on priority basis.
- Recognizing that inadequate and unsafe water supply and sanitation are a major cause of diarrhea and nutritional deficiency in children, which as a consequence contribute towards child mortality. Safely managed drinking water supply and sanitation shall be integrated in health, nutrition and school health programs.
- Access shall be increased to high quality nutrition-sensitive services, including access to water, sanitation facilities, and hygiene.
- Key hygiene actions (safe drinking water, hand washing with soap, safe disposal of excreta, food hygiene) shall be integrated as essential components in all nutrition programs.
- Realizing the fact that access and availability of safe drinking water affects all aspects of life of a citizen, a multi sectoral approach, involving different departments of the government, shall be adopted to address the issues related to safe drinking water.
- Being cognizant of the fact that women are the main providers of domestic water supply and maintainers of hygienic household environment, their participations in planning, implementation, monitoring and operation & maintenance of water supply systems shall be ensured, and WASH shall be integrated in maternal and neonatal health programs.
- Responsibilities and resources shall be delegated to local authorities to enable them to discharge their assigned functions with regard to provision of safe water supply.
- A supportive policy framework shall be developed that encourages alternate options through private provision, public private partnerships, the role of NGOs and community organizations
- The execution of component-sharing model for government programs and projects shall be promoted to ensure financial sustainability and community and private sector involvement in development and O&M.
- Low-cost technologies in water and sanitation, that are easy and cost-effective to maintain shall be developed and used.

Goals and Objectives:

Overall Goal: The goal of the Sindh Drinking Water Policy is to improve the quality of life of people of Sindh by reducing morbidity and mortality caused by water-borne diseases through provision of safely managed and potable drinking water to the entire population that is located on premises, available when needed, and free from contamination, affordable and of sufficient quantity, and in a way, that is efficient, equitable and sustainable.

Objectives:

- Introduce legislative measures and regulations to create an enabling framework for safely managed drinking water supply, regulation of water usage, extraction, treatment, transportation and distribution.
- Ensure that all drinking water resources and supply systems are protected with community involvement.
- Develop district level drinking water availability plans for urban and rural areas to ensure improved planning for equitable access.
- Enhance the coverage of safely managed drinking water supply in the province to achieve the Sustainable Development Goals (SDGs) targets of universal access.
- Develop criteria for installation of new drinking water supply schemes and ensure that all new schemes are safely managed, rationalized and constructed through need-based criteria so that all areas and communities are served.
- Develop standardized service delivery models for both urban and rural drinking water supply schemes to improve efficiency, cost-effectiveness, monitoring & sustainability.
- Develop mechanisms for reuse, recycle and recharge of wastewater for other municipal and productive uses.
- Ensure that all drinking water supply systems are designed and constructed in line with the national drinking water quality standards and all municipal discharges comply with Sindh Environment Quality Standards (SEQS).
- Install water treatment plants at existing drinking water supply schemes where required and incorporate water treatment facilities in all new drinking water supply schemes.
- Ensure development of water safety plans for all drinking water supply systems.
- Develop and sustain regular drinking water quality monitoring & surveillance, and institute mechanisms for remedial action.
- Increase public awareness about water borne and water related diseases (including polio), nutrition and hygiene, and enhance the role of communities for household water treatment/storage, water safety and conservation, and safe hygiene practices.
- Ensure that drinking water supply projects are nutrition sensitive and integrated in health, nutrition and school health programs.
- Institutionalize Water, Sanitation & Hygiene (WASH) in schools (infrastructure and 3 starts) and introduce curricular change to incorporate health, nutrition and hygiene and improve safe water and sanitation practices among school children.
- Institute adaptation measures and disaster risk reduction and mitigation strategies to minimize the impact of climate events on drinking water supply system.

3.6.12 Sindh Sanitation Policy, 2016

The goal of the Provincial Sanitation policy is to ensure that the entire population of Sindh has access to a safely managed sanitation service and sanitary environment that is also nutrition- sensitive and hygienic. The motto of the policy was ‘Saaf Suthro Sindh’ (Neat and Clean Sindh). The Policy sets targets to achieve its motto. For instance, eradication of open Defecation from Sindh Province by 2025, while 70% villages of 13 high priority districts achieve the status of open defecation free by 2020; create and develop wastewater treatment mechanisms to cover 75% of urban areas and 40% in rural areas by 2025, and implement integrated solid waste management with 100% coverage in urban areas and 60%

in rural areas of Sindh by 2025. A WASH behavior changes and communication strategy has also been developed for sustainable and safe hygiene environment by 2025 to enhance the living standards of the people of Sindh.

3.6.13 Sindh Climate Change Policy, 2022

The Sindh Climate Change Policy 2022 outlines a framework for the Sindh government to integrate climate change considerations into all sectors of development, aiming for sustainable socio-economic progress and the well-being of its population. The policy has suggested specific measures with key focus on mitigation, adaptation and capacity development processes for different sectors and sub-sectors like in agriculture, irrigation, forestry, industries, health, nutrition, education, energy, etc.

3.7 International Treaties and Guidelines

3.7.1 The Convention on Biological Diversity

The Convention on Biological Diversity was opened for signature on 5 June 1992 during the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro. The Convention entered into force on its thirtieth ratification on 29 December 1993. Since then, it has received 168 signatures and 190 ratifications. In 1994, the United Nations General Assembly declared May 22nd as the International Day for Biological Diversity. The Convention on Biological Diversity was signed by Pakistan on 5 June 1992, and was ratified by the Cabinet during 1994. Through the Convention, Pakistan and other signatory countries are involved in an international partnership to help halt the global loss of biological diversity. The Convention addresses biological diversity at the genetic and ecosystem level, and provides a framework for its conservation and sustainable use.

The overall objectives of the Convention are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising from the utilization of genetic resources. The Convention was developed in recognition of the environmental, social, cultural and economic value of biological diversity, both now and in the future, and its significant on-going reduction around the world.

Pakistan's Obligations

As a Party to the Convention, Pakistan is obliged to the following general commitments:

- Take general measures for the conservation and sustainable use of biological diversity;
- Identify and monitor components of biological diversity, and activities that have an adverse effect on biological diversity;
- Adopt measures for in-situ conservation, including a system of protected areas, the restoration and rehabilitation of degraded areas, and the development of legislation and other regulatory provisions for the protection of threatened species and their populations;
- Adopt measures for ex-situ conservation, including research on plants, animals, and microorganisms, and measures for the rehabilitation and reintroduction of threatened species;
- Integrate the consideration of sustainable use of the components of biological diversity into national decision making;
- Adopt measures that act as incentives for the conservation and sustainable use of biological diversity;

- Establish and maintain program for scientific and technical education and training in measures for biological diversity conservation. Promote and encourage research and training that contributes to biological diversity conservation;
- Promote understanding of the importance of, and the measures required for, the conservation of biological diversity;
- Ensure environmental impact assessment of projects likely to adversely affect biological diversity with a view to avoiding or minimizing adverse impacts;
- Endeavour to facilitate access to genetic resources for environmentally sound measures;
- Facilitate access of other Contracting Parties to technologies relevant to the conservation and sustainable use of biological diversity;
- Facilitate the exchange of information relevant to the conservation and sustainable use of biological diversity;
- Promote international, technical, and scientific co-operation in the field of conservation and the sustainable use of biological diversity;
- Take measures to provide for participation in technical and scientific co-operation;
- Provide financial support and incentives for activities that are intended to achieve the objectives of this convention.
- The preparation of the Biodiversity Action Plan by the MOE has been the first major step towards the implementation of the CBD.

3.7.2 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 take action to avoid endangering migratory species. The term "migratory species" refers to the species of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries. The 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 to endeavor to:

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

Appendix II lists the migratory species, or groups of species, that have an unfavorable conservation status as well as those that would benefit significantly from the international co-operation that could be achieved through intergovernmental agreements.

3.7.3 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

This convention came into effect on 03 March 1973 in Washington. In all 130 countries are signatory to this convention with Pakistan signing the convention in 1976. The convention requires the signatories to impose strict regulations (including penalization, confiscation of

the specimen etc.) regarding trade of all species threatened with extinction or that may become so, in order not to further endanger their survival.

The Convention contains three appendices. Appendix I include all species threatened with extinction which are or may be affected by trade. The Convention requires that trade in these species should be subject to strict regulation. Appendix II includes species that are not necessarily threatened presently but may become so unless trade in specimens of these species is subject to strict regulation. Appendix III includes species which any contracting party identifies as subject to regulations in trade and requires other parties to co-operate in this matter.

3.7.4 IUCN Red List

The red list is published by IUCN and includes those species that are under potential threat of extinction. These species have been categorized as:

- Endangered: species that are or may be facing a very high risk of extinction in the wild in the near future; reduction of 50% or more either in the last 10 years or over the last three generations, survive only in small numbers; or have very small populations.
- Vulnerable in Decline: species that are seen to be facing a risk of extinction in the wild, having apparent reductions of 20% or more in the last 10 years or three generations.
- Vulnerable: species that are seen to be facing a high risk of extinction in the wild, but not necessarily experiencing recent reductions in population size.
- Lower Risk: species that are seen to be facing a risk of extinction that is lesser in extent than for any of the above categories.
- Data Deficient: species that may be at risk of extinction in the wild but at the present time there is insufficient information available to make a firm decision about its status.

Other International Treaties signed by Pakistan relevant to Environmental Protection are:

International Treaties signed by Pakistan	
Subject	Treaties signed
Climate Change & the Ozone Layer	• UN Framework Convention on Climate Change, 1992 • Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1997
	• Vienna Convention for the Protection of the Ozone Layer, 1985 • The Montreal Protocol on Substances that Deplete Ozone Layer and associated amendments, 1987
Waste & Pollution	Basel Convention on the Control of Trans boundary Movement of Hazardous Wastes and their Disposal, 1989.
Biodiversity & the Protection of Plants & Animals	• Convention on the Biological Diversity, 1992 • Cartagena Protocol on Biosafety to the Convention on Biological Diversity, 2000

3.8 Other Relevant Laws and Policies

3.8.1 Oil and Gas Regulatory Authority Ordinance, 2002

Oil and Gas Regulatory Authority (OGRA) issues all the licenses related to Oil & Gas setup. Section 23 states that no person shall construct or operate any installation relating to

oil, undertake storage of oil, or undertake marketing of refined oil products unless a general or specific license to undertake such activity has been issued and in full force and effect and the person is the licensee. The authority may grant a license subject to such conditions, restrictions or stipulations as may be set out in, or attached to, the license.

3.9 International Environmental Guidelines

3.9.1 World Bank Guidelines on Environment

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

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

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

The Sourcebook identifies a number of areas of concern, which should be addressed during impact assessment. It sets out guidelines for the determination of impacts, provides a checklist of tools to identify possible biodiversity issues and suggests possible mitigation measures. Possible development project impacts on wild lands, wetlands, forests etc. are also identified and mitigation measures suggested. The Sourcebook also highlights concerns in social impact assessment, and emphasizes the need to incorporate socio-economic issues in EIA exercises. The EHS guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP).

3.9.2 IFC Environmental, Health and Safety Guidelines for Onshore Oil and Gas Development

The EHS Guidelines for Onshore Oil and Gas Development include information relevant to seismic exploration; exploration and production drilling; development and production activities; transportation activities including pipelines; other facilities including pump stations, metering stations, pigging stations, compressor stations and storage facilities; ancillary and support operations; and decommissioning. The guidelines especially emphasize on the following items and provides guidelines to cater the following issues:

- Air Quality
- Hazardous Material Management
- Noise



- Terrestrial Impacts and Project Foot print
- Spills
- Fire and Explosion
- Emergency preparedness and response
- Performance Indicators and Monitoring



4.0 ENVIRONMENTAL AND SOCIAL BASELINE

4.1 General

This section describes the project area's existing natural and socioeconomic setting. Discussion on the natural environment covers the area's physical and biological resources, including geomorphology, water resources, climate and air quality, vegetation, and wildlife and wildlife habitat. Description of the socioeconomic environment includes details of the area's population and households, education and health facilities, gender issues, water supply, agriculture, transport and communications, and occupations and income sources.

Description of the environmental and socioeconomic conditions of “Gambat-II block” requires baseline data on the existing resources of its microenvironment and macro environment as well as the following in particular:

1. Physical Resources,
2. Ecological Resources,
3. Social, Economic Development and Cultural Resources.

4.1.1 The Aim of Baseline Study

This section provides a comprehensive profile of the surrounding environment of Gambat II block situated in district Sukkur and Khairpur, where the seismic activities will be conducted by PPL. The study will cover the physical, biological and socio-economic environment of the area prior to the commencement of 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 occur as a result of the project associated activities. 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.

4.1.2 Methodology

The baseline data collected in this section is based on primary and secondary sources. Primary data has been obtained from field visits, site surveys and assessment of the existing environmental conditions on site by EMC experts. The secondary data has been acquired from the literature review of past studies, research studies conducted in the areas, electronic and print media information, maps prepared by the Geological survey of Pakistan and Soil survey of Pakistan, District Census Reports (DCRs) and other information in districts and archives of the experts.

4.2 Physical Environment

4.2.1 Geographical location

The Gambat-II block lies in the Sukkur and Khairpur districts of the province Sindh. The total area of block is approximately 1,697.56 sq km.

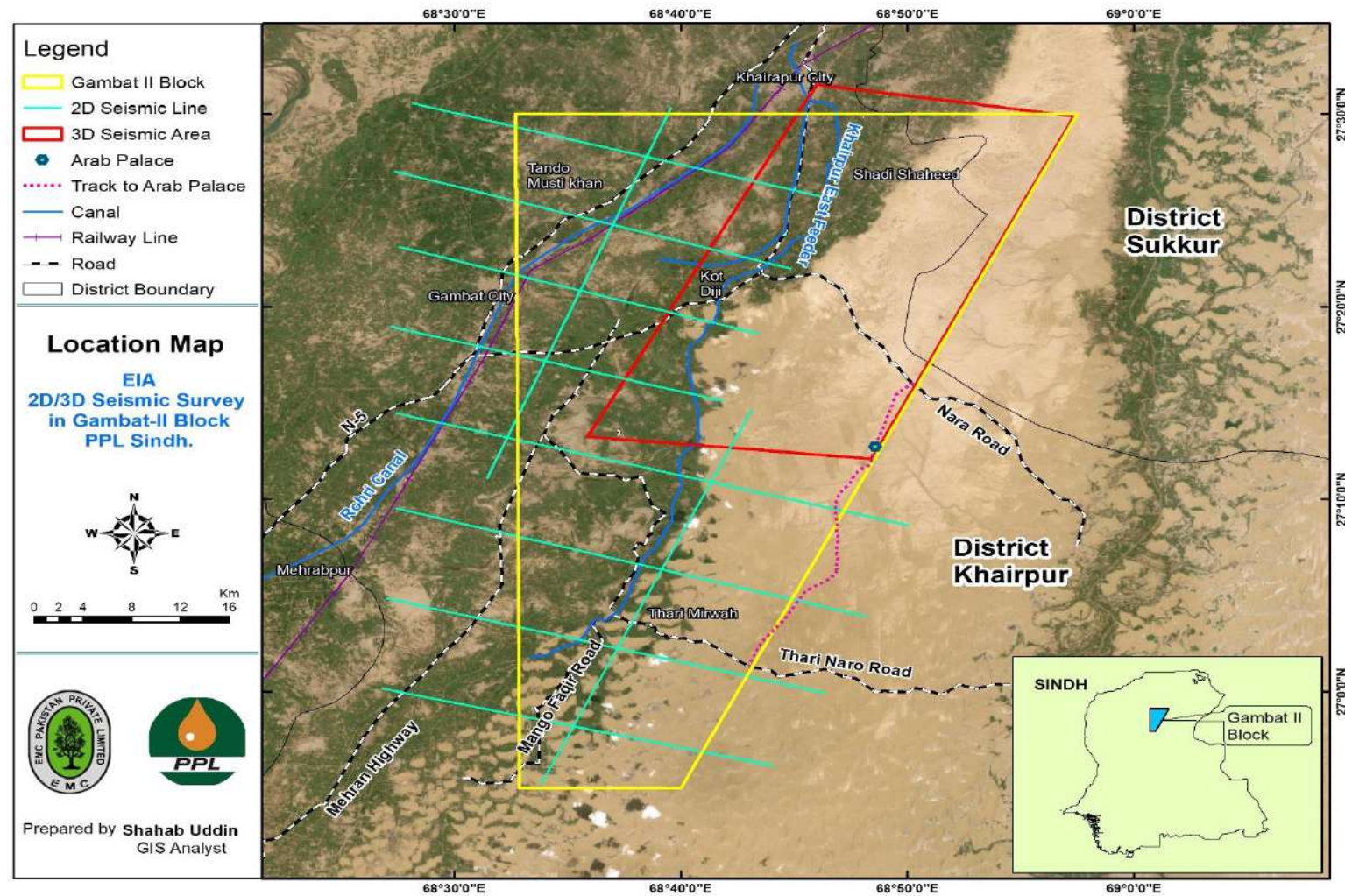


Figure 4.1: Geographical Location of Gambat-II Block

4.3 Micro environment

The microenvironment comprises of the specific site of project i.e. 2D seismic activity will be carried out throughout the district Khairpur while 3D seismic area in Takkar Wildlife Sanctuary (between 27°26'51.87"N, 68°51'46.23"E and 27°13'28.28"N, 68°40'47.17"E) which is tehsil Saleh Pat of District Sukkur and tehsil Nara of District Khairpur.

The project lies in District Sukkur and District Khairpur. District Sukkur has five talukas, named: New Sukkur, Sukkur city, Pano Aqil, Rohri and Saleh Pat and covers an area of 5126 Km². District Khairpur has eight talukas namely, Khairpur, Faiz Gunj, Gambat, Kingri, Kot Diji, Nara, Thari Mir Wah and Sobho Dero and spans over an area of 15,925Km².

The project area is North-South aligned, spanning from Rohri in the North and Jaam Nurullah – Kandiyari road in the southwest. The Western-Southwestern portion of the project area is agricultural, dry, desert hilly land of Rohri hill range having elevation from 180 to 330 ft. The Eastern-Northeastern portion is dry, desert hilly land of Rohri hill range. Elevation of this portion ranges from 200 to 400 ft.

4.4 Macro environment

The Macro environment of the project area includes districts Sukkur and Khairpur and Sindh province on large scale. Khairpur district is located in north-eastern Sindh and is bounded on the north by Shikarpur and Sukkur, on the east by India, on the south by Sanghar and Shaheed Benazirabad and on the west by Larkana and Noshero Feroz. The district lies from 68°10' to 70°10' east longitude and 26°9' to 27°42' north Latitude. The climate of Khairpur is typically that of the upper Sindh region. There are two well defined seasons, hot and cold. The summer spans from the end of March till October. May, June and July are the hottest months. December, January and February are the coldest months.

District Sukkur is bounded by district Ghotki and India on the east, district Kashmore on the north, district Shikarpur on the north-west, and district Khairpur on the west and south. Indus River flows on the north-western side of this district. Sukkur is the narrowest part of the Indus River course. The climate of this district is hot during summer while dry and cold in winter. During January, the temperature ranges from 7°C to 22°C. The summer temperature averages 35 °C though it often reaches up to 52°C. Generally, the summer season commences in March - April and ends before October. The average rainfall of the district is 88 mm, per annum (with monthly ranges from 0.59 mm to 25.62 mm).



Figure 4.2: District map of Sindh

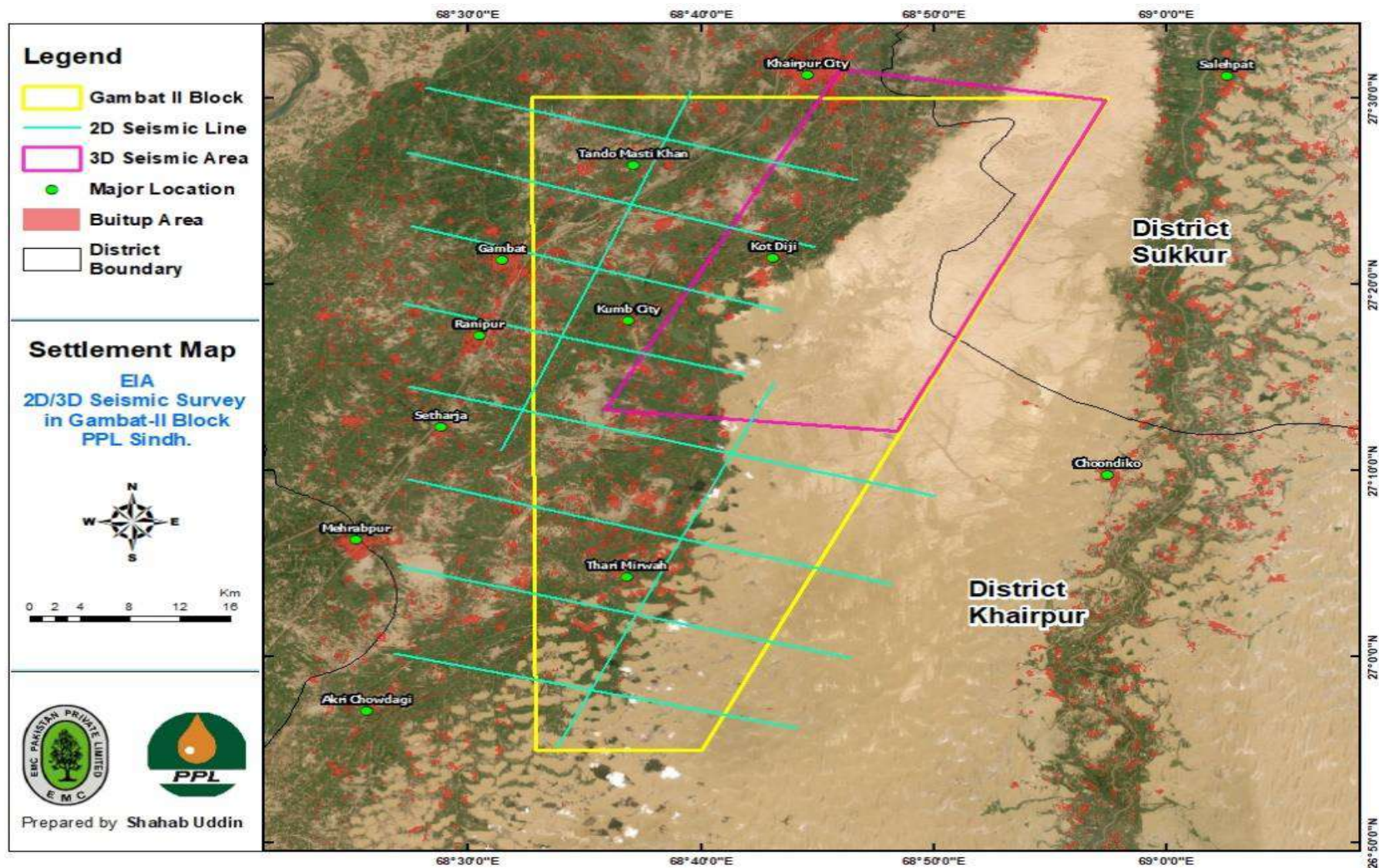


Figure 4.3: Settlement Map of Gambat II Block, District Sukkur and Khairpur

4.4.1 Physiography

Sindh can be divided into four distinct parts; the Kirthar range in the west; a central alluvial plain bisected by the Indus River; the desert to the east; and the Indus Delta in the south. The project area lies in the North eastern part of the Sindh province in talukas Rohri, Saleh Pat of district Sukkur and Talukas Nara, Thari Meer Wah, Kot Diji, Tehsil Khairpur, and Faiz Ganj of district Khairpur.

4.4.2 Geology and Topography

Khairpur

The topography of the desert part of Khairpur district is marked with sandy hills, steep slopes, and vast low-lying areas locally known as Patt. The sand dunes rise up to 150 m in height. The elevations within the interdunal valley vary between 60 to 80 m above mean sea level. The dunes achieve elevations from 80 to 99 m. The Plain Cultivated Area of Khairpur consists of an alluvial plain, which is very rich and fertile in the vicinity of the Indus and the irrigation canals. A small range of hills called Rohri Hills, which are limestone hill formations, acts as a buffer between the fertile agriculture habitat along the left bank of Indus, and is located on the northern part of the district. This range runs southwards from Rohri.

Sukkur

Topographically, the district Sukkur may be divided into two broad parts. Fertile plain in the western half and desert in the eastern half separated by the Rohri Hills. With the exception of the low limestone hills running from the town of Rohri towards the south, and on the west of Nara Canal. The rest of the area of the district in the western half, is flat and level plain. The hills vary in elevation from 100 to 125 meters. There are four prominent hills namely, Adam Shah hills near Sukkur, Kalka hills at Aror, Laheri hills at Rohri and Shadi Shaheed hills at Kandahra. The eastern half of the district is a wasteland. It consists of barren tract of clay and ridges of sand hills covered with caper and thorn jungle.

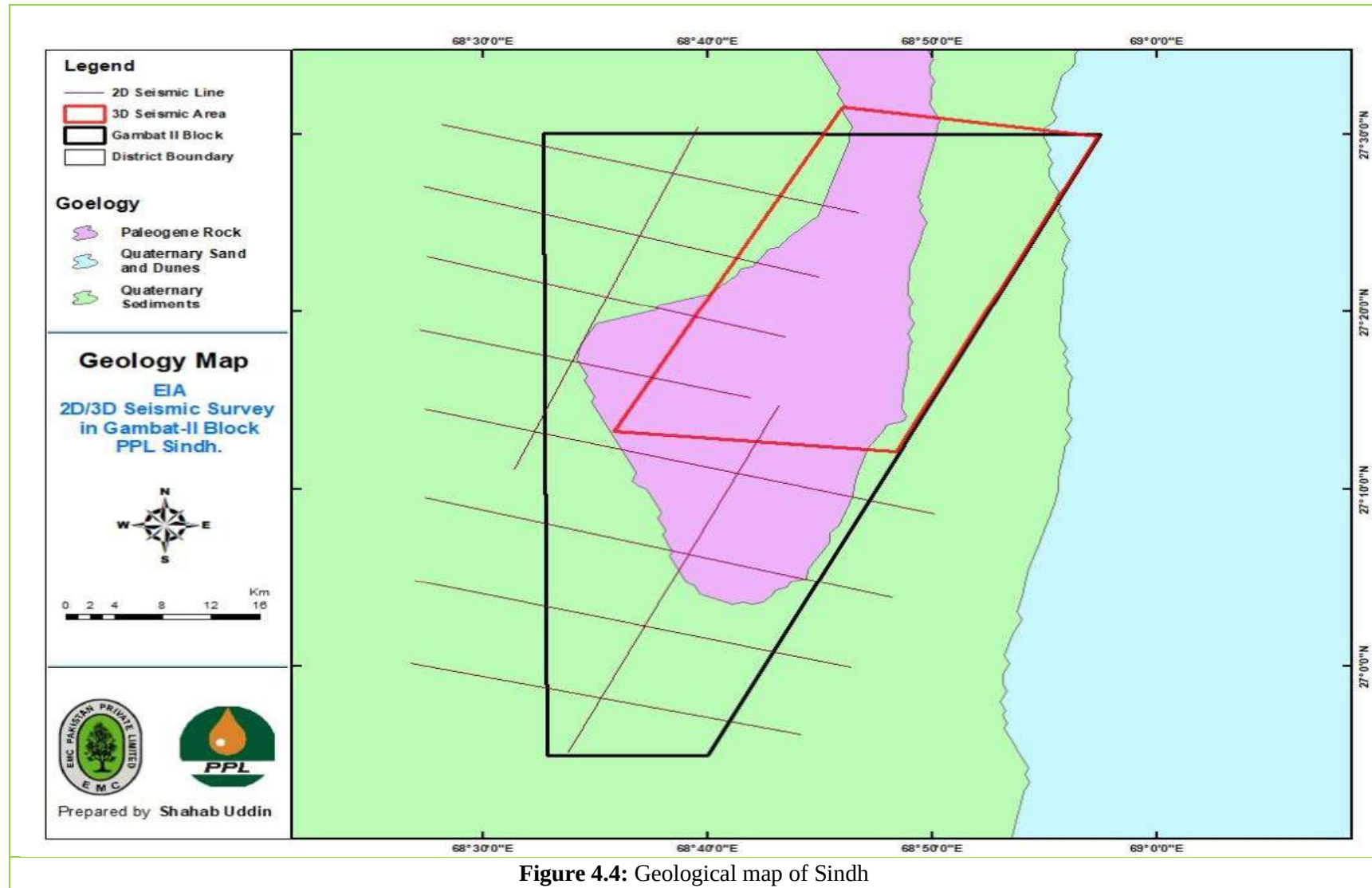
The geological map of the project area (Figure 4.4) indicates that Paleogene rock formations are predominantly located in the central portion of the block. Quaternary sediments are distributed along the southern and peripheral boundaries of the block, while Quaternary sand and dune formations are found in limited eastern sections.

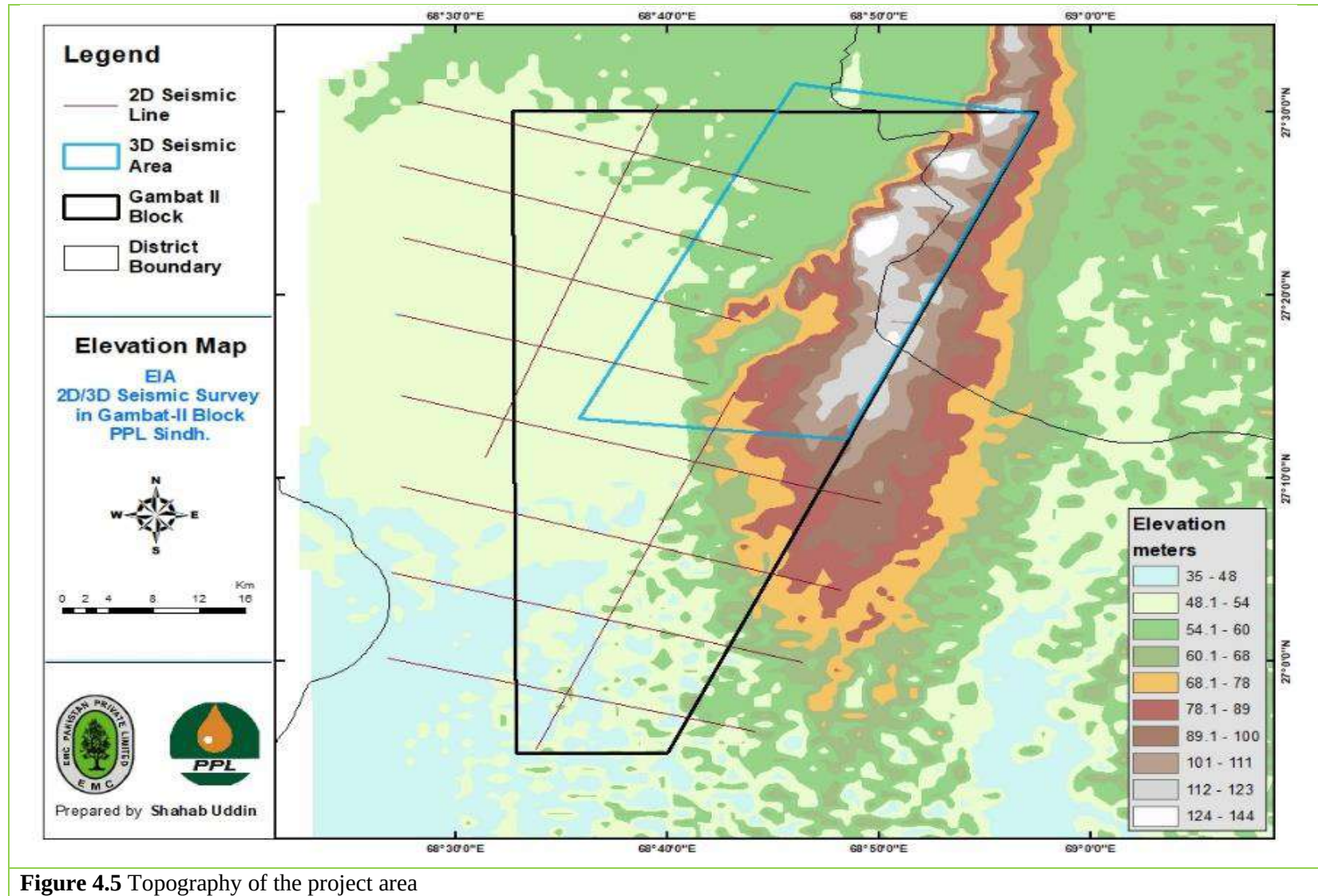
The Paleogene rocks likely consist of shale, limestone, or sandstone deposited during the Paleogene period (66–23 million years ago). In contrast, the Quaternary sand and dunes comprise unconsolidated, wind-blown deposits younger than 2.6 million years. The Quaternary sediments primarily consist of alluvial deposits such as clay, silt, and sand, formed by river or floodplain activity.

This distribution of geological formations influences both the seismic survey's technical approach and the interpretation of subsurface data. The Paleogene rocks, being more

consolidated, may provide clearer seismic reflections, while the unconsolidated Quaternary materials could require adjusted acquisition parameters for optimal data quality.

The topography of project area is presented in figure 4.5, which shows the elevation portion within the project area. The elevation profile of the Gambat-II block exhibits a gradual decline from northeast to southwest. The highest elevations are observed on the northeastern side of the block, ranging between 68 to 148 meters above sea level. Moving towards the western side, the elevation decreases significantly, reaching its lowest point in the southern region, where it varies between 35 to 48 meters. The central southern portion of the block shows slightly higher elevations, ranging from 48 to 68 meters. This variation in topography influences surface drainage patterns and may have implications for seismic survey planning and environmental assessments.





4.4.3 Soil Morphology

The project area has two prominent land types, fertile land in the West and Desert barren area in the east and south. The Rohri canal flows along the western boundary of the project area.

Large part of the project area lies in the Taluka Thari Meer Wah and Kot Diji of District Khairpur. The area forms a part of Indo-gangetic plain formed by the gradual filling up of the trough lying between the foothills of Himalaya and central core of the sub-continent. On regional scale the area is a part of the Indus basin and is composed of alluvial sediments deposited by ancestral and present rivers and their tributaries crossing the alluvial plain. The alluvium brought by the River Indus lies over the basement of tertiary Shales and limestone. The other contributing rocks are granites, schists, gneisses and slates. The alluvium is quite rich in weathered minerals with soils deep and calcareous. The rocks belong to the Paleozoic, Mesozoic and Tertiary geological time scale. The soils of the study area were formed in acolian sands originally deposited in Pleistocene age but reworked by wind until recently to take the form of sand dunes. The texture of the soil ranges from sandy to loamy fine sand but rarely very fine sandy loam in some areas. Soils are generally brown to greyish brown in color with CaCO_3 content between 5 to 15%. Soils in the desert are generally non-saline, non-sodic and deficient in organic matter with a pH between 7.8 and 8.4. Salinity and waterlogging are common in irrigated areas particularly near the canal.⁸

4.5 Protected areas

The 3D seismic survey encompasses an area of approximately 696.00 square kilometers, primarily within ecologically sensitive zones, including the Takkar and Khat Dhoru Wildlife Sanctuaries. Additionally, several 2D seismic lines—specifically GAMII-10, 12, 14, and 16—extend into the Takkar Wildlife Sanctuary's sensitive ecological zone. Other 2D lines pass near the Khat Dhoru (wetland) Wildlife Sanctuary, located in the northern section of the Gambat-II block.

4.5.1 Takkar Wildlife Sanctuary

Takkar wildlife sanctuary is situated in district Khairpur covering an area of 435.13 km². The wildlife sanctuary is barren desert area with sparse vegetation typically found in the desert of hot arid climate. The characteristic features of this climatic zone are low rainfall, absence of a well-defined rainy season, and high temperatures. The sanctuary experiences extreme temperatures in summer.

The project area passes through a section of Takkar Wildlife Sanctuary as shown in the following figure 4.7.

⁸ Ecological Assessment of Fauna at Nara Wetland Complex, District Khairpur, Sindh Baseline Survey 2010 – 2011, Indus for All Program, WWF-Pakistan

4.5.2 Khat Dhoro Wildlife Sanctuary

The Khat Dhoro wetland, which is also known as Kat Dhoro Wildlife sanctuary is also a protected area under the Sindh wildlife protection, preservation, conservation, and management rules, 2022. The wild life sanctuary is located near one of the 2D seismic lines. However, a safe buffer distance of 900 meters has been maintained to avoid any impact on the sanctuary.

The wildlife sanctuary a closed channel of the Indus River that collects seepage and rainwater from nearby lands. The study team visited the Kat Dhoro Wildlife Sanctuary, where they observed some ducks, black partridges and gray partridges. Its indicates that this area has significant biodiversity potential. The surrounding of the Kat Dhoro consists of agriculture land.

Gallery 1: Pictorial record of the Fauna present in the project area	
	
Asiatic jackal	Desert hare
	
Chinkara	Indian crested porcupine
	
Balochistan gerbil	Indian desert Jird



Common red fox



Small Indian mongoose



Long-eared desert hedgehog



Indian desert wild cat



Five Striped Squirrel



Indian Monitor Lizard



Indian Garden Lizard



Indian Spiny Tail Lizard

Gallery 2: Pictorial record of the Avifauna present in the project area



Cattle Egret



Collared Dove



Common Myna



Crested Lark



Crow Pheasant



Glossy Ibis



Great Grey Shrike



Indian Robin



Indian Roller



Kashmir Roller



Pied Bushchat



Purple Sunbird



Red Turtle Dove



Red Wattled Lapwing



Red Shank



Rosy Starling



Sindh Pied Woodpecker



Spotted Owl



White Browed Fantail



Common Buzzard

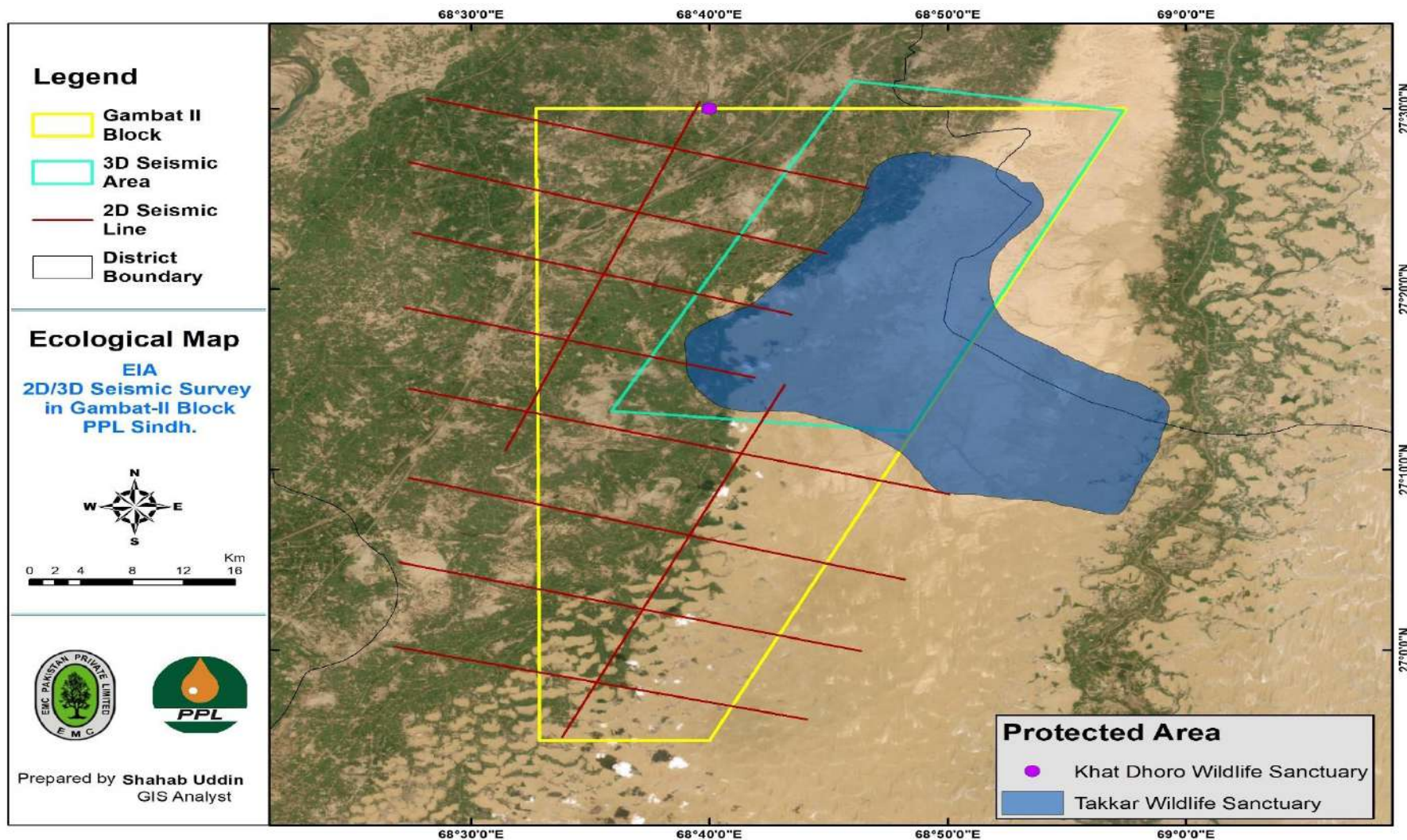


Figure 4.7: Protected Areas within Project Area

4.6 Cultural Antiquities

The historical background of the proposed block including some shrines, ancient cemeteries, old temples, Kot diji fort and graveyard and mosques. Notable shrines include Dargah Long Faqir, Shaadi Shaheed, Chatan Shahi Bukhari, Sultan Badshah, Uban Shah, Nabi Shah, Peer musafr shrine. The area also features ancient cemeteries, and near the Satyaru village lies an ancient Hindu temple. Additionally, the historical Kot Diji Fort, a national heritage site, is located within the Gambat II block.



Dargah Long Faqir



Dargah Shaadi Shaheed



Dargah Chhatan Shah Bukhari



Dargah Sultan Badshah.



Dargah Uban Shah



Dargah Peer musafr



The historical fort of Kot Diji



4.7 Climate

4.7.1 Sukkur

Temperature

The Sukkur District experiences extreme temperatures in summer. The annual average maximum temperature is over 40°C with mean daily maximum temperatures remaining above 40°C in May, June and July. June is the hottest month with highest recorded temperatures reaching up to 50°C. Daytime minimum temperatures even in winter remain above 22°C. Winters are mild and short with mean minimum temperatures not falling below 8°C.

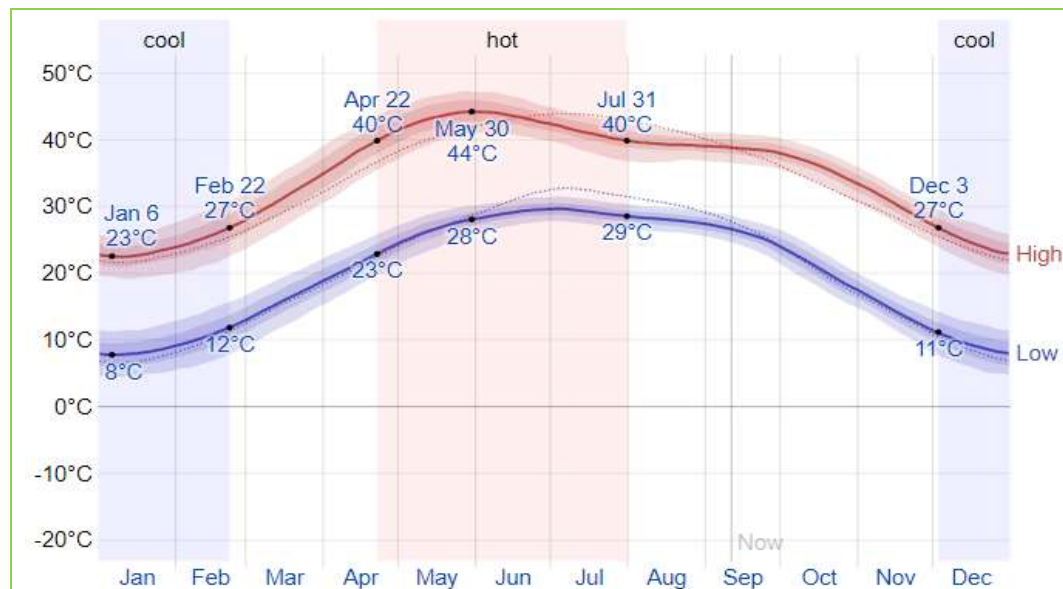


Figure 4.8: The daily average high (red line) and low (blue line) temperature. The thin dotted lines are the corresponding average perceived temperatures. (Source: www.weatherspark.com)

Rainfall

The rainy period of the year lasts for 1.7 months, from July 9 to August 31, with a sliding 31-day rainfall of at least 13 millimeters. The most rain falls during the 31 days centered around August 2, with an average total accumulation of 20 millimeters.

The rainless period of the year lasts for 10 months, from August 31 to July 9. The least rain falls around October 22, with an average total accumulation of 1 millimeter.



Figure 4.9: The average rainfall (Source: www.weatherspark.com)

Humidity

Sukkur experiences extreme seasonal variation in the perceived humidity. The humid period of the year lasts for 3.8 months, from May 30 to September 22, during which time the comfort level is humid, oppressive, or miserable at least 20% of the time. The most humid day of the year is July 31, with muggy conditions 79% of the time. The least humid day of the year is February 6, when humid conditions are essentially unheard of.

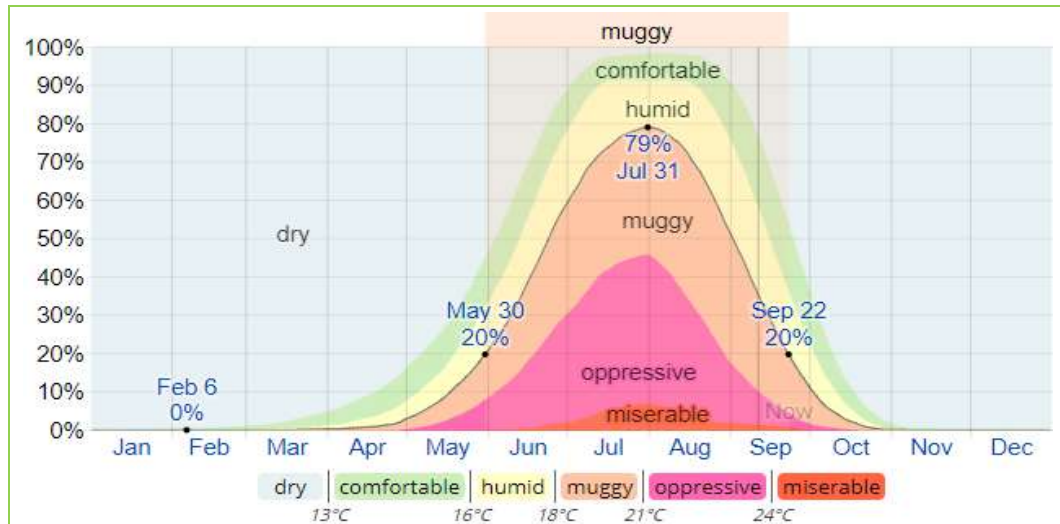


Figure 4.10: Humidity comfort levels, categorized by dew point. (Source: www.weatherspark.com)

Wind

The average hourly wind speed in Sukkur experiences significant seasonal variation over the course of the year. The windier part of the year lasts for 3.8 months, from May 15 to September 10, with average wind speeds of more than 3.6 meters per second. The windiest day of the year is June 29, with an average hourly wind speed of 5.1 meters per second.

The calmer time of year lasts for 8.2 months, from September 10 to May 15. The calmest day of the year is November 7, with an average hourly wind speed of 2.2 meters per second.

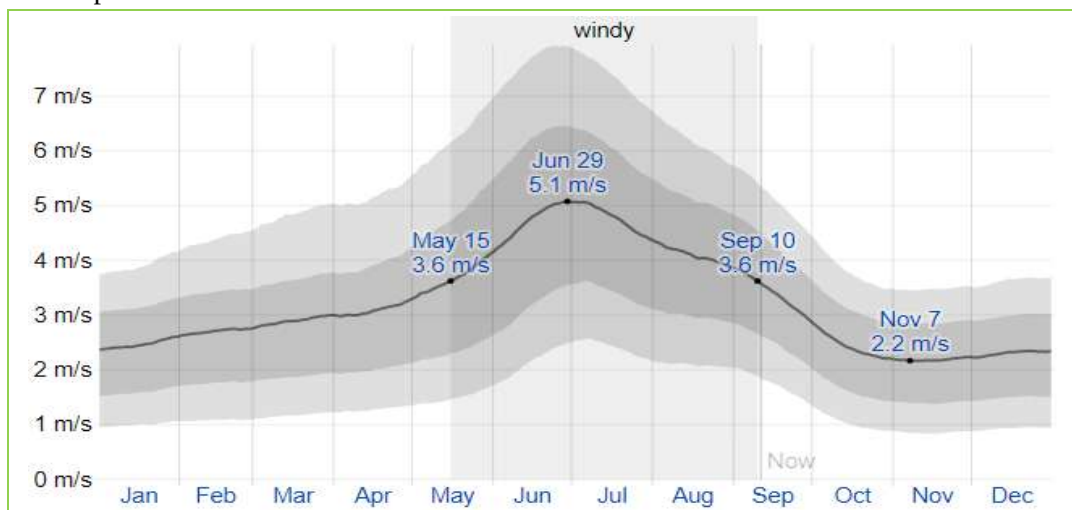


Figure 4.11: The average of mean hourly wind speeds (dark gray line).

(Source: www.weatherspark.com)

The wind is most often from the north for 2.7 weeks, from March 7 to March 26 and for 2.1 weeks, from November 21 to December 6, with a peak percentage of 34% on November 30. The wind is most often from the south for 7.4 months, from March 26 to November 7, with a peak percentage of 83% on July 5. The wind is most often from the east for 2.0 weeks, from November 7 to November 21 and for 3.0 months, from December 6 to March 7, with a peak percentage of 31% on November 20.

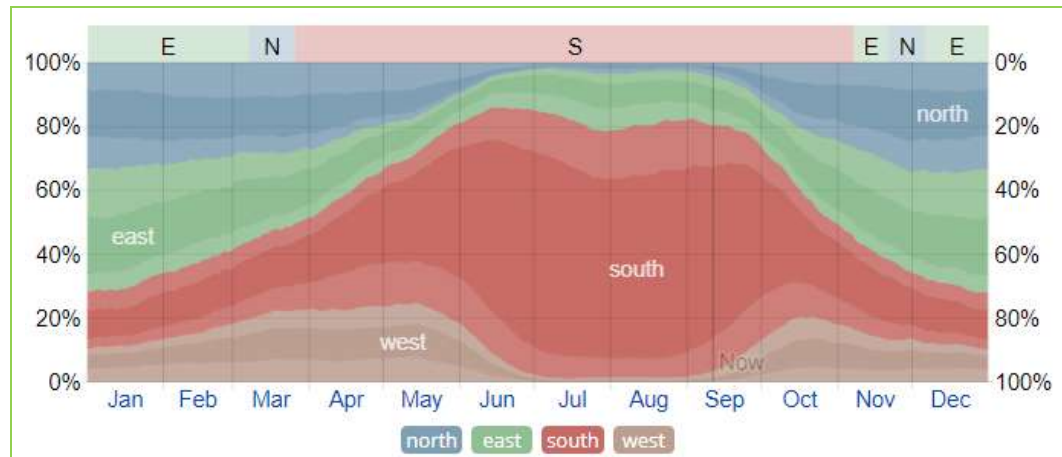


Figure 4.12: Mean Wind direction. (Source: www.weatherspark.com)

4.7.2 Khairpur

Temperature

In Khairpur, the summers are blistering and humid, the winters are short and cool, and it is dry and mostly clear year round. Over the course of the year, the temperature typically varies from 8°C to 44°C and is rarely below 4°C or above 47°C.

The hot season lasts for 3.2 months, from April 22 to July 29, with an average daily high temperature above 40°C. The hottest day of the year is May 27, with an average high of 44°C and low of 28°C.

The cool season lasts for 2.6 months, from December 3 to February 22, with an average daily high temperature below 27°C. The coldest day of the year is January 7, with an average low of 8°C and high of 23°C.

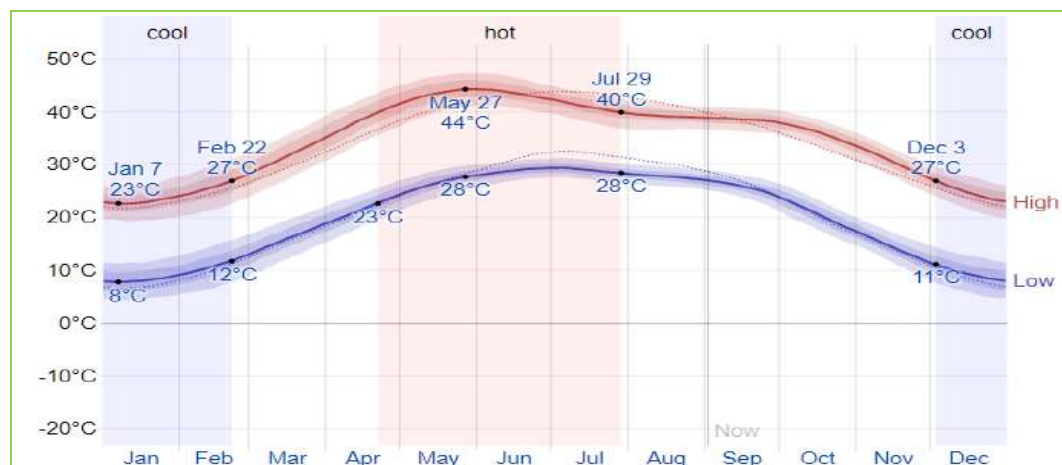


Figure 4.13: The daily average high (red line) and low (blue line) temperature. The thin dotted lines are the corresponding average perceived temperatures. (Source: www.weatherspark.com)

Rainfall

The rainy period of the year lasts for 1.8 months, from July 9 to September 1, with a sliding 31-day rainfall of at least 13 millimeters. The most rain falls during the 31 days centered around August 2, with an average total accumulation of 21 millimeters.

The rainless period of the year lasts for 10 months, from September 1 to July 9. The least rain falls around October 22, with an average total accumulation of 1 millimeter.



Figure 4.14: The average rainfall. (Source: www.weatherspark.com)

Humidity

Khairpur experiences extreme seasonal variation in the perceived humidity. The damper period of the year lasts for 3.9 months, from May 27 to September 24, during which time the comfort level is humid, oppressive, or miserable at least 20% of the time. The most humid day of the year is July 31, with humid conditions 80% of the time.

The least humid day of the year is December 17, when humid conditions are essentially unheard of.

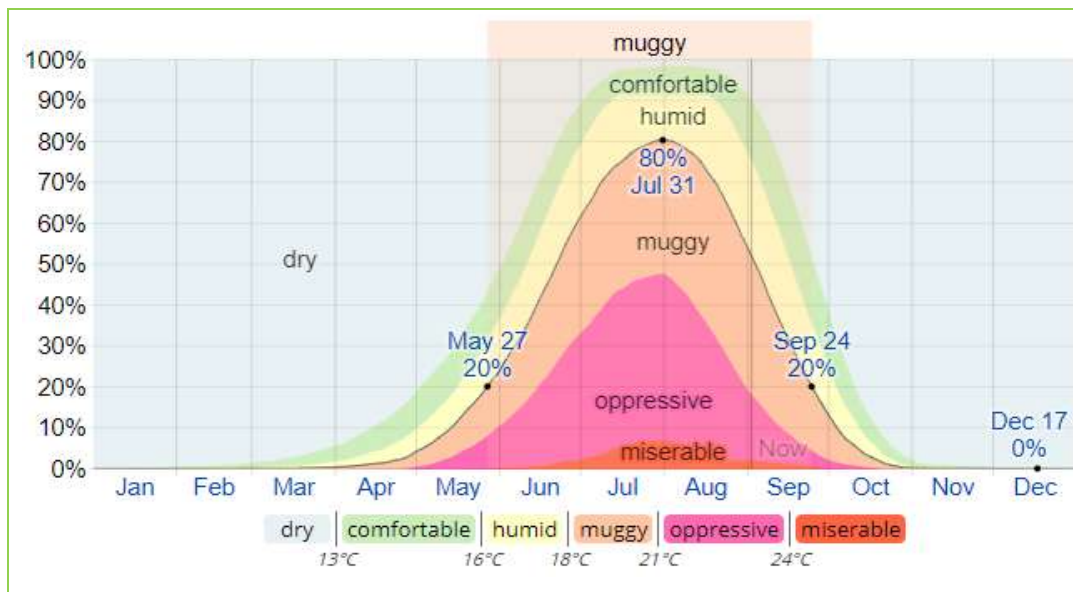


Figure 4.15: Humidity levels. (Source: www.weatherspark.com)

Wind

The average hourly wind speed in Khairpur experiences significant seasonal variation over the course of the year.

The windier part of the year lasts for 3.9 months, from May 15 to September 10, with average wind speeds of more than 3.8 meters per second. The windiest day of the year is June 29, with an average hourly wind speed of 5.3 meters per second.

The calmer time of year lasts for 8.1 months, from September 10 to May 15. The calmest day of the year is November 7, with an average hourly wind speed of 2.2 meters per second.

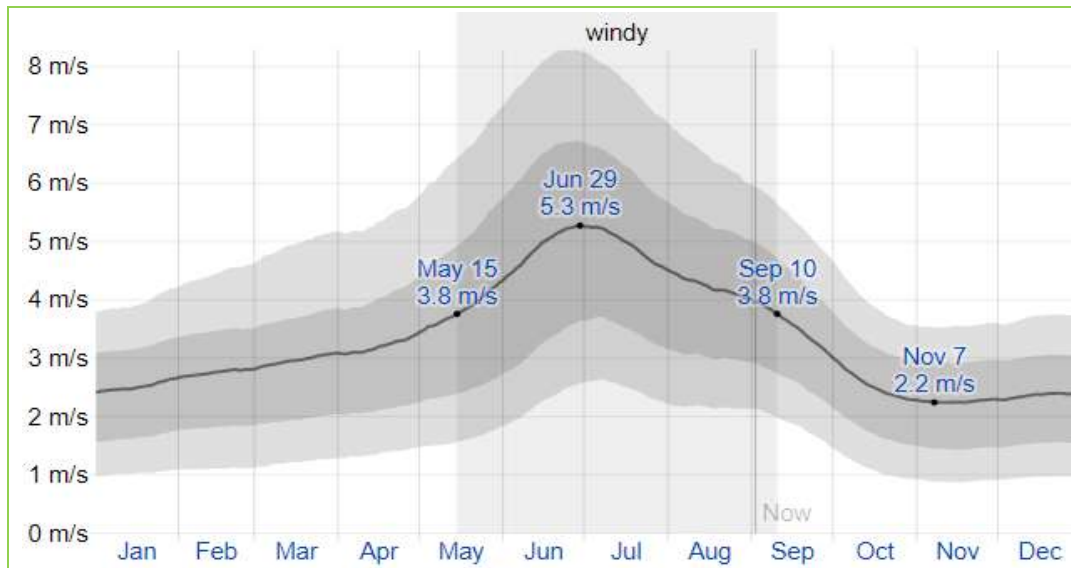


Figure 4.16: The average wind speeds (dark gray line). (Source: www.weatherspark.com)

The predominant average hourly wind direction in Khairpur varies throughout the year. The wind is most often from the south for 7.4 months, from March 26 to November 8, with a peak percentage of 83% on July 5. The wind is most often from the north for 4.6 months, from November 8 to March 26, with a peak percentage of 36% on January 1.

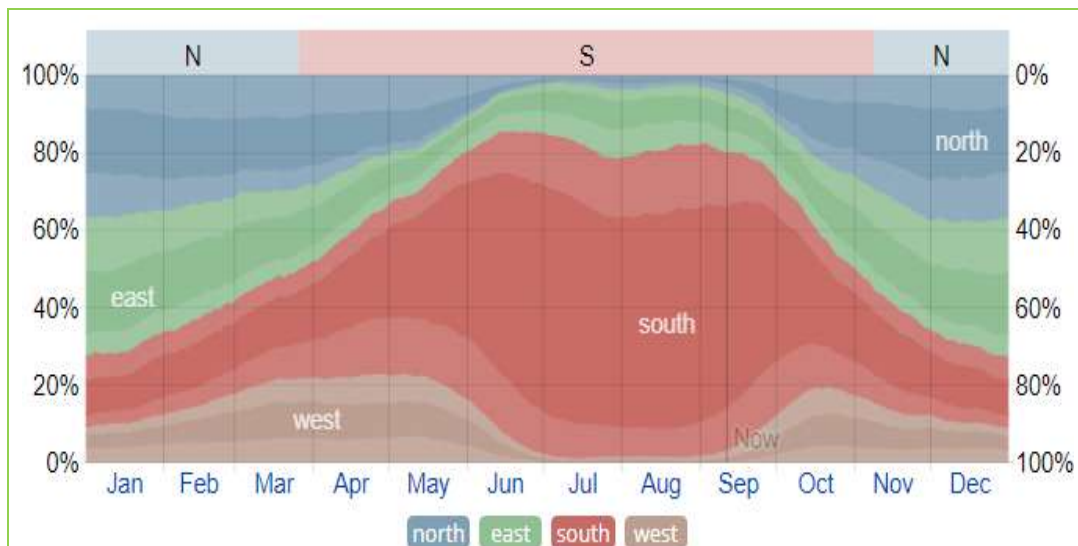


Figure 4.17: Mean Wind direction. (Source: www.weatherspark.com)

4.8 Seismicity

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

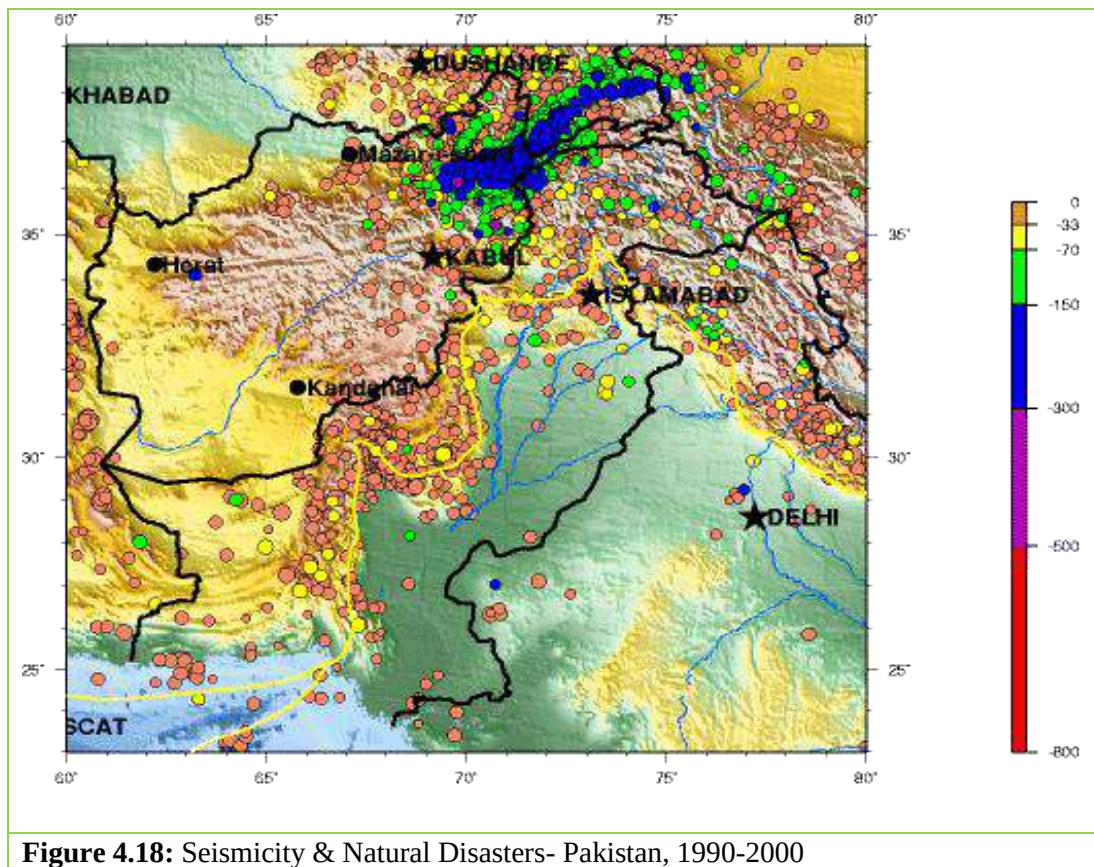


Figure 4.18: Seismicity & Natural Disasters- Pakistan, 1990-2000

Following faults are located within the province of Sindh:

- A. Karachi-Jati Fault
- B. Surjani Fault
- C. Pab Fault
- D. Hub Fault
- E. Allah Bund-Rann of Kutch Fault

A. Surjan Fault

These N-S trending dip-slip or bedding-plane faults are active along the Kirthar Range Front. This fault cuts across the Quaternary deposits on the north of Karachi and west of Mirpur Sakro. The southern end of this fault is intersected by the northwest trending Surjani Fault on the west of Jhimpir. The interaction of these two faults is characterized by at least

four tele-seismic events of shallow focal depth and magnitude 3.6. The maximum magnitude of the earthquake associated with the Surjani Fault is of the order of $M \approx 6.1$.

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

B. Pab Fault

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

C. Hub Fault

The Hub valley is traversed by this fault.

D. Rann of Kutch Fault

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

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

4.9 Flood Risk Map

The flood risk map for the project area, illustrated here and elaborated in Annex III, categorizes flood susceptibility based on topography, soil composition, and historical rainfall patterns across Khairpur and Sukkur districts. A large section of the block—particularly its eastern and northeastern parts—is classified as low-risk (light green), characterized by elevated terrain with minimal flood exposure. In contrast, high-risk zones (red/dark orange) and moderate-risk areas (orange) dominate the western and central regions, forming distinct meandering belts that align with existing or past river channels and floodplains. The highest-risk areas trace the primary drainage corridors, while moderate-risk zones flank them, marking areas of less frequent or severe inundation. This spatial distribution underscores the influence of hydrological features on flood vulnerability.

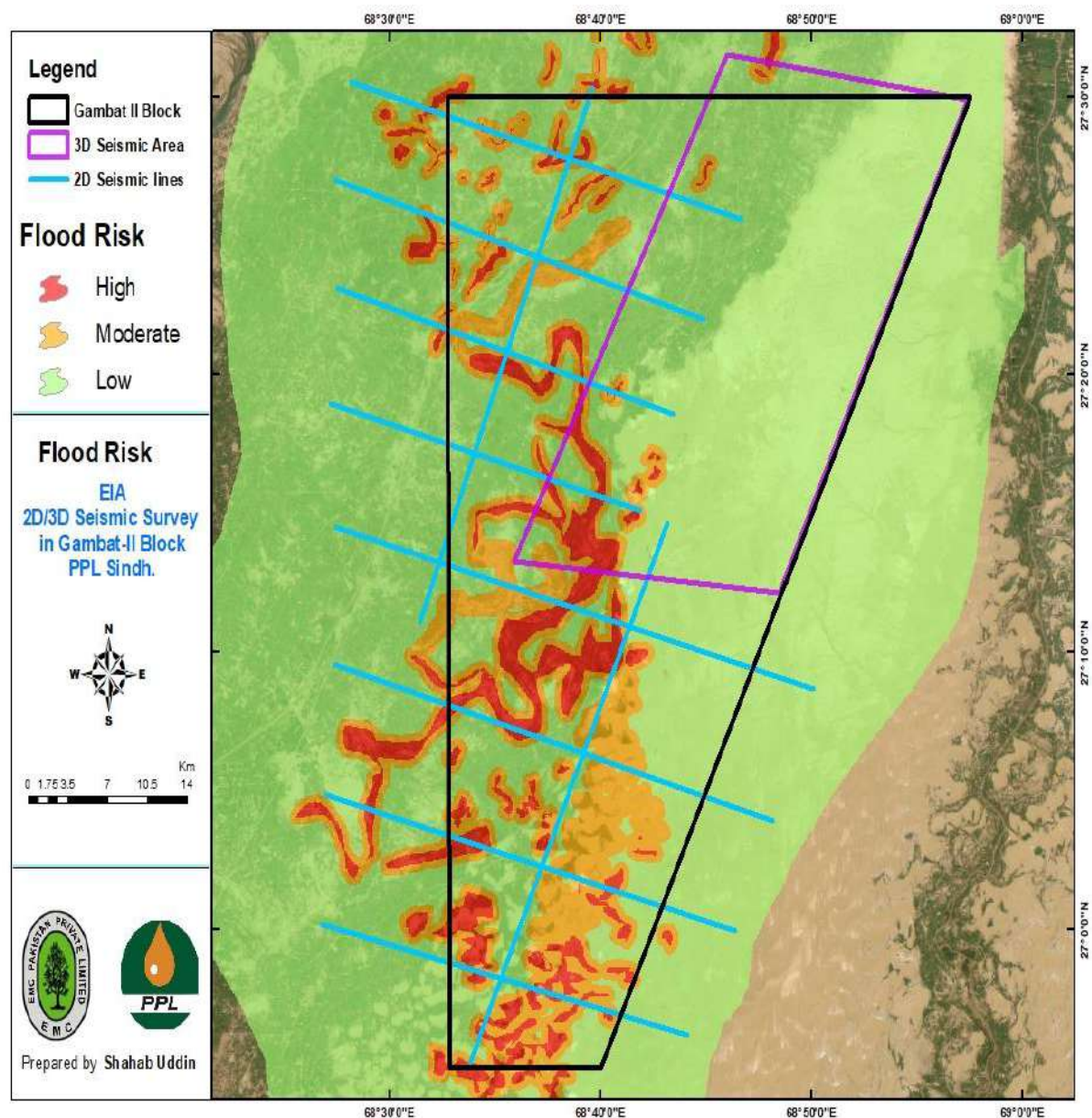


Figure. 4.19: Flood risk map of project area
(Source: Created using ArcGIS)

4.10 Ambient Air & Noise Quality

The project area lies in district Khairpur and Sukkur, east of the river Indus. Project area is barren and thinly populated in the east while the western area is fertile agricultural land. However, these areas are not urbanized therefore, the air quality in the area is generally good, with very few sources of pollution like emissions from vehicles and small industries. Vehicular traffic causes dust emissions and their effects are localized. The main pollutants emitted by vehicle exhaust pipes are particulate matter, carbon monoxide, sulfur dioxide, and nitrogen oxides. These emissions generally may affect the air quality in the vicinity of the roads. It is worth mentioning that mining and mechanized stone crushing is common in area such as Aror in Sukkur, vicinity of Kot Bungalow and Kot Diji and strong winds lead to high levels of air borne dust.

Ambient Air Quality Monitoring was conducted at 10 locations in the project area by EMC. The parameters observed were according to the SEQS for Ambient Air Quality and analysis results meet the SEQS standards.

All the parameters of Ambient Air Quality i.e. Sulfur Dioxide, Nitrous Oxides, Carbon Monoxide, Suspended Particulate Matter, Particulate Matter all were observed to be complying the SEQS standards. Results have been represented in the tables below.

Table 4.1: Ambient Air Quality Testing Result

Parameter	Unit	SEQ S	LDL - Limi ts	Location: AA-1 (27°24'34.4 "N 68°49'39.3 "E)	Location: AA-2 (27°21'50.1 "N 68°44'42.8 "E)	Location: AA-3 (27°18'01.9 "N 68°40'37.5 "E)	Location: AA-4 (27°17'28.4 "N 68°38'43.4 "E)	Location: AA-5 (27°11'36.8 "N 68°39'11.3 "E)	Location: AA-6 27°02'47.9 "N 68°40'09.6 "E	Location: AA-7 27°04'54.2 "N 68°44'34.2 "E	Location: AA-8 27°04'47.9 "N 68°27'13.3 "E	Location: AA-9 27°15'45.6 "N 68°49'51.8 "E	Location: AA-10 27°29'14.9 "N 68°33'06.3 "E
Carbon Monoxide (CO)	mg/m ₃	5.0	0.01	1.77	1.46	1.57	2.44	3.72	1.70	3.51	3.37	3.54	1.65
Nitrogen oxide (NO)	µg/m ₃	40.0	0.0	23.4	14.4	17.5	17.9	17.8	15.5	21.7	15.9	18.2	25.0
Nitrogen Dioxide (NO ₂)	µg/m ₃	80.0	0.0	21.6	18.2	20.35	16.1	22.2	17.3	15.8	13.8	15.5	18.9
Sulphur Dioxide (SO ₂)	µg/m ₃	120.0	0.0	26.16	22.3	21.9	37.4	22.3	10.1	55.25	54.7	47.2	24.2
Ozone (O ₃)	µg/m ₃	130.0	0.0	17.5	17.5	16.4	16.9	17.5	19.5	17.4	15.1	16.9	19.8
Particulate Matter (PM ₁₀)	µg/m ₃	150.0	10.0	116.0	113.8	94.4	124.8	133.8	123.9	155.7	155	138.8	119.2

Particulate Matter (PM_{2.5})	µg/m³	75.0	2.5	55.8	35.4	45.3	44.8	45.7	32	66.5	55.3	42.9	62.3
Suspended Particulate Matter (SPM)	µg/m³	500.0	1.0	311.2	285.1	309.3	377.24	241.5	295.6	353.6	301.3	365.1	277.3
Lead (Pb)	µg/m³	1.5	0.01	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL



Figure 4.20: Ambient Air Quality Monitoring

Noise level Monitoring

No high noise activities were observed in the project area. Generally, noise sources were the vehicles and other activity in the residential areas and high wind noise and noise from bird chirping in the open areas. Noise level observed at different locations in the project area are given below and analysis report has been attached in annexure.

Table 4.3: Noise level monitoring locations

S No.	Location	Coordinate	Minimum (dBA)	Maximum (dBA)	Mean (dBA)
1	Noise Level, N-1	28°13'03.9"N 69°12'52.8"E	50.4	51.6	51.0
2	Noise Level, N-2	28°13'13.8"N 69°12'48.0"E	49.2	50.1	49.6
3	Noise Level, N-3	27°21'27.4"N 68°46'00.5"E	48.1	49.4	48.7

4	Noise Level, N-4	27°19'09.4"N 68°47'48.5"E	52.5	53.1	52.8
5	Noise Level, N-5	27°19'09.6"N 68°47'52.7"E	50.9	51.5	51.2
6	Noise Level, N-6	27°12'59.1"N 68°39'03.8"E	51.4	52.8	52.1
7	Noise Level, N-7	27°11'36.5"N 68°38'35.3"E	52.2	53.2	52.7
8	Noise Level, N-8	27°11'36.5"N 68°38'35.3"E	50.9	52.7	51.8
9	Noise Level, N-9	27°29'54.8"N 68°39'41.0"E	49.1	50.1	49.6
10	Noise Level, N-10	27°24'42.5"N 68°35'18.7"E	48.7	49.9	49.3
11	Noise Level, N-11	27°14'34.2"N 68°32'54.8"E	50.3	51.1	50.7
12	Noise Level, N-12	26°58'57.3"N 68°32'09.7"E	51.4	51.9	51.6
13	Noise Level, N-13	26°58'11.6"N 68°34'34.5"E	49.6	50.1	49.8
14	Noise Level, N-14	27°13'57.6"N 68°47'39.8"E	51.4	52.8	52.1
15	Noise Level, N-15	27°29'09.0"N 68°54'36.4"E	50.7	51.7	51.2
16	Noise Level, N-16	27°04'53.0"N 68°34'21.9"E	52.3	52.6	52.4
17	Noise Level, N-17	27°09'34.1"N 68°46'30.6"E	50.9	51.7	51.3

18	Noise Level, N-18	27°21'47.9"N 68°35'57.4"E	49.4	50.3	49.8
19	Noise Level, N-19	27°26'11.1"N 68°44'27.5"E	52.4	53.1	52.7
20	Noise Level, N-20	27°30'44.2"N 68°47'47.7"E	50.7	51.6	51.1
Noise monitoring limit for Residential area is 55 dB.					



Figure 4.21: Noise Level Monitoring in project area

4.11 Water Resources & Quality

a) Surface Water

The irrigation system of Sindh is entirely dependent on the River Indus for supplies of water downstream of the area. Riverine tract of the River Indus occupies a special significance in the ecology of Sindh. The hydrograph of the river is strongly seasonal with a long low water season between October and March and a high-water season between April and September – driven primarily by snowmelt in the upper catchment and monsoon rainfall. The river usually peaks in mid-August or early September. The river carries large sediment loads due to widespread and rapid erosion in its upper catchments. It is estimated that about 1 billion m³ of sediment is deposited in its floodplain each year. Because of this continuing deposition, the river has developed natural levees along its length.

Expansion of agriculture and subsequent industrial development led to the need for conserving water for agriculture purpose and power generation through construction of

reservoirs on the River Indus and its tributaries with associated irrigation canal networks. A number of Dams, head works barrages and diversion canals have been constructed on Indus and its tributaries from 1886 to 1993. The first barrage on the Indus was commissioned in 1932 (Sukkur Barrage) followed by Kotri (Ghulam Muhammad barrage) and Guddu in 1955 and 1962 respectively (Osmani, 2003). Indus River and Irrigation canals from Sukkur Barrage are the source of water in the macro environment i.e. district Khairpur and Sukkur. Six canals take off from Sukkur barrage for irrigation purposes. These include Dadu Canal, Nara Canal, Rohri Canal, Rice Canal, N.W Canal and Khirthar Canal.

Surface water source inside the project area is the Rohri Canal, and seasonal water bodies/ponds formed from the flood water. Water from canal and branch canals is utilized for agriculture, domestic and livestock feeding.

Table 4.4: Surface Water Quality

Parameters	UNITS	SW-1 27°17'36.27"N 68°38'40.35"E	SW-2 27°29'54.8"N 68°36'11.7"E	SW-3 27°17'26.8"N 68°30'58.1"E
pH value	-	7.57	7.44	7.64
Chemical Oxygen Demand (COD)	mg/L	96	56	21
Biochemical Oxygen Demand (BOD) ₅ at 20°C	mg/L	44	33	9
Total Suspended Solids (TSS)	mg/L	12	2	8
Total Dissolved Solids (TDS)	mg/L	10,200	5,270	418
Oil & Grease	mg/L	0.21	0.11	0.18
Fluoride (as F ⁻)	mg/L	0.02	0.24	0.19
Chloride (as Cl ⁻)	mg/L	2,350	977	82
Total Hardness (as CaCO ₃)	mg/L	4,490	2,470	197
Turbidity	NTU	14	4	5

b) Ground Water

Pakistan's groundwater resources comprise a vast aquifer underlying the Indus Basin, recharged by the river flows, irrigation water and precipitation. The distribution of groundwater within the Indus Basin is non-uniform with majority of freshwater concentrated in Punjab. In Punjab, about 79% of the area and in Sindh, about 28% of the area is underlain by fresh groundwater (IUCN 1992). In Sindh, fresh water invariably occurred in areas where river had its courses during the past 800 years. Between Tando Mohammad Khan and Bulri where river was consistently flowing from 13th to 18th centuries, fresh water is present in shallow depth of about 15m to 18 m⁹. Generally, ground water becomes saline downstream of Hyderabad. This is thought to be because of the recent shift (in terms of geological times) of the Arabian Sea which used to be further southwards until Hyderabad some 12000 years ago. The areas with saline groundwater show higher concentration of chlorine compared to carbonates and bicarbonates suggesting that some millennia ago the area was submerged into seawater. Though meandering of the river Indus had diluted the brackish water, but 800 years of deserting by the Indus River had allowed

⁹ Seepage of water from Indus River and the occurrence of fresh groundwater in Sindh at <http://www.panhwar.com/Article56.htm#top>

saline water down below to displace fresh water of Indus River by various processes including sea water encroachment, surface water evaporation and dilution.

The water table in the Northern part of the project area along canals and Indus ranges from 20ft to 25ft with a gradient generally oriented southward. Groundwater for domestic consumption is abstracted through shallow hand pumps. Water quality is generally sweet, but very few brackish groundwater can also be found in the desert areas of Tehsil Saleh Pat where the groundwater is deeper i.e. 35 to 45ft.

Water Quality

Ground water Quality Monitoring was conducted at 3 locations in the project area by SEPA certified lab. During the study, groundwater samples were collected from Jiskani village and analyzed for physical and chemical parameters. The results, presented in the table, show that while some parameters fall within permissible drinking water standards, others exceed the recommended limits.

Table 4.5: Ground Water Quality

Parameters	Sindh Standard for Drinking Water Quality 2016	UNITS	GW-1 27°18'01.8"N 68°40'37.5"E	GW-2 27°16'44.5"N 68°39'03.4"E	GW-3 26°58'30.9"N 68°34'57.7"E
pH value	6.5-8.5	-	7.56	7.50	7.28
Total Dissolved Solids (TDS)	<1000	mg/L	3,770	497	773
Total Hardness (as CaCO ₃)	<500	mg/L	2,000	375	500
Turbidity	<5	NTU	1.1	0.15	0.11
Nitrate (NO ₃)	<50	mg/L	0.5	0.14	0.4
Nitrite (NO ₂)	<3	mg/L	2	2	2
Phenolic compounds (as phenol)	<0.002	mg/L	BDL	BDL	BDL
Chloride (as Cl ⁻)	<250	mg/L	950	53.5	107
Fluoride (as F ⁻)	<1.5	mg/L	0.22	0.17	0.44



Ground water sampling



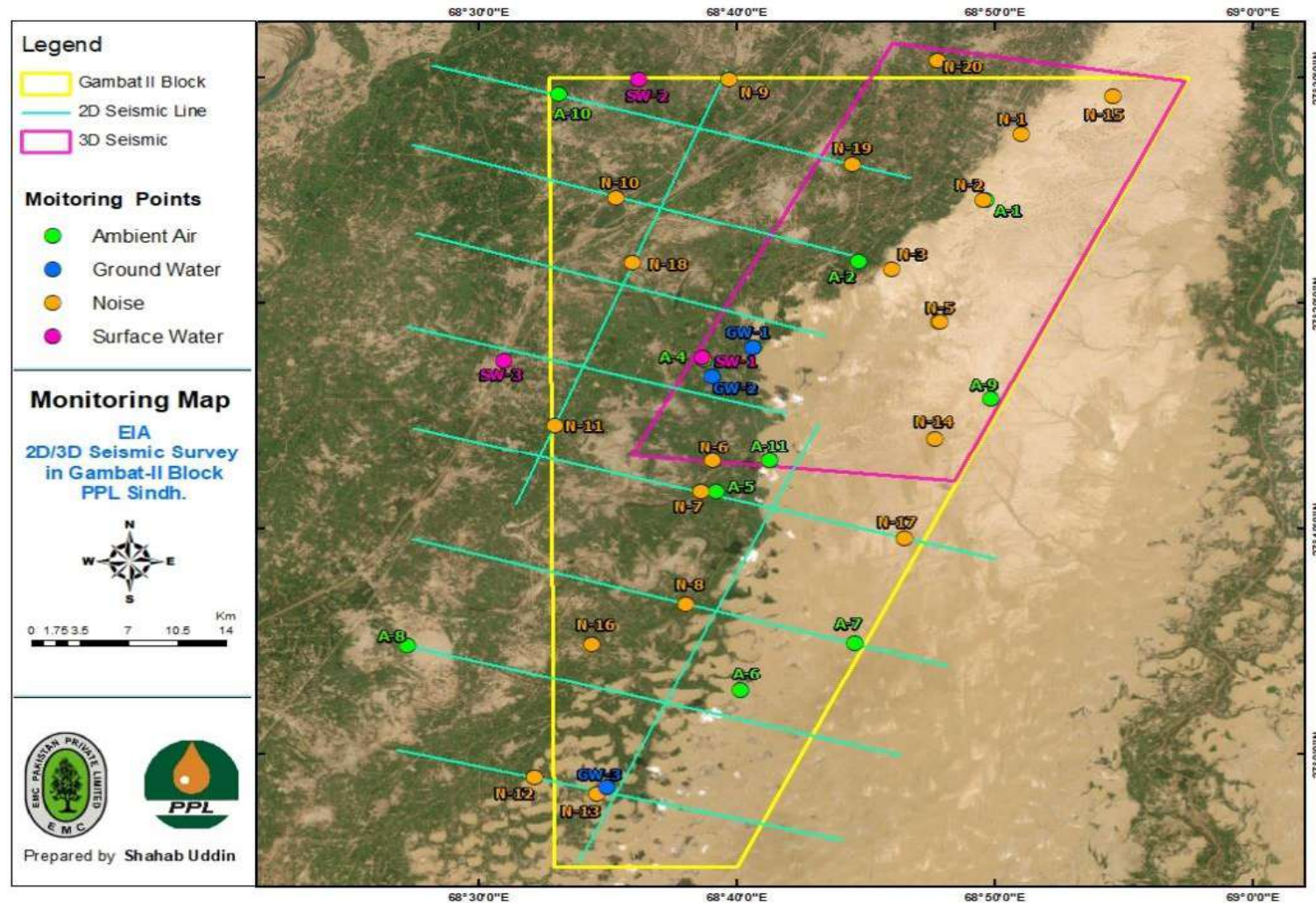


Figure 4.23: Location of Environmental Monitoring areas in Gambat-II

4.12 Ecological Environment

To assess the ecological environment of the project area, including portions of protected areas located within it, a team comprising a wildlife expert and EMC personnel conducted a field visit. On January 14, 2025, the team initiated the survey with a visit to the Takkar Wildlife Sanctuary, which overlaps with the proposed 3D seismic survey area, and where some 2D survey lines also extend.

In the remaining areas of the Gambat-II Block, 2D seismic activity is also proposed. The ecologically sensitive zones within the block include the Takkar Wildlife Sanctuary, the Khat Dhoro Wetland (also designated as the Khat Dhoro Wildlife Sanctuary), and the Mehrano Wildlife Refuge—a privately managed breeding farm comprising lagoons, water ponds, and sand dunes, all of which support a rich and diverse ecological habitat.

4.12.1 Habitats observed

The project area comprises two distinct ecological zones: irrigated agricultural plains and arid desert terrain, supporting diverse flora and fauna. Nine key habitats were identified during field surveys, categorized below based on their geographic and ecological characteristics

1. Hilly plains,
2. Hilly Streams,
3. Hilly slopes
4. Top of the hills
5. Mehrano Wildlife Refuge,
6. Undulating Sand dunes
7. Canals and lagoons
8. Small lakes and ponds,
9. Agricultural Plains

Below mentioned habitats mostly belong to Takkar Wildlife Sanctuary and Mehrano wildlife sanctuary.

1. **Hilly plains:** - This habitat consists mostly of boulders with sandy soil, with little scattered grassy vegetation and livestock, wildlife including reptiles and small mammals.
2. **Hilly streams:** -This habitat is very important because it has more greenery and vegetation than other habitats, which provides food and shelter to wild animals.
3. **Hilly slopes:** - Hilly slopes are the second-best habitat for the wildlife, serving as preferred areas for grazing and prey haunting. The vegetation, including tall trees, is less dense than in than in hilly streams. These slopes are also used by wildlife as grazing and shelter. There are many micro habitats for animals and birds in Mehrano, Khat Dhoro, lagoons, water ponds and sand dunes. During the activity should not be careless in any case.

4. **Top of the hills:** - This habitat is the least vegetated in the area. Rainwater flows rapidly from the hilltop to the slopes and into the river streams. The waters' velocity is reduced relatively at the top of the hill. At the top of the hill there is little soil, so water cannot be absorbed, consequence in less vegetation. Trees and wildlife are more abundant on the slopes and in the river streams.
5. **Mehrano Wildlife Refuge**, located in the Gambat block, hosts diverse habitats with species like deer, black buck, hog deer, wild boar, partridges, and migratory birds. It features dense forest, healthy vegetation, and is well-maintained amidst surrounding agricultural lands.
The 5 habitats mentioned below are mostly outside the Takkar Wildlife Sanctuary and 2D Seismic Survey will be done in these areas including Khat Dhoro wildlife sanctuary.
6. **Undulating Sand Dunes:** - During study visit in this area of sand dunes the ecology which have been observed directly/indirectly consisting reptiles (lizards), birds of prey, local area birds, fox, jackal, hog hedge, porcupine, mongoose and Houbara bustard/Indian courser etc.
7. **Canals and their lagoons:** - As the canals play an important role in agricultural and production, they also greatly benefit the vegetation along their banks, lagoons and depressions. The seepage water from the canals, along with surplus land water and rainwater nourish these areas, providing food and rest for migratory and local Birds. Due to climate change and lack of habitat, these birds have adapted to make these areas habitable.
8. **Small lakes and ponds:** - Although there is no natural lake in the project area of Gambat-II block. Water accumulates in depression that once old tributaries of the river Indus, after the construction of protection bunds. As result of the flow of river water has stopped, and excess irrigation of water, canal seepage and rainwater accumulate in these areas which has no proper drainage for this water. The Khat Dhoro wetland, is also known as Khat Dhoro wildlife sanctuary a closed channel of the Indus River that collects seepage and rainwater from nearby lands. The study team visited the Khat Dhoro Wildlife Sanctuary, where they observed some ducks, black partridges and gray partridges. Its indicates that this area area has significant biodiversity potential. The surrounding of the Khat Dhoro consists of agriculture.
9. **Agricultural Plains:** - In both the protected and non-protected parts of this Gambat-II block, agriculture land predominantly spans the western portion of the block area. The 2D lines extend over the agriculture land. The western half of the 3D seismic activity block spans over agricultural land, while the rest of the area consists of desert sand dunes. The wildlife protected areas mostly consists of desert hills and sand dunes spars vegetations, and bushes and trees where agriculture is almost non-existent. The agriculture area has feature of very fertile land, including dates, mango, banana plantations along with crops like wheat, mustard, sugarcane and rice. Rainwater or seepage from agriculture lands and canals accumulates in this type of dhoras and depressions due to lack of proper drainage systems. water storage bodies. These dhoras

(lakes, ponds) formed micro-habitats where local and migratory birds live and rest in these depressions.



Hilly plains observed in project area



Hilly streams observed in project area



Hilly slopes observed in project area



Undulating sand dunes

Undulating grassy dunes



4.12.2 Biodiversity Recorded

The following species of fauna and flora were recorded from the Project Area.

Table 4.6. Fauna and flora recorded

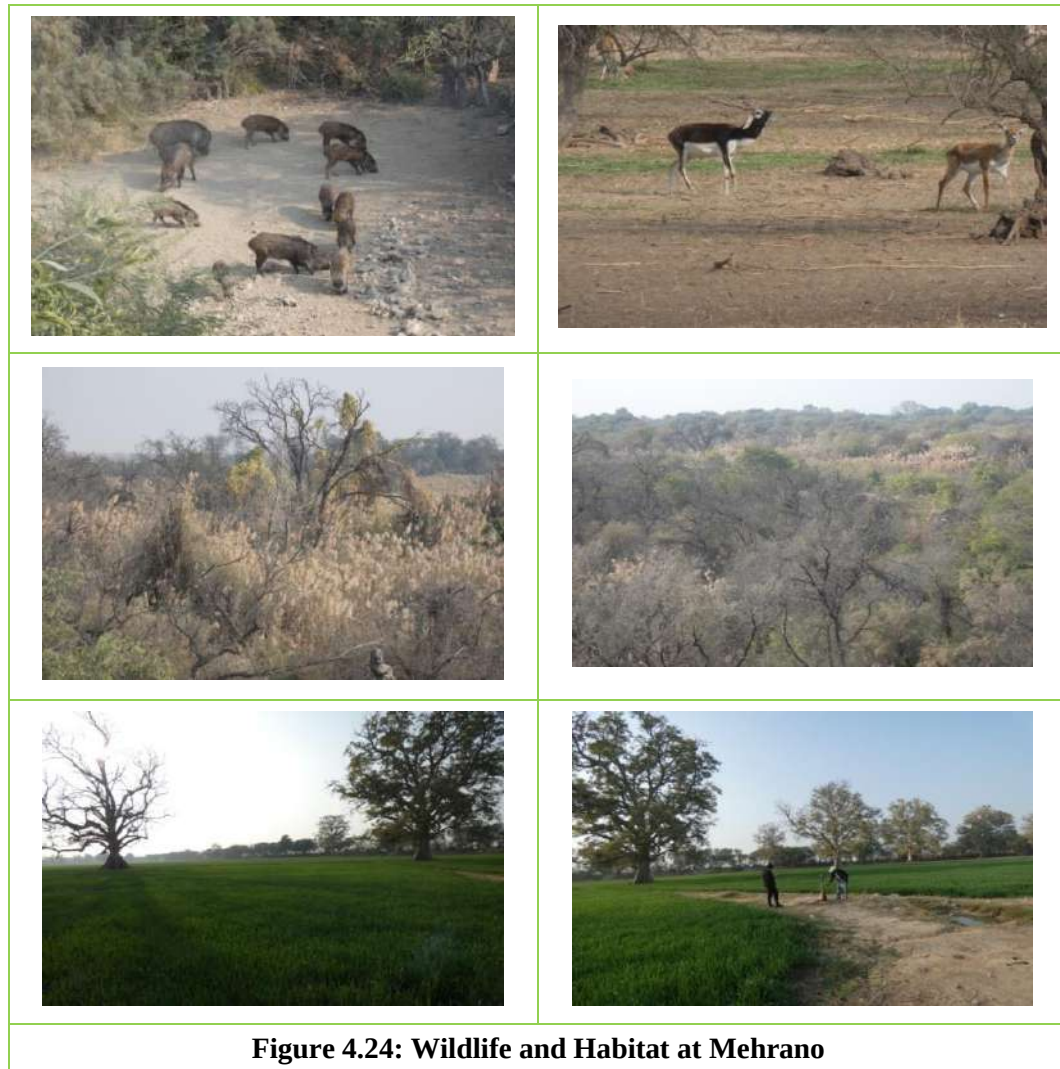
S. No.	Group	Number of species recorded	
		Mehrano Wildlife Refuge	Takkar Wildlife Sanctuary
1	Mammals	09	10
2	Birds	10	21
3	Reptiles	07	11
4	Amphibians	02	02
5	Flora	30	30

4.12.3 Mehrano Wildlife Refuge

Mehrano Wildlife Refuge is located within the Gambat block area, where the 3D seismic activity block spans the sanctuary, while the 2D seismic line # GAMII-12 passes nearby.

Although the legal status of the Mehrano Wildlife Refuge is not on record, the biodiversity within the refuge is well cared for, and it could be declared a private breeding farm under legal status.

In the Mehrano WR various habitats have been developed for flora and fauna where deer, black buck, hog deer, wild boar, black, gray partridges other local and migratory land, water birds are frequently seen, inside the refuge and on other hand agricultural land occupied with wheat and other crops. The environment of Mehrano refuge is well maintained by its caretakers. Outside the refuge there are very old trees while inside the refuge has dense forest and healthy vegetation.



Mammals Recorded

A total of 09 species of mammals were recorded/reported.

Table 4.7. List of Mammals recorded/reported Mehrano Wildlife Refuge

S No.	Common Name	Scientific name	Listing		
			WPO/Act	IUCN Red list	CITES Appendix
1	Deer	Cervidae		LC	III
2	Blackbuck	Antilope cervicapra		LC	
3	Hog Deer	Axis porcinus		EN	
4	Wild boar	Sus scrofa		LC	III
5	Fox	Vulpes vulpes		LC	
6	Jackal	Canis aureus		LC	
7	Porcupine	Erethizontidae		LC	
8	Mongoose	Urva auropunctata		LC	
9	Hedgehog	Paraechinus aethiopicus		LC	

Birds Recorded

A total of 46 species of birds were recorded from the area.

Table 4.8: List of Birds recorded in/near the Mehrano Wildlife Refuge

S No.	Common Name	Scientific name	Listing			
			WPO/Act	IUCN Red list	CMS Appendix	CITES Appendix
1	Black partridge	Francolinus francolinus				
2	Grey partridge	Francolinus pondicerianus				
3	Houbara bustard	Chlamydotis macqueenii				
4	Indian courser	Cursorius coromandelicus				
5	Sandpipers	Actitis hypoleucos				
6	Common swallow	Hirundo rustica				
9	House crow	Corvus splendens	X			II
10	House sparrow	Passer domesticus				

Reptiles Recorded

A total of 17 species of reptiles were recorded from the area.

Table 4.9: List of Reptiles Observed in the Mehrano Wildlife Refuge

S No.	Common Name	Scientific name	Listing		
			WPO/Act	IUCN Red list	CITES Appendix
1	Fat tailed/Leopard gecko	Eublepharis macularius			III
2	Garden lizard	Calotes versicolor			
3	Indian fringe-toed sand lizard	Acanthodactylus cantoris cantoris			
4	Indian spiny-tailed lizard	Uromastix hardwickii	X		II
5	Sindh sand gecko	Crossobamon orientalis			
6	Spotted Indian house gecko	Hemidactylus brookii brookii			
7	Yellow bellied house gecko	Hemidactylus flaviviridis			

4.12.4 Takkar Wildlife Sanctuary

Takkar wildlife sanctuary is situated in district Khairpur covering an area of 435.13 km². The wildlife sanctuary is barren desert area with sparse vegetation typically found in the desert of hot arid climate. Most of the area of Takkar Wildlife Sanctuary consists of small hills, rainwater channels and low-lying valleys which is a semi desert area with hills and Rocky plateau. While some areas in the plain land are undulating. There are no rainwater channels in the plain land, instead there are small sand dunes.

Takkar Wildlife Sanctuary is located in a mountain desert area within District Khairpur. The sanctuary lies within the 3D seismic activity zone, with some 2D seismic lines also crossing it. It is characterized by a hot arid climate, sparse vegetation, and important micro-habitats near water sources like ponds and natural springs, which are critical for wildlife survival in this dry region.

The sanctuary features a mix of hilly plains, slopes, and desert sand dunes. Despite harsh environmental conditions, it supports a wide variety of species and serves as a key ecological zone in the region.

Takkar wildlife sanctuary is the habitat of reptiles, ungulates, nocturnal animals and local and migratory birds and all these species are present and breeding here which have been recorded direct and indirect during the study visit.

In the eastern to southern portion of the Takkar Wildlife Sanctuary, there are sand dunes with sparse agricultural land, which support healthy vegetation. Both direct and indirect sightings of local and migratory wildlife have been observed in this area.

	
Foot marks of Houbara bustard	Foot marks of Indian courser
	
Mouse burrows	Sand Lizard foot marks
	
Mallard resting in seepage water	A group of sandpipers

	
A group of water birds	Little grebe in Khat dhoro

Mammals Recorded

A total of 10 species of mammals were recorded/reported.

Table 4.10: List of Mammals recorded/reported in the Takkar Wildlife Sanctuary

S No.	Common Name	Scientific name	Listing		
			WPO/Act	IUCN Red list	CITES Appendix
1	Asiatic jackal	Canis aureus		LC	III
2	Chinkara	Gazella bennettii		LC	
3	Common red fox	Vulpes vulpes		LC	III
4	Indian Fox	Vulpes bengalensis			
5	Five striped-palm squirrel	Funambulus pennantii		LC	
6	House mouse	Mus musculus		LC	
7	House rat	Rattus rattus		LC	
8	Indian crested porcupine	Hystrix indica		LC	
9	Indian desert wild cat	Felis silverstris ornata		LC	II
10	Long-eared desert hedgehog	Hemiechinus collaris		LC	
11	Asiatic jackal	Canis aureus		LC	III

Birds Recorded

A total of 21 species of birds were recorded from the area.

Table 4.11 List of Birds recorded in/near the Takkar Wildlife Sanctuary

S No.	Common Name	Scientific name	Listing			
			WPO/Act	IUCN Red list	CMS Appendix	CITES Appendix
1	Black kite	Milvus migrans	X			II
2	Black-shouldered kite	Elanus caeruleus/E.leucurus	X			II
3	Chestnut bellied Sandgrouse	Pterocles exustus				
4	Collared dove	Streptopelia decaocto				
5	Common babbler	Turdoides caudatus				
6	Crested lark	Galerida cristata				
7	Desert lark	Ammomanes deserti				
8	Southern Grey shrike	Lanius excubitor				
9	Green bee-eater	Merops orientalis				
10	Grey partridge	Francolinus pondicerianus				
11	House crow	Corvus splendens				
12	House sparrow	Passer domesticus				
13	Indian/Common myna	Acridotheres tristis				
14	Indian robin	Saxicoloides fulicata				
15	Indian roller	Coracias benghalensis				
16	Jungle babbler	Turdoides striatus				
17	Kashmir Roller	C. g. Semenowi				
18	Little brown dove	Streptopelia senegalensis				III
19	Rosy starling	Sturnus roseus				
20	Short toed eagle	Circaetus gallicus	X			II
21	Sindh Nightjar	Caprimulgus mahrattensis				

Reptiles Recorded

A total of 11 species of reptiles were recorded from the area.

Table 4.12: List of Reptiles Observed in the Takkar Wildlife Sanctuary

S No.	Common Name	Scientific name	Listing		
			WPO	IUCN	CITES
1	Brilliant agama	Trapelus agilis isolepis			
2	Garden lizard	Calotes versicolor			
3	Glossy bellied racer	Coluber ventromaculatus	X		
4	Indian desert monitor	Varanus bengalensis			I
5	Indian fringe-toed sand lizard	Acanthodactylus cantoris cantoris			
6	Indian sand boa	Eryx johnii johnii			II
7	Indian sand swimmer	Ophiomorus raithmai			

8	Indian spiny-tailed lizard	Uromastix hardwickii	X		II
9	Pakistan ribbon snake	Psammophis leithii	X		
10	Saw scaled viper	Echis carinatus pyramidum			
11	Sindh sand gecko	Crossobamon orientalis			

Amphibians Recorded

A total of two species of amphibians were recorded.

Table 4.13: List of Amphibians recorded in the Project Area

S. No.	Order	Family	Scientific name	Common name	Status
1	Anura	Ranidae	Euphlyctis cyanophlyctis	Skittering Frog	Common
2	Anura	Bufonidae	Duttaphrynus stomaticus	Indus Toad	Less Common

4.12.5 Vegetation Recorded in the project area

A total of 30 species of flora were recorded from the area.

Table 4.14: List of Floral Species Observed in the Project Area

S No.	Family Name / Plant Specie	Local Name	Life form / Habit
1	Cyperus conglomeratus	Moniah gaah	Sedge
2	Aristida adscensionis .	Lumb gaah	Grass
3	Aristida funiculata	Lumb gaah	Grass
4	Cymbopogon jawarancusa	Kattan	Grass
5	Dactyloctenium aegyptium	Gandheer gaah	Grass
6	Lasiurus sindicus	Booro	Grass
7	Ochthochloa compressa (Forssk.)	Gandheer gaah	Grass
8	Panicum turgidum	Sewan	Grass
9	Stipagrostis plumose	Lumb gaah	Grass
10	Limeum indicum	Dhoor chhapri	Herb
11	Calotropis procera.	Ak	Shrub
12	Aerva javanica	Booh	Subshrub
13	Heliotropium crispum	Kharsun	Herb
14	Leptadenia pyrotechnica	Khip	Shrub
15	Cassia italic	Ghora wal	Herb
16	Capparis decidua	Kirar	Shrub
17	Dipterygium glaucum	Phair	Bushy subshrub
18	Citrullus colocynthis	Trooh	Prostrate subshrub
19	Saueda fruticose	Lano	Shrub
20	Alhagi maurorum .	Kandero	Herb
21	Indigofera oblongifolia	Jhil	Subshrub
22	Crotolaria burhia	Chag	Subshrub
23	Tephrosia falciformis	Andhri/Siringh	Herb
24	Prosopis juliflora	Devi	Shrub
25	Acacia nilotica	Babur	Tree

Table 4.14: List of Floral Species Observed in the Project Area

S No.	Family Name / Plant Specie	Local Name	Life form / Habit
26	Prosopis cineraria	Kandi	Tree
27	Calligonum polygonoides	Phog	Shrub
28	Zizyphus nummularia	Jhangoori ber	Shrub
29	Salvadora oleoides	Jar/Peroon	Shrub
Tamaricaceae			
30	Tamarix aphylla	Lai	Tree

4.12.6 Threats

The area is under heavy pressure due to the increasing human population and habitation, impact of developmental projects, oil and gas exploration, road construction, hunting activities for Houbara Bustard, wood cutting for coal production, firewood collection, and degradation of land etc.

Overgrazing

There is large scale grazing by livestock in the desert area.

Wood Cutting

The communities depend on the woodland for acquisition of firewood and construction of their homes.

Infrastructure Development

There is a wide range of gravel-top roads and tracks leading to different gas exploration facilities and also for the movement of hunting parties.

VIP Hunting

Hunting of the Houbara Bustard is carried out by foreign dignitaries during the designated hunting season, which runs from November to February. The Houbara is typically hunted using Saker Falcons and Peregrine Falcons.

Extensive areas within the Houbara Bustard's natural habitat are allocated to Arab Sheikhs, who establish temporary camps in the region. These camps are supported by approximately 1,000 personnel responsible for managing hunting operations and associated facilities.

The Arab Sheikhs reside in palatial accommodations, also shown in the map, and have constructed access roads and designated routes leading to their residences. Hunting activities are generally conducted along the perimeter of these palaces and along the designated routes.

This activity results in significant ecological disturbance, primarily due to high levels of vehicular movement, which can negatively impact the local environment and wildlife.



Access tracks prepared by Arab Shaikh's in Desert at Gambat-II block



Palace of Arab Shaikh's



Foot marks of Houbara Bustard near to the access tracks in desert

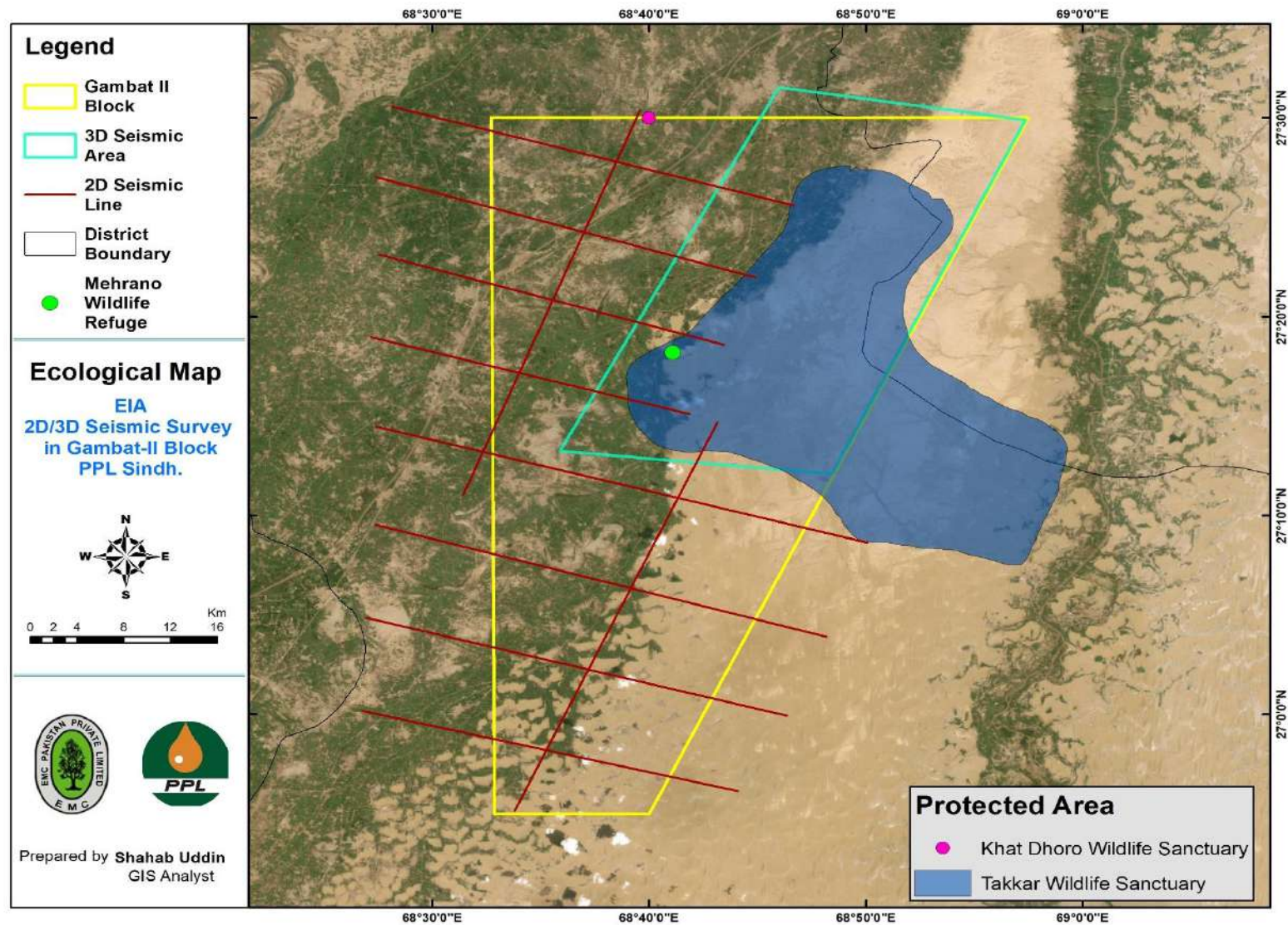


Figure 4.25: Ecological Map of the Project Area

4.13 Socio- Economic Environment

The social baseline chapter provides a comprehensive review of the socio-economic condition of the project area. This socio-economic profile based on a literature review and several primary data gathering activities including site visits, sample, socio-economic survey of stakeholders in the area and consultation with primary and secondary stakeholders. This social baseline provides an overview of socio-economic condition of the people who reside and work in project vicinity. It also includes an assessment of public utilities and social services (education and health services) in the area.

The socio-economic baseline data in this chapter identifies the existing socio-economic trend in the area and the potential impacts of the project providing the basis for the development of a Social Management Plan. The social baseline is divided into macro and microenvironment of the project area. The macro-environment encompasses District Khairpur and Sukkur of Sindh Province. The discussion on macro environment covers the administrative setup, demography, education, transport, communication and health profile of the area. The project falls under the district Khairpur and its sub-division Gambat, Nara, Faiz Ganj, Mirwah, Kot Diji, Khairpur and district Sukkur and its sub-division Saleh pat, Rohri is considered to be the micro-environment of the project and covers education, health and utilities profile of the area.

Table 4.15: Consultation conducted in Settlements within the Gambat – II block

District	Number of Settlements
Khairpur	2
Sukkur	6
Total	8

4.13.1 Macro Environment of the Project (Khairpur)

Administrative Context

The district Khairpur acceded to Pakistan in October 1955. The district is located in northern Sindh consists of eight talukas namely Gambat, Nara, Faiz Ganj, Mirwah, Kot Diji, Khairpur, Kingri, Sobho Dero. The majority of the population 96.86% belongs to Muslim religion, Hindus share 2.82%. Head quarter of district Khairpur is presented in Khairpur.

The proposed project Gambat-II EL is located in Khairpur and Sukkur districts, having an area of 1,697.56 square kilometers, and falls in prospectivity zone-III in the middle Indus Basin. Pakistan Petroleum Limited (PPL) is planning to acquire 3D seismic activity in 696 sq. kilometers and 2D seismic activity in 330 sq. kilometers. Seismic activity is designed for efficient and safe exploration of subsurface formations.

Demography

The district is comprised of various linguistic and religious communities. The majority of individuals identify as Muslims, Christians, Hindu Jatis, Ahmadis, Sikhs, and Parsis. The majority of 2,513,753 people are Muslims. Sindhi is the widely spoken language in the

district; after that, Punjabi and Urdu, a minimum number of people speak Pushto and Balochi.

Table 4.16: Population of Religious Groups

District	Total Population	Muslim	Christian	Hindu Jati	Ahmadi	Castes	Sikh	Parsi	Other
Khairpur	2,597,448	2,513,753	5,366	63,366	309	12,041	28	2	2,583

Source: Pakistan Bureau of Statistics

The table shows the population distribution of various religious and social groups in the Khairpur district. The total population is 2,597,448, with the majority being Muslim (2,513,753). Smaller populations include Christians (5,366), Hindus (63,366), Ahmadi (309), Sikhs (28), Parsis (2), and others (2,583). The table provides insights into the religious and social composition of the district.

Table 4.17: Population of District Khairpur and Its Sub-Division

Name of Administrative Unit	Area S.Q Kilometers	Total Population of the Area	Population Density per S.Q.K.M	2017- 2023 Average Annual Growth rate
Khairpur district	15,910	2,597,535	163.26	1.29
Faiz Ganj taluka	946	243,254	257.14	1.38
Gambat taluka	582	286,129	491.63	1.40
Khairpur taluka	585	465,233	795.27	0.92
Kingri taluka	531	370,304	697.37	1.42
Kot Diji taluka	520	385,872	742.06	1.71
Mirwah taluka	631	379,615	601.61	1.23
Nara taluka	11,611	173,968	14.98	1.34
Sobho Dero taluka	504	293,160	581.67	1.06

Source: Pakistan Bureau of Statistics 2023

According to Pakistan Bureau of Statistic (PBS) 2023, Khairpur District spans an area of 15,910 square kilometers with a population density of 163.26 people per square kilometer and a total population of 2,597,535 growing at an average annual rate of 1.29%. Among its sub-divisions, Khairpur taluka has the highest population density (795.27) and growth rate (0.92%), while Nara taluka has the lowest population density (14.98).

Table 4.18: Comparative Analysis of District Khairpur

Name of Administrative Unit	Population 2017	Population 2023	% Change
Khairpur district	2,405,190	2,597,535	7.4
Faiz Ganj taluka	224,088	243,254	7.9
Gambat taluka	263,218	286,129	8.0
Khairpur taluka	440,412	465,233	5.3
Kingri taluka	340,297	370,304	8.1
Kot Diji taluka	348,582	385,872	9.7
Mirwah taluka	352,764	379,615	7.1
Nara taluka	160,643	173,968	7.7
Sobho Dero taluka	275,186	293,160	6.1

Source: Pakistan Bureau Of Statistics 2023

The comparative analysis of District Khairpur's population from 2017 to 2023 shows an overall population increase of 7.4%. Among the various talukas, Kot Diji experienced the highest growth at 9.7%, followed by Kingri (8.1%) and Gambat (8.0%). Khairpur taluka (5.3%) and Sobho Dero (6.1%) saw relatively lower growth rates. This data reflects population trends across different administrative units within the district.

Education

District Khairpur Mirs has 3,104 schools in total out of which 2,925 schools are functional. The student enrollment is 411,311 and 11,877 teachers are deployed.

Table 4.19: District wise Number of School, Enrolment of Students and Teacher										
Level of Education	No. of Schools				Enrolment			Teacher		
	Boys	Girls	Mixed	Total	Boys	Girls	Total	Male	Female	Total
Primary	1,087	306	1,178	2,571	136,717	115,790	252,507	4,284	1,988	5,272
Elementary	41	41	49	131	19,579	16,515	36,094	870	482	1,352
Middle	13	18	24	55	3,458	3,063	6,521	196	108	304
Secondary	45	38	43	126	42,661	27,693	70,354	1,865	825	2,690
HI, secondary	16	3	23	42	33,516	12,319	45,835	1,040	219	1,259
<i>Source: Sindh Education Management Information System (SEMIS) 2023-24</i>										

According to the Sindh Education Management Information System (SEMIS), The education landscape is represented by a variety of schools catering to different levels of education. The table presents data on the number of schools, student enrollment, and teachers at various educational levels. Primary education has the largest number of schools (2,571) with a total enrollment of 252,507 students. The teacher-to-student ratio for primary education is 1,988 male and 4,284 female teachers. Enrollment decreases progressively in higher levels, with the highest secondary education enrollment at 70,354 students and 2,690 total teachers. The data highlights the distribution of boys, girls, and mixed schools at each level of education.

Table 4.20: Taluka wise Students and Teacher Enrollment		
Taluka	Student Enrollment	Teacher Enrollment
Faiz Ganj	47,693	1,167
Gambat	40,982	1,162
Khairpur	70,379	2,458
Kingri	59,965	1,710
Kot Diji	59,439	1,827
Mirwah	68,901	2,040
Nara	23,767	547
Sobho Dero	40,185	966
<i>Source: Sindh Education Management Information System (SEMIS) 2023-24</i>		

The above-presented data shows the students and teachers enrollment in schools; Khairpur Taluka has the highest enrollment with 70,379 students and 2,458 teachers. While Nara taluka has the lowest enrollment with 23,767 students and 547 teachers. Other talukas, such as Kingri, Kot Diji, and Faiz Ganj, show moderate figures in both student and teacher enrollment

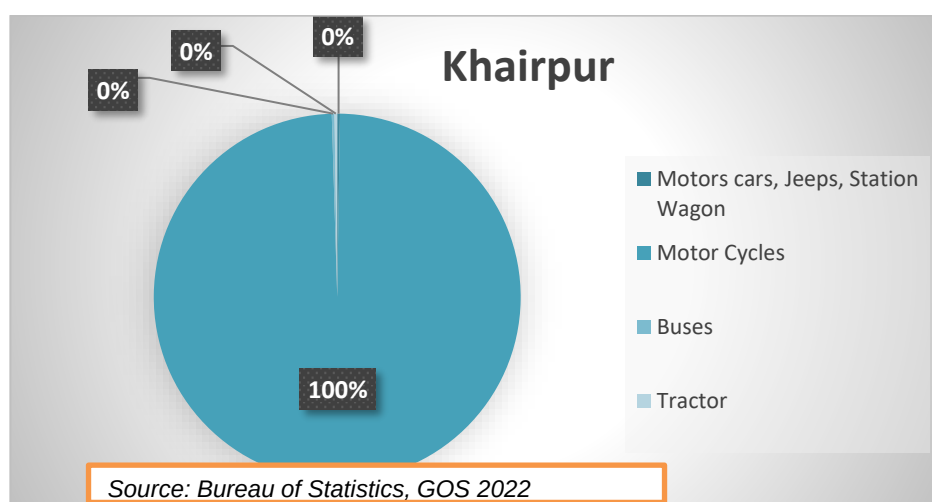
Health

In district Khairpur the health infrastructure is comprised of various government and specialized health facilities aimed at providing healthcare services to the population.

Table 4.21: Health Facilities in district Khairpur		
Health Facilities	No	Beds
Government Hospitals	264	1,586
Dispensaries	105	118
M.C.H.C	6	12
T.B. Clinics	12	36
BHUs	89	178
RHCs	11	104
Unani Shifa Khana	21	
Leprosy Clinics	1	
Maternity Homes	9	
Source: Development department, Gos 2022		

The table provides an overview of health facilities in District Khairpur. The district has a total of 264 government hospitals with 1,586 beds, along with 105 dispensaries offering 118 beds. Other facilities include 6 Maternal and Child Health Centers (M.C.H.C.) with 12 beds, 12 T.B. clinics with 36 beds, and 89 Basic Health Units (BHUs) with 178 beds. Additionally, there are 11 Rural Health Centers (RHCs) with 104 beds, 21 Unani Shifa Khana, 1 Leprosy Clinic, and 9 Maternity Homes. This data reflects the district's health infrastructure.

Transport and Communication



The above data shows the vehicle distribution in District Khairpur. The district has 2 motor cars, jeeps, or station wagons, 832 motorcycles, 2 buses, and 2 tractors. This provides a snapshot of the types of vehicles in the district, indicating a predominance of motorcycles compared to other types of transport. There are no trucks, tractors, taxis, or rickshaws in the district

4.13.2 Micro Environment of the Project (Khairpur)

Administrative Context

The proposed project 2D and 3D seismic activity falls under district Khairpur and its subdivision namely Gambat, Nara, Faiz Ganj, Mirwah, Kot Diji and Khairpur.

Education

The proposed project encompasses these subdivisions: Gambat, Nara, Faiz Ganj, Mirwah, Kot Diji, and Khairpur. Schools and universities that lie inside the project area are The Educators, Green City Public School, IT Training Center, Government Elementary School, and Shah Abdul Latif University. Some schools and universities lie outside the project area: The City School is 1.70 km away, The Academy of Excellence School is 2.23 km away, Allied School is 2.85 km away, and Mehran University of Engineering and Technology is 3.25 km away from the project area.

Health

The proposed project site has health facilities, including Al-Shifa Hospital, Memon Maternity Home and Clinic, Al-Murad Clinic, and BHU Fateh Ali Lashari. Some health care services lie outside the project area; it includes Sindh Medical Center, which is 2.37 km away from the project area, Laraib Clinic is 2.57 km away, and City Hospital is 3.20 km away from the project area.

Utilities

The proposed project site faces significant challenges, including the lack of access to essential utilities such as gas and electricity. Sukkur Electric Power Company (SEPCO) serves energy to various districts, including Sukkur, Ghotki, and Khairpur. Districts have access to electricity, but they experience frequent and massive load shedding, making it unreliable for daily use. Some parts of the desert regions of Takar and Nara have power, but others do not. People use underground salty water, tankers, and line water for daily use, like cooking and washing. Cities and towns have proper waste management managed by local government, except Nara and Takar people do the open dumping.

Transport

People primarily rely on motorbikes, private cars, wagons, and public vehicles for transportation, as it is the most feasible means of travel. The project area has three roads that connect some towns and cities. Old National Highway starts from Theri to the city of

Khairpur and Kot Diji and then connects to N5 that leads to Ranipur and Hyderabad. Nara road starts from Kot Diji to Choontko and Sanghar.

4.13.3 Macro Environment of the Project (Sukkur)

Administrative Context

Sukkur is situated in northeastern part of Province Sindh. The district consists of five administrative divisions namely New Sukkur, Sukkur City, Saleh Pat, Pano Aqil and Rohri. The district was constituted in 1901 out of part of Shikarpur district. District head quarter is presented in Sukkur.

The proposed project Gambat-II EL is located in Khairpur and Sukkur districts having an area of 1,697.56 square kilometers and falls in prospectivity zone-III in middle Indus Basin. Pakistan Petroleum Limited (PPL) is planning to acquire 3D seismic activity in 696 Sq. kilometer and 2D seismic activity in 330 Sq. kilometer. Seismic activity is designed for efficient and safe exploration of subsurface formations.

Demography

The district is comprised of various linguistic and religious communities. The majority of individual identifies as Muslims, Chirstian, Hindu Jati, Ahmadi, Sikh and Parsi. The majority of 1,558,888 people are Muslims. Sindhi is the widely spoken language in the district after that Urdu and Punjabi a minimum number of people speak Pushto and Balochi.

The table shows the population distribution of various religious and social groups in the Sukkur district. The total population is 1,625,467 with the majority being Muslim (1,558,888) Smaller populations include Christians (6,499), Hindus (55,285), Ahmadi (26), Sikhs (232), Parsis (3), and others (787). The table provides insights into the religious and social composition of the district.

Table 4.22: Population of Religious Groups

District	Total Population	Muslim	Christian	Hindu Jati	Ahmadi	Castes	Sikh	Parsi	Other
Sukkur	1,625,467	1,558,888	6,499	55,285	26	3,747	232	3	787

Source: Pakistan Bureau of Statistics – (Table 9) The numbers in table 4.22 based on all population of Pakistan including the headcount information received mainly restricted areas, where no demographic& housing information received. However, from table 4.23 onwards details of all population where all detailed information is received. Table 4.23 will be basis for matching the population for detailed characteristics

Table 4.23: Population of District Sukkur and Its Sub-Division

Name of Administrative Unit	Area S.Q Kilometres	Total Population of the Area	Population Density per S.Q.K.M	2017- 2023 Average Annual Growth rate
Sukkur district	5,165	1,639,897	317.50	1.63
New Sukkur taluka	109	356,473	3,270.39	1.81
Pano Aqil taluka	1,042	457,078	438.65	0.78
Rohri taluka	807	421,500	522.30	2.17
Saleh pat taluka	2,957	137,738	46.58	1.01
Sukkur city taluka	250	267,108	1,068.43	2.42

Source: Pakistan Bureau of Statistics – (Table1) The numbers in table 1 based on all population of Pakistan including the headcount information received mainly restricted areas, where no demographic & housing information received. However, from table 4 onwards details of all population where all detailed information is received. Table 4 will be basis for matching the population for detailed characteristics.

According to Pakistan Bureau of Statistic (PBS) 2023, Sukkur District spans an area of 5,165 square kilometers with a population density of 317.50 people per square kilometer and a total population of 1,639,897 growing at an average annual rate of 1.63%. Among its sub-divisions, New Sukkur has the highest population density (3,270.39) and growth rate (1.81%), while Saleh pat has the lowest population density (46.58)

Comparative Analysis

Table 4.24: Comparative Analysis of District Sukkur			
Name of Administrative Unit	Population 2017	Population 2023	% Change
Sukkur district	1,488,372	1,639,897	9.24
New Sukkur taluka	320,223	356,473	10.2
Pano Aqil taluka	436,372	457,078	4.53
Rohri taluka	370,582	421,500	12.08
Saleh pat taluka	129,736	137,738	5.81
Sukkur city taluka	231,459	267,108	13.35

Source: Pakistan Bureau Of Statistics

The comparative analysis of District Sukkur population from 2017 to 2023 shows an overall population increase of 9.24%. Among the various talukas, Sukkur city taluka experienced the highest growth at 13.35%, followed by New Sukkur (10.2%) Rohri (12.08%). Saleh pat (5.81%) and Pano Aqil (4.53%) saw relatively lower growth rates. This data reflects population trends across different administrative units within the district.

Education

District Sukkur has 1,149 schools in total out of which 1,032 schools are functional. The student enrollment is 201,484 and 6,149 teachers are deployed

Table 4.25: District wise Number of School, Enrolment of Students and Teacher										
Level of Education	No. of Schools				Enrolment			Teacher		
	Boys	Girls	Mixed	Total	Boys	Girls	Total	Male	Female	Total
Primary	342	92	424	858	60,525	44,906	105,431	2,021	651	2,672
Elementary	16	15	28	59	11,792	9,011	20,803	495	264	759
Middle	10	13	9	32	3,437	2,583	6,020	130	82	212
Secondary	25	22	17	64	25,732	17,123	42,855	1,137	736	1,813
HI, secondary	9	6	4	19	14,661	11,714	26,375	385	248	633

Source: Sindh Education Management Information System (SEMIS) 2023 - 24

According to Sindh Education Management Information System (SEMIS). The education landscape is represented by a variety of schools catering to different level of education. The table presents data on the number of schools, student enrolment, and teachers at various educational levels. Primary education has the largest number of schools (858) with a total enrollment of 105,431 students. The teacher-to-student ratio for primary education is 2,021 male and 651 female teachers. Enrollment decreases progressively in higher levels, with the highest secondary education enrollment at 26,375 students and 633 total teachers. The data highlights the distribution of boys, girls, and mixed schools at each level of education.

Table 4.26: Taluka wise Students and Teacher Enrollment

Taluka	Student Enrollment	Teacher Enrollment
City Sukkur	27,835	1,475
New Sukkur	39,667	1,140
Pano Akil	62,677	1,756
Rohri	52,851	1,441
Saleh pat	18,454	337

Source: Sindh Education Management Information System (SEMIS) 2023-24

The above presented data shows the students and teachers enrollment in schools, Pano Aqil has the highest enrollment with 62,677 students and 1,756 teachers. While Saleh Pat has the lowest enrollment with 18,454 students and 337 teachers. Other talukas, such as City Sukkur, New Sukkur and Rohri show moderate figures in both student and teacher enrollment

Health

In district Sukkur the health infrastructure is comprised of various government and specialized health facilities aimed at providing healthcare services to the population.

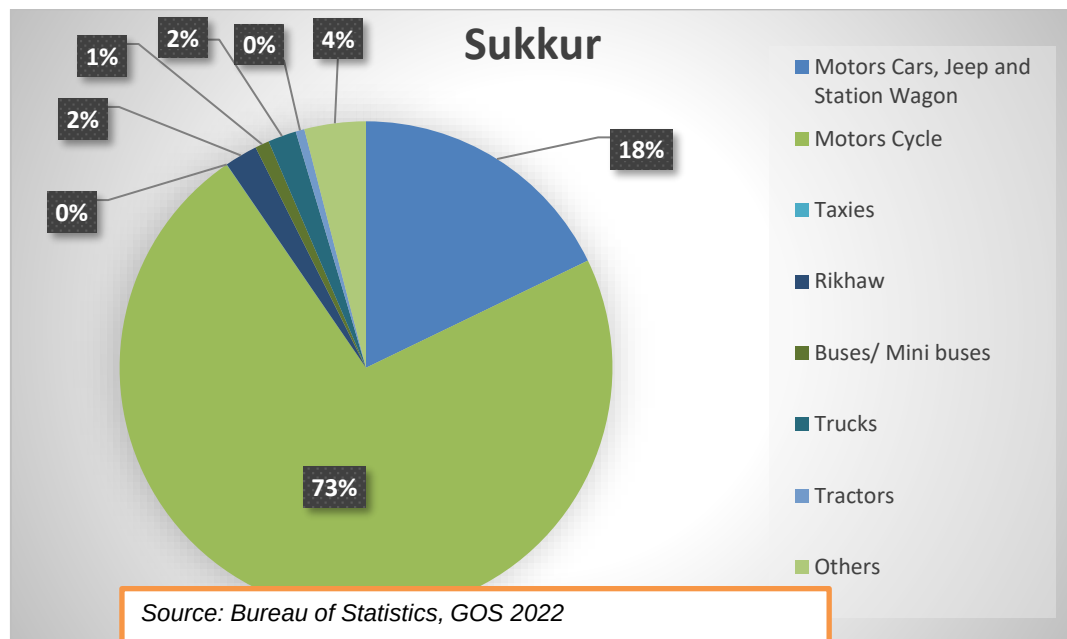
Table 4.27: Health Facilities in district Sukkur

Health Facilities	No	Beds
Government Hospitals	101	831
Dispensaries	36	6
M.C.H.C	2	4
T.B. Clinics	14	0
BHUs	26	52
RHCs	5	38
Unani Shifa Khana	1	
Leprosy Clinics	1	
Maternity Homes	8	
Trauma Centers	2	
Urban Health Units	1	

Source: Development department, Gos 2022

The table provides an overview of health facilities in District Sukkur. The district has a total of 101 government hospitals with 831 beds, along with 36 dispensaries offering 6 beds. Other facilities include 2 Maternal and Child Health Centers (M.C.H.C.) with 4 beds, 14 T.B. clinics with 0 beds, and 26 Basic Health Units (BHUs) with 52 beds. Additionally, there are 5 Rural Health Centers (RHCs) with 38 beds, 1 Unani Shifa Khana, 1 Leprosy Clinic, 8 Maternity Homes, 2 Trauma Centers and 1 Urban Health Units. This data reflects the district's health infrastructure.

Transport:



The above data shows the vehicle distribution in District Sukkur. The district has 12,582 motor cars, jeeps, or station wagons, 51,194 motorcycles, 12 taxies, 1,523 rikshaws, 655 buses/mini buses, 1,313 trucks, 405 tractors, 2,843 others. This provides a snapshot of the types of vehicles in the district, indicating a predominance of motorcycles compared to other types of transport.

4.13.4 Micro Environment of the Project (Sukkur)

Administrative context

The proposed project 2D and 3D seismic activity falls under district Sukkur and its sub-division namely Saleh pat and Rohri

Education

The proposed project encompasses these sub-division namely Saleh pat and Rohri. Project area have education facility, Jinnah Public High School Saleh pat which is (9.37 KM) away from the project area, GPS School Jani Bux Saleh pat which is (9.25 KM) away from the project area. Government boys' high school Rohri is (19.35 Km) away, The Edlead school Rohri is (19.86 Km) away from the project area.

Health

The district has a health facility that's very far from the project area, including Basic Health Unit Saleh Pat, which is 10 KM away. RHC/BHU Saleh Pat is 11.89 KM away, Dr. Farhan Baloch Clinic Rohri is 15.80 KM away, and Sharezer Clinic Rohri is 18.73 KM away from the project area.

Utilities

The proposed project site face significant challenges, including the lack of access to essential utilities such as gas and electricity, Sukkur Electric Power Company (SEPCO) serves energy to various districts including Sukkur, Ghotki and Khairpur. District have access to electricity but they experience frequent and massive load shedding, making it unreliable for daily use. People use underground salty water, tankers, and line water for daily use, like cooking and washing. Cities and towns have proper waste management managed by local government.

5.0 Stakeholder Consultation

5.1 Overview

Public consultation and information disclosure is an essential component of the Environmental assessment process, recognized by development agencies and national governments alike. Similarly, to incorporate the views, concerns, and suggestions of project stakeholders and to provide them with sufficient opportunity to become part and parcel of the development process, the importance of stakeholder engagement throughout the project life cycle cannot be dismissed.

Stakeholder consultation presents an opportunity for mutual information-sharing and dialogue between the project proponent and stakeholders. An effective public consultation 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 perceived positive impacts.

5.2 Consultation Objectives

Effective stakeholder engagement enhances project beneficiaries' role from "participants" to "enabling agents" that proactively provide insights to project planning and implementation. The stakeholder consultation process for this project has been designed to enhance the role of stakeholders and thereby contribute towards project success and sustainability. Specific tasks and purposes of consultations with stakeholders have been given in the table below.

Table 5.1 - Tasks and Purposes of Consultation

Task	Purpose of Consultation with Stakeholders
Need for consultation with the stakeholders	- To build trust to ensure sustained support for the proposed project and build resilience during the times of crisis. - To learn about public concerns that need to be addressed and considered in designing of the project concept and preparing mitigation measures and programs. - To learn about the strengths, skills, and organizational support that the stakeholders can bring to support project planning and implementation. - To introduce the project and obtained their views and feedback on it, along with measures to incorporate to improve the project
Modes and benefits of consultation	- Listening and creating dialogue with stakeholders to keep the project tuned to public concerns early, to pre-empt breakdowns, and avoid mistrust in public confidence. - Engaging the public as advocates for the project construction and to support the implementation of social, resettlement, and environment and health programs.

The specific objectives of the stakeholder engagement exercise carried out for the 2D and 3D Seismic Survey in Gambat Block II, Sindh include:

Ensure all stakeholders are informed about the project's objectives, context, and scope, including the key design features, dredging activities, and potential environmental and social implications.

- Promote active engagement with project-affected parties, beneficiaries, and other stakeholders to foster acceptance, ownership, and sustainability of the project. Ensure participation from diverse groups, irrespective of gender, ethnicity, income level, or ability, in an inclusive, transparent manner.
- Leverage local expertise and knowledge to refine project interventions, particularly regarding navigation, dredging activities, and sustainable sediment disposal strategies.
- Gather community feedback on potential impacts, such as environmental changes or livelihood disruptions, and develop practical solutions to address these concerns while enhancing project outcomes.

5.3 Stakeholders Identification and Analysis

Primary Stakeholders – Primary stakeholders are those who are directly impacted by the project, including local communities whose livelihoods and daily activities are affected. This group also includes individuals or organizations that depend on the project's resources or infrastructure for their operations.

Details regarding Primary stakeholders and their roles and responsibilities is represented in Table 5.2 below:

Table 5.2 - Roles and Responsibilities of Primary Stakeholders

Project Stakeholder	Roles and Responsibilities
Local Communities	▪ Participate in project consultations and provide feedback on potential social, environmental, and economic impacts. ▪ Share local knowledge and traditional practices to inform the project's design and implementation. ▪ Support the project through community engagement, ensuring the concerns and interests of community members are addressed.

5.4 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.

5.5 Consultations with Primary Stakeholders

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.

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 2D and 3D Seismic 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. The interviewees had any queries regarding the project, the team responded to their queries during the session. Key Informant Interviews (KIIs) were conducted with project stakeholders to gather their perspectives on project implementation, and their feedback was formally documented.

5.6 Departmental Consultations

Departmental consultations were held with the Sindh Wildlife Department to understand their perspective on the proposed seismic survey project, which is planned within designated protected areas. The Sindh Wildlife Department is a key regulatory body responsible for the conservation and management of wildlife and habitats in the province. It plays a critical role in overseeing activities within protected zones. These consultations aimed to gather insights into the department's concerns, suggestions, and expectations regarding the project's potential environmental impacts. Engaging with the department was essential to ensure that the project activities align with conservation objectives and do not compromise the ecological integrity of the sanctuaries involved.

5.7 Consultation Feedback and Analysis

5.7.1 Project Affected Parties - 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.

3D Seismic Area

Table 5.3 - Stakeholder Feedback from Primary Stakeholders

Stakeholder	Feedback & Suggestions
Village Shaadi Shaheed including heritage sites within the area: Respondents: 1. Fakeer Sher Ali 2. Fakeer Hussain Baksh 3. Ramazan	The villagers reported that their community comprises of more than 1000 households. In this area, the communities that reside there are Halepoto, Sheikh, Lakho, Rind, and Bhambhro. They have gas and electricity with heavy loadshedding. There are schools and basic health facilities like a clinic and BHU. They rely on tap water and handpump for drinking water and daily needs. The underground water is brackish. The primary crops grown include rice, wheat, vegetables, fodder and fruits such as dates, mangoes, guava, jujube, grapefruit while livelihoods are mainly supported through livestock farming, agriculture, labor work, government employees or privately employed. On average,

4. Zaheer Khan 5. Fakeer Zakir Hussain Rind	residents earn between Rs. 500 to 600 per day. The heritage sites of this area include Dargah Long Fakhir, Dargah Shaadi Shaheed and Chattan Shah. The respondents emphasized that the heritage sites are very old and sacred, with their infrastructure now in a fragile condition. They expressed concerns that activities involving vibrations or dynamite explosions could potentially damage these historical sites. They urged that such activities be conducted at a safe distance from both residential areas and heritage sites. Additionally, they highlighted the scarcity of water in the area and requested that the government and the company install an Reverse Osmosis (RO) plant, as the underground water is saline and unsuitable for consumption.
Sathyo Canal Stop/Chowk Respondents: 1. Ahmed Katohar	The villagers reported that their community comprises of more than 500 households. In this area, the communities that reside there are Halepoto, Sheikh, Lakho, Rind, Katohar, Jalbani, Syed, Bhutto and Bhambhro. They have gas and electricity with heavy loadshedding. There are schools and basic health facilities like a private clinic. They rely on handpump for drinking water and daily needs. The underground water is brackish. The primary crops grown include rice, wheat, vegetables, fodder and fruits such as dates, guava, mangoes, jujube, grapefruit and lemon while livelihoods are mainly supported through livestock farming, agriculture, labor work, government employees or privately employed. On average, residents earn between Rs. 500 to 600 per day. There is one canal named Sathyo Canal that passes through the village area. The respondents stated that the nearby land is primarily agricultural, which would be displaced due to the project. They emphasized that if this occurs, appropriate compensation should be provided for the impact on their land and livelihoods.
Village Badshah Sultan and nearby settlements near Badshah Sultan Dargah Respondents: 1. Ali Ahmed 2. Jakhro 3. Shahnawaz 4. Mureed	The villagers reported that their community comprises of more than 800 households. In this area, the communities that reside there are Sheikh, Lakho, Rind, Syed, Khaskheli and Gopang. The area has access to electricity, but it experiences frequent load shedding. Some parts also have gas availability, though it is similarly affected by heavy load shedding. There are some schools but no basic health facilities near the settlements. The residents travel to Kot Digi for medical reasons. They rely on handpump and tankers for drinking water and daily needs. The underground water is mostly salty. The surrounding terrain consists of agricultural land and hilly areas. The primary crops grown include wheat, vegetables,

5. Nawaz	fodder and fruits such as dates, mangoes, jujube and lemon while livelihoods are mainly supported through livestock farming, agriculture, labour work, government employees or privately employed. On average, residents earn between Rs. 400 to 500 per day. The respondents highlighted two primary concerns: firstly, the scarcity of water in the area, noting that the underground water is saline and unsuitable for consumption, and requesting that the company assist in addressing this issue; secondly, the low employment rates in the region, expressing a desire for job opportunities within the project, suggesting that local hiring would be beneficial.
Village Surya Respondents: 1. Hub Ali Abro 2. Kamran Gopang 3. Muhammad Ali	The villagers reported that their community comprises of more than 1000 households. In this area, the communities that reside there are Sheikhs, Lakho, Wasang, Abro, Rind, Syeds, Khaskheli, Gopang, Panhwar and Rajpar. The area has access to electricity, but it experiences frequent load shedding. Some parts also have gas availability, though it is similarly affected by heavy load shedding. There are some schools and basic health facilities near the village. Although, the residents travel to Kot Digi for major medical treatments. They rely on handpump, tankers and line water for drinking water and daily needs. The underground water is mostly salty. The surrounding terrain consists of agricultural land and hilly areas. The primary crops grown include wheat, vegetables, fodder and fruits such as dates, mangoes and jujube while livelihoods are mainly supported through livestock farming, agriculture, labour work, government employees, privately employed and business owners. On average, residents earn between Rs. 600 to 800 per day. The respondents expressed a positive attitude toward the project and requested that the company provide employment opportunities for unskilled labourers from the local villages to support their livelihoods.
Village Uban Shah near Uban Shah Dargah Respondents: 1. Muhammad Mithal 2. Arbelo	The villagers reported that their community comprises of 80 – 100 households. The area has access to electricity, but it experiences frequent load shedding. Gas is not available. There are no schools and no basic health facilities near the settlements. The residents travel to Kot Digi for medical treatment. They rely on line water and tankers for drinking water and daily needs. The surrounding terrain is all barren land. Livelihoods are mainly supported through labour work or are privately employed. On average, residents earn between Rs. 400 to 500 per day.

3. Jani	The respondents identified water scarcity as their most pressing issue, noting that despite the availability of pipelines, water is very scarce, and they often rely on expensive tanker deliveries. They emphasized that the underground water is both deep and saline, rendering it unsuitable for consumption. Consequently, they requested the installation of a Reverse Osmosis (RO) plant in the area to provide access to potable water.
Mehrano Wildlife Refuge and nearby settlements Respondents: 1. Hameer Burdi 2. Ali Gul 3. Sattar Burdi	The settlements that were in the surrounding area of the sanctuary reported that their community comprises of around 200 – 300 households. In this area, the communities that reside there are Talpur, Burdi, Rind, Wasan, Syed, Khaskheli and Gopang. The area has access to electricity, but it experiences frequent load shedding. Some parts also have gas availability, though it is similarly affected by heavy load shedding. There are some schools but no basic health facilities near the settlements. The residents travel to Kot Digi for medical treatments. They rely on handpump for drinking water and daily needs. The underground water is mixed, fresh and salty both depending on the area. The surrounding terrain consists of only agricultural land. The primary crops grown include wheat, vegetables, fodder and fruits such as dates, mangoes, jujube and lemon while livelihoods are mainly supported through livestock farming, agriculture, labour work, government employees, business owners or are privately employed. On average, residents earn between Rs. 600 to 800 per day. The respondents from the wildlife sanctuary expressed concerns regarding the proposed project, emphasizing that the sanctuary houses sensitive species, including various types of birds, deer and pigs. They cautioned that activities involving dynamite explosives could disturb or harm these animals. Consequently, they strongly recommended that such operations be conducted at a considerable distance from both the sanctuary and nearby residential areas to prevent any adverse effects on the wildlife. They stressed the importance of addressing these concerns to protect the sanctuary's inhabitants.
Village Jiskani near natural Dhora Respondents:	The villagers reported that their community comprises of more than 800 households. In this area, the majority communities that reside there are Bhatti and Jiskani, while there are some others as well. The area has access to electricity, but it experiences frequent load shedding. Some parts also have gas availability, though it is similarly affected by heavy load shedding. There are some schools and basic

1. Zahid Hussain Bhatti 2. Tariq 3. Muhammad Yousuf 4. Ali Dino 5. Allah Dino	health facilities near the settlements. The residents also travel to Kot Digi for big medical treatments. They mostly rely on handpump for drinking water and daily needs. The surrounding terrain consists of agricultural land and natural dhoras. The primary crops grown include wheat, vegetables, fodder and fruits such as dates and mangoes while livelihoods are mainly supported through livestock farming, agriculture, labour work, government employees or privately employed. On average, residents earn between Rs. 500 to 800 per day. The respondents expressed a positive attitude toward the project and requested that the company provide employment opportunities for unskilled labourers from the local villages to support their livelihoods. They also emphasized the importance of offering training sessions for skilled positions, enabling them to be hired for long-term roles and ensuring that the project benefits the community. They expressed a willingness to learn and contribute in any way possible.
Bozdar Wada Town Respondents: 1. Jan Muhammad 2. Edhu 3. Khadim 4. Nawaz	The town comprises of more than 2000 households. In this area, the communities that reside there are very diverse such as Burdi, Rind, Wasan, Syed, Khaskheli, Gopang, Bozdar, Panwhar and Solangi. The area has access to electricity, but it experiences frequent load shedding. Most parts also have gas availability, though it is similarly affected by heavy load shedding. There are many schools and colleges in the town and all basic health facilities are available. However, for major medical treatments, residents may travel to Kot Digi or Khairpur. They rely on handpump for drinking water and daily needs. The underground water is mixed, fresh and salty both depending on the area. The surrounding terrain consists of only agricultural land. The primary crops grown include wheat, vegetables, fodder and fruits such as dates, mangoes, jujube and lemon while livelihoods are mainly supported through livestock farming, agriculture, labour work, government employees, business owners or are privately employed. On average, residents earn between Rs. 600 to 800 per day. The respondents expressed concerns regarding the lack of vocational training centres for women in their area, highlighting the absence of facilities where women can acquire skills to support themselves. They requested the establishment of such centres to empower women through skill development. Additionally, they emphasized the importance of hiring local villagers, particularly for unskilled jobs, to provide employment opportunities and support the community's livelihoods.

Thari Mirwah Town Respondents: 1. Qurban Soomro 2. Farooq Ahmed Panwhar 3. Kher Muhammad	The town comprises of more than 3000 households. In this area, the communities that reside there are very diverse such as Burdi, Rind, Wasan, Syed, Khaskheli, Gopang, Bozdar, Panwhar and Solangi. The area has access to electricity, but it experiences frequent load shedding. Most parts also have gas availability, though it is similarly affected by heavy load shedding. There are many schools and colleges in the town and all basic health facilities are available. However, for major medical treatments, residents may travel to Ranipur, Kot Digi or Khairpur. They rely on tapwater or handpumps for drinking water and daily needs. The underground water is mixed, fresh and salty both depending on the area. The surrounding terrain consists of only agricultural land. The primary crops grown include wheat, vegetables, fodder and fruits such as dates and mangoes while livelihoods are mainly supported through livestock farming, agriculture, labour work, government employees, business owners or are privately employed. On average, residents earn between Rs. 600 to 800 per day. The respondents expressed significant concerns regarding the health and sanitation conditions in their area, highlighting the lack of basic facilities and the scarcity of fresh water, with all available water being saline. They emphasized the urgent need for the company to implement Corporate Social Responsibility (CSR) initiatives focused on improving health and sanitation, as well as providing access to clean drinking water.
Takkar Area (near Naro desert)	The household number in this area is not confirmed as settlers migrate seasonally. Due to water shortages, they move away but return toward the end of summer or the monsoon season. There are no basic facilities in the area. Settlers may travel to Thari Mirwah, Kot Digi and Khairpur. The surrounding terrain consists of only barren desert land. Livelihoods in the area are primarily earned through labour work. Seasonally, there are wheat and fodder crops sometimes. The respondents expressed significant concerns regarding the lack of basic facilities in their area, including the absence of gas, water, and electricity. They requested the government to provide essential services such as healthcare, education, and utilities. Additionally, they urged the company to utilize its profits to benefit the community, as they are facing challenging circumstances.
Kot Digi Town next to Kot Digi Fort	The town comprises of more than 5000 households. In this area, the communities that reside there are very diverse such as Burdi, Rind, Wasan, Syed, Khaskheli, Gopang, Bozdar,

	Panwhar and Solangi. The area has access to electricity, but it experiences frequent load shedding. Most parts also have gas availability, though it is similarly affected by heavy load shedding. There are many schools and colleges in the town and all basic health facilities are available. They rely on tapwater or handpumps for drinking water and daily needs. The underground water is mixed, fresh and salty both depending on the area. The primary crops grown include wheat, vegetables, fodder and fruits such as dates and mangoes while livelihoods are mainly supported through livestock farming, agriculture, labour work, government employees, business owners or are privately employed. On average, residents earn between Rs. 600 to 800 per day. The respondents expressed significant concerns regarding the project's potential impact on Kot Diji Fort, a major heritage site. They emphasized that the fort's structure is extremely fragile, and any seismic activity should be conducted at a considerable distance to prevent damage to its foundation. Despite these concerns, they welcomed the project and requested that employment opportunities be provided to the local community to support their livelihoods.
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2D Seismic Area

Table 5.4 - Stakeholder Feedback from Primary Stakeholders

Stakeholder	Feedback & Suggestions
Village Nabi Shah near Khat Dhora (protected area) Respondents: 1. Misri Shah 2. Faraz Shah	The villagers reported that their community comprises of more than 500 households. In this area, the communities that reside there are Phulpoto, Syed and others. They have no gas and electricity with the electric lines being cut for 2 years. There is only one primary school which is non-functional and no basic health facilities. They rely on handpump for drinking water and daily needs. The primary crops grown include wheat, vegetables, fodder and fruits such as dates while livelihoods are mainly supported through livestock farming, agriculture, labour work, government employees or privately employed. On average, residents earn between Rs. 500 to 600 per day. The respondents expressed significant concerns regarding the lack of basic facilities in their area, including the absence of electricity and qualified teachers in schools, which are currently unoccupied buildings. They requested assistance in addressing these issues. Additionally, they highlighted that their area is a protected habitat for wildlife, including species such as partridges. They emphasized that any seismic

	activities should be conducted at a considerable distance to prevent disturbance to these animals.
Gambat City Respondents: 1. Dar Ali 2. Abdulah 3. Nafees 4. Asif	The town comprises of more than 20,000 households. In this area, the communities that reside there are very diverse such as Burdi, Rind, Wasan, Abro, Narejo, Lakho, Bhatti, Mangi, Syed, Khaskheli, Gopang, Bozdar, Panwhar, Solangi and others. The area has access to electricity, but it experiences frequent load shedding. Most parts also have gas availability, though it is similarly affected by heavy load shedding. There are many schools and colleges in the town and all basic health facilities are available such as GIMS (Gambat Institute of Medical Sciences). They rely on tapwater or handpumps for drinking water and daily needs. The underground water is mixed, fresh and salty both depending on the area. The surrounding terrain consists of only agricultural land. The primary crops grown include wheat, vegetables, fodder and fruits such as dates and mangoes while livelihoods are mainly supported through livestock farming, agriculture, labour work, government employees, business owners or are privately employed. On average, residents earn between Rs. 600 to 800 per day. The respondents expressed a strong desire to be employed in both skilled and unskilled positions within the project, aiming to benefit directly from its development.
Village Sutaro Kubar near Musafir Shah Dargah Respondents: 1. Haqnawaz Kubar 2. Qamar Uddin 3. Dhani Baksh 4. Shahid 5. Mumtaz	The town comprises of more than 200 - 400 households. In this area, the majority community that resides there are Kubar along with some Hindu minority. The area has access to electricity, but it experiences frequent load shedding. Gas is not available. There is only one primary school available, no other educational facilities are available. There are no medical facilities. Residents travel to Thari Mir Wah for bigger medical treatments. They rely on tapwater or handpumps for drinking water and daily needs. The underground water is mostly salty. The surrounding terrain consists of agricultural land and mostly barren land. The primary crops grown include wheat, fodder and fruits such as dates. Livelihoods are mainly supported through livestock farming, agriculture, labour work, government employees, business owners or are privately employed. On average, residents earn between Rs. 600 to 800 per day. The respondents expressed significant concerns regarding the project's potential impact on their agricultural land, which was

	severely affected by the 2022 flood, rendering it unsuitable for cultivation. They requested transparency about any wastewater discharge from the project, emphasizing the need for prior information to mitigate adverse effects on their land. Additionally, they highlighted severe water scarcity issues, relying on tankers due to the high salinity of underground water, making it unsuitable for daily use. They appealed for assistance in addressing this critical issue. Furthermore, they requested employment opportunities within the project to enhance local employment prospects.
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5.7.2 Sindh Wildlife Department

The comments, concerns, and suggestions received from the Sindh Wildlife Department represented by Wildlife Conservator Mr. Javaid Ahmed Maher, during the consultation process have been compiled and presented in this section. The Sindh Wildlife Department, which manages wildlife and habitat protection in the region, shared helpful insights. Their input contributed significantly to the environmental screening process and the formulation of precautionary and mitigation measures.

Key suggestions and concerns raised by the Sindh Wildlife Department include:

- It was emphasized that any access tracks created or used during the survey should be properly rehabilitated after project completion. This is to prevent their continued use by the local population, which could result in increased poaching, illegal logging, and long-term degradation of sensitive habitats.
- The department recommended that the project proponent implement effective security and surveillance mechanisms to monitor and control access to the newly created tracks. These measures are crucial to deter unauthorized entry and to minimize human disturbance in protected areas, which could otherwise threaten wildlife and the ecological balance.
- A strong emphasis was placed on the protection of existing natural habitats, particularly the conservation of indigenous flora. In arid and semi-arid regions where reforestation is often impractical due to harsh climatic conditions, the preservation of existing vegetation is considered far more sustainable and ecologically appropriate.
- For CSR initiatives within project area, the department advised active role to be given to wildlife officials and locals.



Consultation with Sindh Wildlife Department



Consultation with Local Residents of Sathyio Wah Village / Stop



Consultation with Local Residents of Sorah Village / Stop



Consultation with Local Residents of Badshah Sultan Dargha / Village





Consultation with Local Residents of Ubhan Shah Wah Dargha / Village



Consultation with Local Residents of Mehrano Village



Consultation with Local Residents of Bozdar Wada Village



Consultation with Local Residents of Meer Muhammad Solangi Village



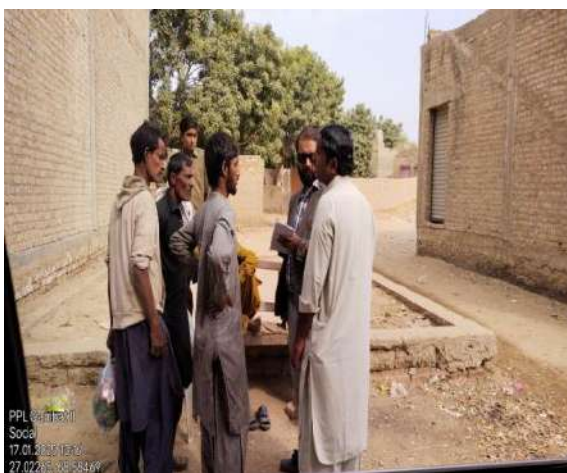
Consultation with Local Residents of Ubhan Shah Jiskani Dhoro / Village



Consultation with Local Residents of Thari Mir Wah City / Village



Consultation with Local Residents of Takar Area



Consultation with Local Residents of Thari Mir Wah City / Village



Consultation with Local Residents of Sutyaro Kubar Dargha / Village



Consultation with Local Residents of Khat Dhoro / Nabi Shah Village



Consultation with Local Residents of Gambat City / Village



Consultation with Local Residents of Mehrapur Village



EIA study team during Gambat-II survey

6.0 POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

6.1 Introduction

This chapter evaluates the potential environmental and socioeconomic impacts of the proposed 2D and 3D seismic surveys within the Gambat-II Block. The project involves the deployment of seismic data acquisition equipment, the construction of access roads, and the establishment of campsites.

Gambat II block is located in Sukkur and Khairpur districts of province and encompasses a landscape characterized by agricultural fields, rocky outcrops, and desert terrain. It also includes ecologically sensitive habitats, such as hilly slopes, wetlands, sand dunes, and canal-fed depressions, which support a diverse range of flora and fauna, including migratory birds and endangered species. The project area also extends into the ecological sensitive sites of Takkar and Khat Dhoru wildlife sanctuaries along with Mehrano Wildlife Refuge necessitating a thorough assessment of environmental impacts and the development of appropriate mitigation measures to safeguard these areas.

Impacts have been identified through a combination of literature review, baseline data analysis, expert consultations, and field observations. The screening process assesses both positive and negative effects of project activities during different stages, particularly regarding emissions, waste discharges, and their influence on aesthetics, air and water quality, local biodiversity, and the overall living environment. A structured impact rating system and professional judgment have been used to determine the significance and residual nature of the identified impacts, along with appropriate mitigation strategies to reduce or compensate for adverse effects.

6.2 Methodology for Impact Assessment

The screening methodology that was adopted for the EIA study comprises impact screening followed by detailed assessment process. It includes literature research and review of Oil and Gas Exploration projects implemented in other parts of the world as well as in Pakistan. The screening highlighted the major impacts that might be associated with normal operations based on the literature research and the nature of the surrounding environment.

The key issues identified were further investigated and evaluated based on planned project operations including proposed project activities, time duration, national and provincial environmental regulations, Proponent's HSE policies and commitment, and the environmental baseline conditions. Using the data collected during surveys and project information provided by client, the results were channeled to a secondary screening process.

The general evaluation process will include the following stages:

- **Step 1:** Identification of project related activities (sources) and environmental aspects;
- **Step 2:** Identification of potential impacts to the environment (physical, biological, human and cultural);
- **Step 3:** Evaluation and assessment of the related unmitigated impact significance;
- **Step 4:** Identification of Good Industry Practices and Best Practicable Environmental Options (BPEO); and
- **Step 5:** Re-evaluation and assessment of the mitigated impact significance.

The nature and severity of impacts was first assessed for current project plans. This identifies the potential unmitigated impacts and the residual impacts under project designs and control measures which are already part of the design.

After having identified and characterized the potential significant impacts during each phase using the screening procedure identified above, an impact rating Matrix was developed to summarize all identified impacts during each phase of the project (refer to Table 7-8). The impact severity was derived from:

- Scoring exercise for each environmental impact,
- Results from primary data collection e.g. environmental monitoring, analysis and calculations, and scientific predictions based on similar projects conducted abroad or locally.

6.3 Screening of Potential Environmental Impacts at different stages of project development

Screening of potential environmental and socio-economic impacts resulting from various activities performed during seismic survey identifies following environmental constraints that need to be addressed during project implementation:

- Landscape and Soil Erosion
- Soil and Water contamination
- Changes in Ambient Air Quality
- Noise Pollution
- Impact due to Vibration
- Impact on Water resources
- Impact on Water availability
- Flooding management
- Blockage of Natural Drainage
- Impact due to Hazardous material and solid waste generated
- Impacts on Eco-system
- Socioeconomic Impact.

6.4 Environmental and Social Impacts from seismic survey

6.4.1 Changes in Landscape and Soil Erosion

Potential Sources of impacts

The use of heavy machinery during access track and seismic operations can lead to soil compaction, disturbance, and erosion. Soil disturbance can alter the natural landscape, leading to increased runoff and sedimentation in nearby water bodies. This is especially critical in areas such as the hilly slopes and undulating sand dunes of the Takkar Wildlife Sanctuary, where the soil is already fragile and prone to wind erosion and sediment loss.

Land use impacts from the proposed project activities include land disturbance, habitat destruction, and soil erosion. These impacts result from several factors including changes in runoff patterns, hydrological alterations, emissions and sediment runoff. Other activities include preparation of camp sites and construction of an access road. The use of the project access road, off-road travel, and development of new access tracks will further impact the land. Seismic lines that cross through ecologically valuable areas, such as microhabitats in Mehrano Wildlife Refuge or wetlands in Khat Dhoru wildlife sanctuary, may also disrupt wildlife movement and increase fragmentation of natural habitats. Many impacts can be reduced or avoided when considered during siting and planning of the project.

Clearing of land for seismic line

Land clearing for seismic lines will be kept to the minimum required. Unnecessary clearing within the corridors along the access track and campsites will be avoided. Vegetation such as native shrubs, saltbush, and desert trees (e.g., *Prosopis juliflora* and *Tamarix*), which support wildlife shelter and nesting, should not be removed unless absolutely necessary. Sensitive timing considerations should also be made to avoid disrupting breeding seasons and migratory bird arrivals (e.g., April to August window recommended for activity commencement).

Construction of access road

Access tracks will be prepared to access the seismic lines (where required). Construction of the access road will involve cutting and filling. The topping can be done with in-situ gravels or gravels brought from nearby areas. Route planning must avoid protected wildlife habitats, cultural sites (shrines, ancient cemeteries), and ecologically sensitive depressions that serve as resting grounds for migratory birds. Mitigation measures to minimize chances of soil erosion or land slippage during the entire length of the road have been recommended at the end of this section. This will primarily be due to wind erosion from earth-fill stockpiles and loose road surface during construction.

Preparation of campsites

For seismic survey activities campsites will be developed to house the survey crew and equipment/machinery. This will require flat and clear land which is easily accessible.

Camps should be sited away from wildlife refuges, wetlands, and lagoons to avoid noise and human disturbance to sensitive species like Houbara bustard, gray partridge, and waterfowl. This could have impact on soil and landscape due to movement of vehicle and construction activities. In addition, care must be taken to ensure no plastic, diesel, chemicals, or construction debris is left in or near the habitat zones.

Mitigation Measures

- Land surveying techniques will be employed to map sensitive areas, and access routes will be planned to avoid these zones.
- Existing roads and pathways will be used wherever possible to minimize land disturbance and prevent unnecessary soil compaction.
- The total land uptake for camps and access roads will be limited to the minimum required.
- Camps will be constructed on existing flat land to minimize soil disturbance.
- Movement of survey vehicles and equipment will be restricted to designated work areas to prevent unnecessary soil disturbance.
- A single approved track will be identified along sections of the main access route during construction. Vehicles will only be allowed on this track.
- Access tracks, including those used by tankers and trucks, will be monitored and maintained. The width of new or improved access tracks will be limited to 9–10 meters.
- The access track will be properly compacted during construction and maintained through watering and compaction as needed.
- Areas along access tracks and campsites will be visually monitored.
- Sections showing signs of erosion will be stabilized through watering and compaction.
- Improvement or construction of stream crossings will ensure proper slope adjustment and compaction for a stabilized and sealed surface.
- Dumping of gravel on or near active construction access tracks will not be allowed.
- Erosion control measures, such as geotextiles, ripraps, and retaining walls, will be implemented in high-risk areas.
- Soil conservation techniques, including contour plowing and terracing, will be applied on slopes. Vegetation clearing will be minimized, and tree cutting will be avoided.
- Seismic lines in undulating areas will follow natural contours where possible. Where line cutting is necessary, it will be done with minimal disturbance to the terrain.
- Photographic documentation will be used to monitor soil conditions throughout project activities.
- Septic tanks and soak pits will be constructed for black and grey water disposal, provided the groundwater table is at least 4 feet below the bottom of the soak pit.

- Septic tanks will be of sufficient capacity, constructed from concrete with inlet/outlet baffles to prevent infiltration. A two-pipe system will be used for black and grey water separation.
- Soak pits will be located at least 300 meters from local water sources.
- Sprinkling of sewage is prohibited. If a soak pit is filled, a new one will be prepared, or excess wastewater will be directed to the nearest municipal drain.
- Grey water may be sprinkled only if it meets SEQS limits.
- Septic tanks and soak pits will be restored after use by backfilling with at least one meter of soil cover. Concrete structures may be broken and buried below the rooting zone (1–1.5 meters).
- Contaminated bricks and materials from black/grey water facilities will be removed from the site and not distributed locally for reuse.
- Vehicle speeds will be regulated and monitored to avoid excessive dust emissions.
- Off-road travel should be avoided as much as possible and observance of this should be monitored during the operation.
- Periodic trainings will be provided to drivers on mitigation measures related to off-road travel and speeds limits.
- Movement of equipment will be restricted to work areas only to avoid unnecessary disturbance to soils in the project area.

6.4.2 Soil and Water Contamination

During Potential spills of oil, chemicals, and other hazardous materials during seismic operations can contaminate the soil, leading to long-term degradation of soil quality and potential impacts on groundwater. This concern is particularly significant in ecologically sensitive zones such as the Takkar Wildlife Sanctuary, where soil contamination may affect microhabitats and natural springs, and in Khat Dhoru and canal-fed lagoons, where seepage zones connect directly to wildlife drinking sources and seasonal wetland ecosystems.

Throughout seismic operations, potential impact sources may arise from domestic waste, fuel or oil leaks, spills, and the use of bentonite mud in drilling shot holes and up-holes. If not carefully managed, such contaminants could seep into nearby depressions and dhoras, which serve as water reservoirs for migratory birds, amphibians, and other fauna. In addition, soil pollution in sandy dune areas which are already vulnerable to erosion, could exacerbate the degradation of fragile desert ecosystems and impact vegetation that provides nesting, food, and shelter for wildlife.

From a management perspective these spills have been categorized as minor, moderate or major and detailed below along with the recommended mitigation measures.

- **Minor Spills:** Leaks from vehicles, equipment, or storage containers at campsites or work areas outside the campsite or oil or fuel stains produced during handling and

transfer operations such that the area and depth of soil contaminated is less than 1 square meter and 0.3 m respectively.

- **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.

At a given time and location of the project, activities will be undertaken in a confined area of land demarcated by fences/fringes. During the proposed project activities, there is a possibility of:

- a) Soil contamination through oil spills and other chemical spills like solvents etc. which may have adverse effects on endemic plant species (e.g., saltbush, desert acacia) and disrupt soil microfauna.
- b) Water contamination by the runoff from project site which takes away the traces of oil, chemicals or other drilling waste thus contaminating the receiving water bodies mainly the seasonal streams, ponds, and canal-fed lagoons that support both resident and migratory birds, including species like black-winged stilts, sandpipers, and little grebes.

Mitigation Measures

- A comprehensive spill prevention and response plan will be developed, detailing hazardous waste storage, spill prevention protocols, response actions by waste type, training requirements, response equipment, and official notification procedures.
- All personnel will undergo regular training and spill response drills.
- Fuel and chemical storage areas will include secondary containment of at least 110% of the largest tank capacity. These will be made of concrete, brick masonry bunds, or HDPE-lined systems with sump pits to collect spills.
- Spill detection systems will be installed in all hazardous material storage areas.
- Absorbent materials, shovels, and plastic bags will be available at all handling sites to manage spills.
- Soak pits will be built in absorbent soil and located 300 m away from a surface water source or ground water well.
- Soak pits will be constructed such that surface runoff cannot enter into the pits.
- Soak pits will be designed to accommodate wastewater generated during the total duration of the operation.
- All spills will be immediately contained and neutralized using appropriate agents.
- Soil remediation methods such as bioremediation or soil washing will be employed.

- Contaminated soil will be collected and disposed of through SEPA-approved waste contractors.
- A contingency plan will be in place for moderate to major spills.
- Fuel and oil storage tanks will be clearly labeled, inspected daily, and repaired immediately in case of leaks.
- Fuel storage is a temporary activity and will be dismantled post-construction or seismic work.
- Fuel transfer (e.g., to bulldozers) will use drip pans to prevent spills.
- Vehicles will be inspected daily for leaks and removed from service until fixed if leaks are detected.
- Vehicle servicing and washing will be carried out only in designated, concrete-paved areas within campsites.
- Bentonite mud (for drilling for seismic) will be prepared in earthen pits. Used mud will be dried in the same pit and then backfilled with a 1m soil cover.
- Sensitive zones (e.g., Takkar Wildlife Sanctuary, and Khat Dhoro) should have additional geotextile barriers installed beneath mud pits to prevent seepage into soil and groundwater.
- Used oil will be provided to OGRA-licensed oil reclamation plants or disposed of through SEPA-certified waste contractors.
- Waste from vehicle maintenance will be handed over to approved recycling/disposal contractors.
- Food waste will be buried onsite or handed over to a certified contractor; open disposal is prohibited.
- Combustible packaging waste without reuse will be stored in designated areas and disposed of through certified contractors.
- Recyclable materials like glass, tin, and metal will be sent to recycling contractors.
- Medical waste will be stored separately and incinerated through SEPA-approved contractors.
- Septic tank systems with soak pits will be used for sewage disposal. Soak pits will be built in absorbent soils, away from water bodies, and designed for total wastewater volume.
- Buffer zones of native vegetation will be established around soak pits to naturally filter potential contaminants.
- Runoff from campsites will be controlled to prevent contamination of nearby water bodies.

- If soak pits are filled, greywater (meeting SEQS standards) may be sprinkled on access tracks, avoiding water accumulation.
- Sewage generated at the campsites will be disposed of in septic tanks and soak pits.
- Sprinkling of sewage is strictly prohibited. Excess sewage will be sent to municipal drains with written approval and SEQS compliance.
- Regular environmental monitoring will be conducted in high-risk zones to detect early signs of soil or water contamination. Reports will be reviewed monthly to inform adaptive management strategies.
- During fuel and oil transfer operations such as re-fueling vibroseis/bulldozers through a dedicated fuel vehicle, drips and spills will be avoided and drip pans will be used.
- The water discharge from septic tank and soak pit will be monitored before its discharge into water body / Nullah. If water quality is exceeding SEQS limits for effluents then it should be treated to comply with SEQS. Wastewater disposal to local nullah will only be carried out after taken approval from relevant authority / TMA.
- At the time of restoration all pin flags, signs, and refuse from seismic lines will be removed.

6.4.3 Changes in Ambient Air Quality

Impacts would depend upon the amount, duration, location, and characteristics of the emissions and the meteorological conditions (e.g., wind speed and direction, precipitation, and relative humidity). Air quality may be temporarily impacted by emissions and dust generated from earth-moving equipment, vehicles, and seismic survey operations. Pollutants such as particulates, nitrogen oxides, carbon monoxide, and sulfur dioxide can be released during these activities.

While these emissions are expected to be short-term and unlikely to significantly contribute to climate change, their localized environmental impact may be more pronounced in ecologically sensitive zones such as the Takkar Wildlife Sanctuary, Mehrano Refuge, and areas with dense vegetation and tree cover. Dust emissions in particular can settle on native plants, potentially affecting photosynthesis and the health of forest floor vegetation which supports reptiles, birds, and small mammals. Additionally, airborne particulates may pose respiratory stress to birds and mammals, especially during the dry season when natural dust levels are already high.

The impact on local human communities is anticipated to be minimal due to the sparse population and distance between the operational area and nearby settlements. However, careful monitoring of air quality within wildlife zones is recommended, particularly near campsites or areas with prolonged vehicular activity.

Transportation on unpaved tracks can be a significant source of dust emissions and will require careful management by implementation of good industry practices (such as keeping

stock piles down wind and away from communities and camp) and sprinkling water over the access road.

Mitigation Measures

- All generators, compressors, vehicles, and other equipment used during seismic activities will be well-maintained to minimize emissions and ensure compliance with SEQS standards.
- Emission control devices will be required on drilling and construction equipment.
- Vehicle will be restricted, and route optimization protocols will be implemented to reduce fuel consumption and associated emissions.
- Vehicle speeds will be strictly regulated and monitored on-site and on access roads to control dust generation.
- Dust suppression techniques (e.g., regular water spraying) will be used on unpaved and unvegetated surfaces, particularly during activities such as clearing, excavation, grading, backfilling, and blasting.
- Water mist cannons and sprinklers will be installed and used on dusty work areas and roads as needed.
- Only treated or non-potable water will be used for dust suppression to avoid depletion of community water sources.
- Construction materials and stockpiled soil will be covered to prevent fugitive dust emissions.
- Soil loads in dump trucks will be kept below the truck's freeboard, kept moist if dusty, covered with tarpaulins, and minimized in drop height when loaded.
- Leveling and widening of access roads will be followed immediately by watering and, where needed, compaction to control dust.
- Campsites will be located at least 500 meters from communities to reduce exposure to dust and emissions.
- The area of vegetation clearance will be minimized to limit surface exposure and dust generation.
- Open burning of waste and combustible materials at the project site is strictly prohibited.
- Workers will be trained on proper handling of construction materials and debris during construction and dismantling phases to minimize fugitive emissions.
- Ambient air quality and emissions from point sources will be monitored regularly as per EMP of this document and ensure compliance with SEQS.
- Adaptive management strategies (e.g., temporary activity halts or rerouting) should be implemented when pollutant levels exceed threshold values in critical habitats.

6.4.4 Noise Pollution

The primary sources of noise related with seismic survey activities comprise earth-moving equipment, vehicle traffic, diesel generators, etc. Detonation of dynamite in shot holes will only be heard at the surface like a muffled thud.

While human settlements are at a considerable distance and thus unlikely to experience significant noise impact, the effect on wildlife within protected areas such as the Takkar and Khat Dhoro Wildlife Sanctuaries and Mehrano Wildlife Refuge, may be more pronounced. Sudden loud noises and continuous low-frequency vibrations from machinery and Vibrioses trucks can cause stress or displace sensitive species, particularly nocturnal mammals, ground-nesting birds, and reptiles. Disturbance during breeding or migratory periods may also lead to habitat abandonment or reduced reproductive success.

Therefore, even though the impact of noise emissions on nearby settlements is not considerable, noise management within ecologically sensitive zones is essential to prevent disruption of wildlife behavior and breeding cycles. It is particularly important to avoid high-noise activities during early mornings and late evenings when many species are most active.

Mitigation Measures

- Generators, vehicles, machinery, and other equipment will be well-maintained to minimize noise emissions.
- All equipment will be fitted with sound-control devices and, where feasible, placed within acoustic enclosures or shelters to reduce sound propagation.
- Stationary noise-generating equipment (e.g., pumps, generators) will be positioned as far as possible from communities and other sensitive receptors.
- Pressure horns will be strictly prohibited, and the use of vehicle horns will be minimized.
- Temporary and permanent noise barriers will be erected using materials with high sound absorption properties, especially around high-noise equipment and along site perimeters.
- High-noise activities will be scheduled during late mornings or early afternoons, when they are least likely to disturb nearby communities or wildlife.
- In wildlife zones, high-noise activities will be avoided during early mornings and dusk to prevent disruption of peak activity periods for birds and nocturnal mammals.
- Where feasible, combine multiple noisy activities (e.g., excavation and earthmoving) into single periods to reduce frequency and duration of noise events.
- Heavy truck traffic will be routed away from residential areas and sensitive receptors.
- Movement of project vehicles and personnel will be restricted to designated work areas.
- The distance of well site and campsite (from outer periphery) to nearby community / village shall be maintained preferably for 500m.
- Engage with local communities to communicate construction schedules and noise mitigation plans.
- Implement wildlife protection measures, including the creation of quiet zones and avoiding protected areas and critical habitats during sensitive periods.
- Timing of seismic operations will be coordinated with wildlife experts to avoid breeding, nesting, and migratory seasons for key species.

- Noise monitoring equipment will be deployed to regularly assess levels and ensure compliance with SEQS or other applicable standards.
- If noise exceeds acceptable limits near communities, additional mitigation measures will be implemented.
- Workers exposed to high noise levels will be provided with personal protective equipment (PPE) such as earplugs and earmuffs, and clear communication protocols will be enforced to mitigate noise interference.

6.4.5 Impact due to Vibration

The use of different equipment during different stages of oil and gas operations produces varying levels of vibration, depending on the type of equipment and the work being done. It is important to protect workers from the effects of vibration, as excessive exposure can increase the risk of hand-arm vibration syndrome. Seismic activities produce ground vibrations that spread through the ground and weaken with distance. These vibrations are unlikely to reach levels that can damage structures, but they can be heard and felt in buildings very close to the site.

However, even at lower intensities, ground vibrations may disturb local wildlife, particularly in sensitive habitats such as the Takkar Wildlife Sanctuary and Mehrano Wildlife Refuge. Burrowing animals like foxes, porcupines, and rodents, as well as ground-nesting birds such as the Indian courser and Houbara bustard, may perceive these vibrations as threats, leading to behavioral changes or temporary displacement. Additionally, vibrations near canal-fed wetlands or in areas with sandy soils may impact nesting grounds or fragile root systems of desert vegetation that support biodiversity in these microhabitats. Therefore, while structural damage to buildings is not expected, vibration-sensitive zones—especially within protected habitats—should be identified and monitored, and activities adjusted accordingly to minimize ecological disruption.

Mitigation Measures

- Protection from vibration associated effects usually requires a combination of appropriate tool selection, the use of appropriate vibration-absorbing materials (e.g., gloves), good work practices (like avoiding continuous exposure by taking rest periods, refraining from using faulty tools), education programs and consulting a doctor at the first sign of vibration disease and ask about the possibility of changing to a job with less exposure.
- In addition to this, mitigation for vibration impacts can take place at the source, sensitive receiver, or along the propagation path from the source to the sensitive receiver.
- Workers operating hand-held vibrating tools shall undergo regular health assessments to monitor for signs of Hand-Arm Vibration Syndrome (HAVS).
- Operational schedules will limit the daily exposure duration for personnel using vibration-intensive machinery.
- Low-vibration machinery or alternative methods (e.g., hydraulic drilling over pneumatic where feasible) will be selected for use in ecologically sensitive areas.

- Seismic activities will be coordinated with wildlife specialists to avoid peak breeding, nesting, or migratory windows, especially in known habitats of ground-nesting birds or burrowing mammals.
- Buffer zones of at least 1 km shall be established between vibration-intensive activities and known habitats of sensitive fauna (e.g., Houbara bustard nesting areas).
- Pre-operation surveys shall be conducted to identify and map vibration-sensitive zones, including areas with sandy soils, canal-fed wetland peripheries, and desert vegetation with fragile root systems.
- If vibration thresholds are exceeded in sensitive areas, seismic shall be paused and reviewed for mitigation adjustments.

6.4.6 Impact on Water Resources

Proximity of water bodies including Khat Dhoro (wetland), canals and its tributaries increases the risk of water contamination from spills or runoff. Contaminants can include oil, chemicals, and sediment, all of which can severely harm aquatic ecosystems, disrupt biodiversity, and degrade water quality.

Mitigation Measures

- Install automatic shutoff valves on tanks and pipelines to prevent large-scale spills.
- Septic tank to be constructed to collect black water during the time seismic operation. Once seismic operation is completed, the waste water will be tested on the parameters mentioned in SEQS, and if the results are within the SEQS limits, then wastewater to be disposed into TMA drain, after getting their due permission from relevant authority.
- The greywater can be collected in soak pit and it can be used for sprinkling purpose provided it does not have excessive oil and grease. Further, provide oil and grease traps to avoid entry of oil and grease into grey water soak pits.
- Station floating booms, absorbent pads, and other spill response equipment near water bodies to quickly contain and clean up spills. Train personnel in rapid response techniques and conduct regular drills to ensure preparedness.
- The grey water can be used for sprinkling purpose.

6.4.7 Impact on Water Availability

The extraction of water for project activities can affect groundwater availability in the short term, which implies that the groundwater immediately available to the communities may fall. This should not however, affect the long-term availability of the area's water resources. Short-term water extraction may affect the quantity and, indirectly, the quality of water available to local communities. In this discussion, 'short-term' refers to a time period ranging from a few hours to a few days.

In ecologically sensitive areas like the Takkar Wildlife Sanctuary, Mehrano Wildlife Refuge, and wetland Khat Dhoro, and surrounding dhoras and seasonal ponds, short-term extraction may also temporarily reduce the recharge capacity of microhabitats that support local biodiversity. These water sources are critical for wildlife survival, particularly during dry seasons when natural water availability is already limited. Even slight fluctuations in

groundwater levels can affect spring-fed ponds or depressions where birds, reptiles, and mammals depend on consistent moisture levels.

Careful selection of extraction points and timing, preferably away from sensitive wildlife zones and outside peak migration or breeding periods, is recommended to avoid ecological stress.

Mitigation Measures

- The quantity of water used for the project activities will be kept to the minimum required by taking prudent water conservation measures on site. A complete record of water consumption will be maintained.
- Avoid abstraction of water from surface water resources. If there is no other source of water available, then for abstraction of water from surface water body, prior approval from relevant government department should be taken.
- The quantity of water used during construction and seismic activities will be kept to the minimum required by taking prudent water conservation measures on site. A complete record of water consumption will be maintained.
- Water from the tube well will only be used after ensuring that the available capacity of that resource is roughly 50% greater than the project demand.
- Discharge from the installed tube well or tube well owned by locals will be regularly monitored to check any changes in the yield of the wells.
- If a new water well is to be installed for project activities, the well should not be located within 500 meters from existing local wells and will be designed to abstract water preferably from a deeper aquifer not being used by local communities.
- For all water sourced from local wells, the project will compensate well owners at the prevailing market rate for the volume of water abstracted. Prior to water abstraction, a formal written agreement will be established between the project and well owners to document the agreed rates and terms of water use. This agreement will be maintained on record and made available for verification by the Independent Monitoring Consultant (IMC) upon request, ensuring transparency and compliance with established water use protocols.
- The use of new wells installed or to be installed for community benefits will be allowed.
- The quantity of water used during seismic and gravity and magnetic surveys 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.
- A complete record of water consumption during seismic survey, and construction of camp will be maintained.
- Water extraction points will be located at least 1 km away from ecologically sensitive zones, including wetlands, spring-fed ponds, and seasonal depressions in Takkar and Khat Dhoru wildlife sanctuaries and Mehrano Wildlife Refuge.

6.4.8 Flooding

The flood risk map drawn for proposed project activities shows (chapter 4) that seismic activities still pose a risk of exacerbating flood-related issues, especially the area of lower depression or near to the rainfed water channels. It is important to take all appropriate measures to offset flooding impacts onto the labor camps and during the seismic operation activities.

Mitigation Measures

- Develop and implement emergency response procedures for flood events, including evacuation plans and spill containment strategies.
- Ensure equipment can be quickly deployed and removed to minimize exposure to floodwaters.
- Maintain reliable communication systems for coordination and emergency response.
- In addition to this, PPL will maintain a Spill Response Procedure to prevent and response to oil spill during operation phase.
- The Exploration and HSE departments will consistently monitor meteorological conditions. In the event of anticipated heavy rainfall in the area, field travel will be minimized.
- Prior information will be gathered from local sources (e.g., Rangers, community) to anticipate floodwater arrival, facilitating the shutdown of the facility and the evacuation of personnel from wellhead locations.
- Field travel during regular rainy conditions will be contingent upon the accessibility of the access roads.
- If a cloud outburst occurs, and the likelihood of a flash flood is high, immediate evacuation of workers to the campsites will be executed, subject to road conditions.
- In case of flash flooding of rig sites or access roads, personnel will be directed to reach high grounds, marked on call point cards.
- Night travel to project area site will be suspended during flood threat durations.
- Provide training to personnel on flood safety and emergency procedures.
- Ensure the effective implementation of the flood risk management plan, focusing on elevating critical infrastructure, constructing flood barriers, and designing drainage systems to handle floodwaters.
- Inform local communities about the project and potential risks, seeking their input and cooperation.

6.4.9 Blockage of Natural Drainage

The campsites will be situated in pre-existing flat areas where sheet flow occurs during rainfall. Since the campsites will occupy limited space, they won't obstruct the natural sheet flow. Nonetheless, as a precautionary step, the surroundings of the campsites will be landscaped to ensure there's no interference with the natural drainage system.

However, in ecologically sensitive areas like Takkar Wildlife Sanctuary, Mehrano Refuge, and Khat Dhoru, even minor alterations in sheet flow can affect localized water retention

zones—especially dhoras, ponds, and seasonal streams that act as microhabitats for migratory birds and small mammals. These habitats rely on the natural flow and collection of rainwater and seepage to maintain their ecological balance.

Consequently, the possibility of blockage of natural drainage exists from either the construction of access tracks, land clearing or preparation, the establishment of campsites, or seismic activities. It is essential that camp placement and infrastructure development avoid natural depressions, ephemeral stream channels, or areas that serve as seasonal recharge zones for wetlands and wildlife watering points.

Mitigation Measures

- Area around the campsite(s) shall be landscaped to avoid blocking of natural drainage.
- Detailed topographic surveys shall be conducted prior to camp placement to map sheet flow patterns, ephemeral streams, and natural depressions. Campsites will be sited to avoid these features entirely.
- All access tracks and infrastructure will be aligned to run parallel to natural drainage paths wherever possible, with adequate setbacks from dhoras, ponds, and water retention zones.
- Construction of camps or roads will not be permitted within 100 meters of any visible depression, streambed, or seasonal recharge feature unless hydrological modeling shows zero impact on natural drainage.
- Natural contours will be preserved during land preparation. Where minor leveling is necessary, micro-channeling will be incorporated to ensure continued sheet flow across cleared areas.

6.4.10 Impacts due to Hazardous Material and Solid Waste Generated

Waste management is a critical component of 2D and 3D seismic survey activities, as various types of waste are generated during seismic operations. These include human waste, chemical waste from explosives and other substances, general campsite waste, domestic waste (such as food wrappers and scraps), woody vegetation, and wastewater.

While much of the solid waste may be non-hazardous, improper handling and disposal, particularly of hazardous materials—can lead to serious contamination of soil and water resources. This is particularly critical in ecologically sensitive areas such as Khat Dhoro, Mehrano Wildlife Refuge, and the Takkar Wildlife Sanctuary, where even minor contamination can disrupt the fragile balance of seasonal wetlands, groundwater-fed ponds, and vegetative microhabitats that support migratory birds, reptiles, and small mammals. The dhoras and depressions in these regions often serve as water collection and recharge zones, and contamination in these areas can quickly enter both terrestrial and aquatic food chains.

This poses significant risks to local ecosystems, aquifer recharge areas, flora and fauna, and human health. The severity of these impacts depends on the types and quantities of materials and chemicals used, and how effectively they are managed on-site.

Proper segregation, handling, storage, and disposal of hazardous and non-hazardous wastes are essential to mitigate these risks and ensure environmental safety throughout the duration

of seismic operations. Special attention must be given to waste containment systems at campsites near or within wildlife zones to avoid accidental leaching or surface runoff into sensitive habitats.

Mitigation Measures

- Install disposal toilets and septic tanks at the campsite to manage human waste efficiently.
- Store chemicals, including explosives, in secure, designated areas to prevent accidental spills or leaks.
- Implement a waste segregation system to separate recyclable materials from general waste. Provide designated bins for different types of waste (e.g., plastics, metals, organic waste).
- Ensure that collected waste is handled by certified contractors for proper disposal in compliance with environmental regulations
- Prepare a comprehensive list of all hazardous materials to be used, stored, transported and disposed of during all phases of activity.
- Develop a hazardous materials management plan addressing storage, use, transportation and disposal (interim and final) for each item in the comprehensive list.
- Develop a waste management plan identifying anticipated solid and liquid waste streams and addressing determination, inspection and waste minimization procedures, storage locations and waste-specific management and disposal requirements.
- Include a recycling strategy to be practiced by workers during all project phases.
- Develop a spill prevention and response plan for addressing storage locations of hazardous wastes, training requirements, waste-specific spill response actions, spill response kits, and notifications to authorities.
- Develop a storm water management plan to ensure compliance with regulations and prevent off-site migration of contaminated storm water or increased soil erosion.
- 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 storage area/ tank capacity) . Fuel storage should be a temporary activity and fuel storage facilities should be removed upon completion of the seismic activities.
- Containerize and periodically remove wastes for disposal at appropriate off-site permitted disposal facilities. The goal would be to minimize the amount of hazardous materials and waste onsite.
- Waste containers will be clearly labeled with contents and hazard symbols and stored in weatherproof, ventilated shelters.
- Waste containers will be clearly labeled with contents and hazard symbols and stored in weatherproof, ventilated shelters.
- Employ a long-term monitoring program to ensure that mitigation measures (e.g., closure of reserve pits) employed throughout the project is effective.

Much of the solid material can be recycled and sold as scrap or used for other projects; the remaining non-hazardous waste would be sent to permitted disposal facilities. Industrial wastes (oils, hydraulic fluids, coolants, solvents, and cleaning agents) would be treated similarly to wastes during the production phase (e.g. put in containers, characterized and labeled, possibly stored briefly, and transported by a licensed hauler to an appropriate permitted off-site disposal facility).

6.4.11 Impact on Ecology, fauna and flora due to the seismic survey

Major source of impacts during seismic survey are due to:

- Loss of vegetation and clearing of land along seismic lines, base camp and fly camp site area, preparation of new tracks during seismic operation.
- Dust emission due to movement of vehicle and equipment and construction activities,
- Camp activities,
- Waste handling and storage.
- Noise from vehicle, machinery and various activities (blasting, drilling etc.).

Impacts on vegetation from dust emissions due to road travel and crew movement during seismic activities will be minimized through mitigation measures. Dust can accumulate on roadside vegetation, potentially affecting plant metabolism and growth, especially in arid zones with already stressed plant life. Sensitive areas such as Takkar Wildlife Sanctuary, Mehrano Refuge, and Khat Dhoru (wetland) sand dunes may be particularly vulnerable, where dust can hinder native plant health and affect species that rely on them.

While areas with active nesting, denning, or feeding will be avoided where possible, seismic activities require workforce movement which may disturb wildlife. Large animals may relocate, but smaller fauna like reptiles and ground-nesting birds may struggle to adapt. Noise and vibrations from seismic operations can indirectly affect vegetation by displacing pollinators and seed dispersers, contributing to habitat degradation and biodiversity shifts. In flood-prone areas and seasonal ponds, seismic activity may also alter natural water flows, impacting riparian and aquatic vegetation critical to local ecosystems.

Mammals

Though areas with dense vegetation will be avoided while clearing the seismic lines and operating the vibroseis truck, yet there will be some impact on the small mammals of the area, such as damage to their burrows and dens that may need protective measures. Project area has a number of mammalian species. Project impact on these species is expected to have considerably reduced significance, since large mammals will temporarily leave the specific area of the project activity, and will come back once the activity level decreases.

Birds

Birds, being highly mobile and therefore capable of avoiding project activity areas, are generally the least vulnerable species of wildlife to the long-term impacts of temporary activities that form part of seismic surveys. Two avian species, the Houbara bustard and the partridge are included in the project area's species of special significance. The Houbara bustard is a winter visitor, whereas the partridge is a resident of the area. Damage to vegetation, will also have adverse effects on the avian species of the area, particularly the

bustard, as it is dependent upon the vegetation for nesting and feeding. Although steering clear of large bushes and areas of dense vegetation will reduce the impact of the project on these avian species; there will nonetheless be some residual impact which may not be completely avoided.

Reptiles and Amphibians

The project activities' impacts on the reptiles and amphibians of the project area will be similar to those on the small mammals discussed earlier. The leveling and vibroseis truck operation may destroy the burrows of these animals. Though avoiding areas of dense vegetation will reduce this impact, yet a certain degree of residual effects is expected to persist over a period when the new generation attains maturity. However, in view of the subsistent population of these species in the area, the unmitigated residual impacts could be considered insignificant.

Small Mammals and Reptiles

It is expected that small mammals, mainly rodents and reptiles will displace from a corridor of 5-25 m (or more depending on the species and local conditions) along the access road and around the campsites. However, owing to the large and wide spread population size of these species and the large area otherwise available to them, no significant effect of the project on small mammals and reptiles will occur. Mortality of small mammals and reptiles during construction or due to road travel will be avoided by adopting mitigation measures.

Mitigation Measures

- Strict protocols for handling and storing hazardous materials to prevent spills and contamination will be developed and enforced.
- A habitat restoration plan will be implemented to rehabilitate disturbed areas, including planting native vegetation and creating artificial habitats if necessary.
- Sediment control measures such as fences, fiber rolls, and sediment basins will be installed where appropriate to prevent runoff into aquatic ecosystems.
- Buffer zones around wetlands and aquatic habitats will be established and enhanced with native vegetation to minimize construction impacts.
- Camp sites will be located away from reserve forest areas. No activities will occur within undisturbed reserve forests, and a minimum 500-meter buffer will be maintained.
- Access tracks will be used to avoid the need for new road construction.
- Environmental awareness training will be conducted for the contractor's management and field crew before beginning construction, especially regarding wildlife protection.
- Land uptake for camp sites and access roads will be minimized to reduce environmental disturbance.
- All EIA-recommended mitigation measures for noise, dust, air emissions, and waste management will be fully followed.
- Food waste will not be disposed of in open areas. It will be collected in waste segregation units and either buried or disposed of through certified waste contractors.

- In areas with small mammal and reptile populations, construction will start gradually (soft start-up) and will be monitored for wildlife disturbances.
- Vehicle speeds on access roads will be controlled and randomly checked to prevent wildlife collisions, particularly with reptiles.
- Vehicle speeds on access road will be controlled to avoid incidental mortalities of reptiles. Any such incident will be reported to the PPL HSE Advisor. Vehicle speeds will be monitored.
- Movement of all project personnel will be restricted to work areas.
- Campsites will be located preferably 500m from perennial water bodies.
- Night work will be prohibited; night traveling will not be allowed unless absolutely necessary.
- Prior to commencement of any exploration activity, awareness trainings will be provided to contractor's management and field crew on matters related to the requirements of the EMP in this regard.
- In the rainy season, vehicle movement should be reduced. Blockages in the flow of rain water in major canals should be removed to prevent flooding in the surrounding.
- The dens and burrows of wildlife should be protected and seismic survey should be conducted at safe distance from them.
- Maintain safe distance from the breeding locations of birds and mammals. The wildlife, especially their offspring should not be threatened.
- Sightings of wildlife in the project area should be reported.
- Wildlife may come in contact with the project personnel. They should not be chased or scared.
- Tree cutting will be avoided as much as possible. If necessary, approvals from the relevant government department will be obtained, and compensation will be paid to private landowners where applicable.
- The number, species, and location of any cut trees will be documented for environmental records.
- Personnel movement will be restricted to designated work areas, and project vehicles will be limited to approved access roads to avoid unnecessary habitat disturbance.
- Project activities will be restricted during critical breeding or migration periods of sensitive species in wildlife sanctuaries.
- In consultation with wildlife experts, artificial water points or shade areas may be provided temporarily if natural habitats near camps are disrupted.

6.4.12 Socioeconomic, cultural and archaeological environmental Impact

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 project is expected to generate significant socio-economic benefits for local communities, primarily through employment opportunities and broader economic development. However, potential archaeological impacts must be carefully considered, as the project area contains several sensitive heritage sites including tombs, graveyards, and mosques. Of particular concern are certain tombs that currently exist in fragile condition. Appropriate mitigation measures will be implemented to ensure these cultural heritage assets are protected throughout project implementation.

Sustenance income

The livelihood of local communities largely depends on agricultural, livestock farming and other land related activities. For the seismic operations land availability for the project needs to be ensured and therefore land for other purposes will not be available till the project completes. The land for the project has been leased as per Petroleum Concession Agreement (PCA), by Ministry of Energy (Petroleum Division).

Local Economy

- Increased turnover of local businesses and shops due to an increased demand from project contractors and their employees.
- An increase in the income of locals may occur due to employment in the projects.

Drinking water

- Sharing of limited local domestic water sources.

Employment

- Distribution of employment opportunities during project activities.

Health

- Effect on health of local communities due to project wastes and dust emissions

Safety and Security

- Potential risk for road accidents, conflicts with locals and safety of local employees

Mobility and transportation

- Ease/difficulty in mobility and transportation.

Sources of Income: Potential issues related to sustenance incomes have been assessed below:

Leasing of Agricultural Lands/Uptake of livestock grazing area/effect on mobility of livestock herds/potential for loss of livestock due to road accidents

The land for the project has been leased as per Petroleum Concession Agreement (PCA), by Ministry of Energy (Petroleum Division). The project area may cover livestock grazing areas. Compared to the total available grazing area, the uptake by the project will not be significant and will not have any measurable significant affect. Project vehicles will follow safe speed limits, especially on seeing a livestock herd near the road to avoid any road accidents.

Sharing of Water Source

As discussed earlier the project water usage will not affect the accessibility of locals to the water source in the long or short term as project's water demand is low. Water from local source will only be used after ensuring that the abstraction process will not result in any water shortages and get approval from concerned department.

Effects on Local Businesses

Local businesses (such as shops and tea stalls) will experience a rise in sales as junior level project staff and local employees will purchase items of general use from shops and will patronize local tea stalls and eateries on a regular basis. This will have a positive impact on the local businesses.

Employment

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. All unskilled and some semi-skilled workforce shall be hired equitably from within the local communities.

Safety and Security

The operations may affect the safety and security of the inhabitants of the areas in the following ways: issues of road safety, conflicts between residents and the construction contractors, safety and security issues pertaining to the carriage of fire arms on the site. Community sensitive project planning and implementation as prescribed through the recommended mitigation measures will minimize the occurrence of any such impacts.

Disturbance from Noise

The camps will be located preferably more than 500 m from communities. Seismic survey activities need to be carefully planned to avoid impact on local communities.

Mobility and Transportation

The project activities may affect mobility of local women. 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.

Community Grievances

Communities that are located close to the access road and seismic lines will be exposed to dust emissions, wastes from the labor camps, and any accidental 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.

Cultural and Religious Opportunities

Cultural sites in the form of shrines/ziarats, mosques and graveyards exist in the project area. Campsite(s) and access track shall be located at appropriate distances from such cultural sites to avoid any interruption in access of local communities to these sites.

Damage to cultural, archaeological or religious sites. In Gambat II block area there are some shrines, old graveyards and antiquities sites. Fort Kot Diji is an ancient site which was part of the Indus Valley Civilization,

Mitigation Measures

- Develop alternative access routes for the farmers workers to ensure they can continue their activities without interference from project operations.
- Commit to regular maintenance and repair of local roads to minimize damage from heavy project-related traffic.
- Implement traffic management strategies (where needed), including designated truck routes and restricted driving hours, to reduce safety hazards and privacy disruptions for local residents.
- Appoint a community liaison officer to keep residents informed about project activities, timelines, and any changes that may affect them.
- Install protective barriers around sensitive areas to prevent contamination from project activities.
- Local sources of drinking water will not be exploited without taking steps listed in water use mitigation measures,
- The access road will be watered regularly to minimize dust emissions (if required),
- Drivers will be trained in responsible and safe driving practices, a speed limit shall be set and maintained; in addition, vehicle logbooks will be maintained and inspected for compliance,
- Labor from local communities will be recruited equitably, avenues for conflict resolution will be open, and the employment procedures will be transparent,
- Use of local firewood for cooking by contractor staff to be prohibited,
- The vehicle speed for traveling along the access road will be limited,
- The campsite site and other sites for sensitive activities will be located at a safe distance from residential communities; thereby mitigating the effect of noise and emissions,
- Generators and vehicles will be regularly maintained to minimize emissions,
- Damage to any artifacts (if present) will be prohibited and any construction activities near these areas will be monitored by PPL,
- A safe distance will be maintained from sites of archaeological significance (if present),
- The road will be re-aligned to maintain safe distance from the edge of any graveyard (if found),
- All community grievances will be addressed and resolved accordingly,
- If any archeological site is discovered during the survey / construction, PPL shall be liable to halt all the work activities, demarcate the area & notify the department.

6.4.13 Fire Safety Measures

Fire safety at the seismic survey site involves the careful handling and secure storage of flammable materials such as dynamite and fuel. Firefighting equipment must be maintained at strategic locations, and regular fire drills should be conducted to ensure preparedness. All personnel must be trained in emergency response procedures, including handling accidental ignition during explosive operations. Clearly marked and unobstructed evacuation routes should be established to protect lives and property in the event of a fire.

Mitigation Measures;

- Ensure all fire safety measures comply with relevant NFPA standards, such as NFPA 10 for portable fire extinguishers, NFPA 30 for flammable and combustible liquids, and NFPA 72 for fire detection and alarm systems.
- Install fire detection and alarm systems in all critical areas. Conduct regular testing and maintenance as per NFPA 72.
- Equip the site with adequate firefighting equipment, including portable fire extinguishers, fire hoses, and water supply systems. Ensure the equipment is regularly inspected and maintained.
- Provide comprehensive fire safety training to all personnel, including the use of firefighting equipment and emergency evacuation procedures. Conduct regular fire drills.
- Conduct regular fire risk assessments to identify potential fire hazards and implement measures to mitigate these risks.

6.4.14 Occupational Health and Safety

According to the U.S. Bureau of Labor Statistics, in 2022, the oil and gas exploration industry reported an injury rate of 1.8 per 100 full-time workers and a fatality rate of 3.7 per 100,000 workers. While these figures span various industry operations, they underscore the inherent risks of seismic survey activities, reinforcing the need for stringent safety protocols to prevent accidents and fatalities.

Major hazards at seismic sites include slippery, uneven terrain that increases the risk of slips, trips, and falls. Handling explosives and chemicals poses serious health threats, while prolonged exposure to loud seismic equipment can lead to hearing damage and other health issues. Operating heavy machinery on rugged landscapes may result in equipment-related injuries. Repetitive tasks and heavy lifting can cause musculoskeletal disorders. Additionally, adverse weather—especially in high heat seasons, muddy or remote areas—can lead to hypothermia, heat stress, or general fatigue. The remoteness of many survey sites, far from medical facilities, further compounds the risks in case of emergencies.

Mitigation Measures;

- Provide proper closed footwear with anti-slip soles, conduct regular site inspections to address hazard. Use clear and visible signage to indicate wet or slippery areas. Implement temporary barriers and warning signs during wet conditions.
- Equip workers with appropriate PPE, train them on safe handling and storage practices, and ensure proper ventilation when using chemicals.
- Use hearing protection, implement a hearing conservation program with regular tests, and limit exposure to high-noise areas.
- Provide ergonomic tools and equipment, train workers on proper lifting techniques, and rotate tasks to minimize repetitive motion injuries. Provide training on proper lifting techniques and ergonomics to prevent musculoskeletal injuries. Include practical demonstrations and assessments.

- Ensure operators are trained and certified, conduct regular maintenance and safety checks, and maintain a safe distance policy for non-essential personnel.
- Provide weather-appropriate clothing and gear, set up shelters for extreme conditions, and monitor weather forecasts to adjust work schedules.
- Develop detailed emergency response plans for various scenarios, including medical emergencies and chemical spills. Conduct regular emergency response drills with all personnel to ensure readiness.
- Provide comprehensive training and conduct regular drills to ensure all personnel are prepared for emergencies, including first aid and evacuation procedures.

6.4.15 Site Restoration after Seismic activities

Site restoration is the process of returning the seismic survey site to its original or an improved condition after the completion of seismic activities. This includes the removal of all equipment, waste, and temporary structures, as well as the rehabilitation of any disturbed land and vegetation. The goal is to minimize the environmental footprint of the project, ensuring that the natural habitat is preserved and any negative impacts are mitigated.

The activities during site restoration will include:

- Demobilization of all equipment and machinery
- Disposal of any waste material remaining at the time of completion of the operation
- Backfilling of all soak pits and septic tanks
- Removal of fence or barriers surrounding the campsite area
- General restoration of the site area including landscaping and restoration of drainage where required

Mitigation Measures;

- All machinery, equipment, and temporary structures will be removed from the site, and equipment will be decontaminated before removal.
- All waste will be transported to appropriate disposal or recycling facilities, with waste segregated into hazardous and non-hazardous categories.
- Compacted soil will be aerated, and organic matter or soil conditioners will be applied to restore soil structure and fertility.
- Native vegetation will be replanted, erosion control measures such as mulching and planting cover crops will be implemented, and newly planted areas will be protected until vegetation is fully established.
- Altered drainage channels will be reconstructed, wetlands will be restored, artificial barriers to water flow will be removed, and water quality will be monitored.
- Wildlife corridors will be created, artificial habitats will be installed, and wildlife activity will be monitored to ensure effective habitat restoration. Regular site inspections will be conducted to adapt restoration strategies as needed, and local communities and stakeholders will be engaged in monitoring efforts.
- Seismic line restoration will include the removal of all cables, geophones, station units, flags, stakes, and waste materials from the lines, and all mud pits will be backfilled.

- All fencing or barriers surrounding the seismic and base camp area will be removed, and the area will be levelled. Concrete structures will be left intact if desired by the landowner; if not, the concrete will be broken up and either disposed of, reused for backfilling pits or septic tanks (below the main rooting zone, 1–1.5 meters), or provided to locals for reuse where appropriate.
- Wastewater from the septic tank will be removed, and the tank will be dismantled in place (top roof and at least 1 meter of the wall or more if feasible), followed by backfilling with at least 1 meter of native soil cover.
- The soak pit will be restored after wastewater removal or handling, and will be covered and backfilled with at least 1 meter of native soil.
- Contaminated bricks from black/grey water pits and other structures will not be given to locals for any purpose and will be handled as per hazardous waste protocols.

7.0 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

7.1 Introduction

This Environmental Management Plan (EMP) has been prepared to outline the environmental management strategies and mitigation measures required to minimize the potential adverse environmental impacts associated with the 2D and 3D seismic survey activities in the Gambat-II Block, conducted by Pakistan Petroleum Limited (PPL) & their contractors. The EMP serves as a comprehensive guide to ensure that all activities are carried out in an environmentally responsible manner, adhering to local and international standards.

7.2 Purpose of EMP

PPL has committed to implementing a comprehensive EMP to help ensure the environmental protection.

The purpose of EMP is to:

- Clearly define the roles and responsibilities of all stakeholders involved in the project.
- Outline precise procedures and actions required to mitigate identified environmental impacts.
- Provide a framework for monitoring and reporting environmental performance.
- Ensure compliance with relevant environmental laws and regulations.
- Facilitate effective communication and documentation of all environmental management activities.

7.3 Structure of EMP

7.3.1 Environmental Management Framework

Given the nature and scale of the proposed seismic survey activities, several environmental risks are inherent to the project. To mitigate these risks to the lowest practicable level, control measures have been adopted. PPL is committed to conducting its field activities in a manner that either eliminates or minimizes these risks to the greatest extent possible.

The environmental management of the project will be executed within a comprehensive framework that includes:

PPL's Health, Safety, and Environmental Policy Statement: This policy outlines PPL's commitment to maintaining high standards of health, safety, and environmental protection in all its operations.

Operational Controls and Specific Environmental Procedures: The EMP includes detailed operational controls and procedures designed to address specific environmental aspects of

the project. These controls and procedures are tailored to manage and mitigate identified risks effectively.

Implementation of Environmental Management and Monitoring Plan: Comprehensive plan for ongoing environmental management and monitoring will be implemented. This plan includes regular assessments and audits to ensure compliance with environmental standards and the effectiveness of mitigation measures.

7.4 Organizational Structure

The proposed project encompasses the following key organizations;

- Pakistan Petroleum Limited (PPL)
- Contractors and Sub-contractors
- Sindh Environmental Protection Agency (SEPA)

7.5 Pakistan Petroleum Limited

For the proposed project, PPL will appoint seismic 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 PPL. Overall responsibility for the implementation of EMP will rest with PPL concerned Departmental Head (i.e., Exploration departments at the Head Office include):

The responsibilities of PPL's 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 which includes notification of the environmental objectives;
- 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 the project activities.
- Take update from HSE representative on compliance status with EMP requirements during construction and operation phases and involve HSE representative in decision making regarding the HSE matters and implementation of EMP.

7.6 Contractors & Subcontractors

Contractor(s) will bear the primary responsibility for the implementation and adherence to all provisions of the Environmental Impact assessment (EIA) and the EMP, along with any environmental and other codes of conduct mandated by PPL. The Site Manager of the contractor(s) will ensure the effective implementation of the EIA and EMP requirements. However, the overall responsibility for the implementation of the EIA and EMP resides with PPL's Exploration Department. Key responsibilities include:

- Execute project activities in an environmentally responsible manner.
- Coordinate with the Health, Safety, and Environmental (HSE) officer to address issues during project execution.
- Manage construction teams to minimize environmental impacts.
- Appoint dedicated HSE officers to better manage and address environmental concerns.
- Review weekly progress reports with management, focusing on environmental management issues.

7.7 Sindh Environmental Protection Agency

The Sindh Environmental Protection Agency (EPA) acts as the regulatory authority ensuring that the project complies with rules and regulations define under the Sindh Environmental Protection Act, 2014. The Sindh EPA has the authority to conduct surprise inspections or site visits to monitor environmental compliance.

7.8 Implementation of Environmental Management Plan

The implementation of EMP will be the responsibility of PPL's management, supervisory staff and operations staff etc. and will be implemented during the seismic activities. The information to be included regarding EMP would be risk assessment, environmental management plans, environmental management activities and controls and environmental schedules.

7.8.1 Approvals

Obtaining Environmental Approval from EPA does not relieve the proponent of other obligations and hence PPL's Seismic Contractor (SC) will obtain all relevant clearances and necessary approvals required by the government prior to commencing the operations.

7.8.2 Contractual Provisions

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

7.8.3 Training

Comprehensive training programs are essential to ensure that all personnel involved in the seismic 2D and 3D survey activities are fully aware of their environmental responsibilities and the specific requirements of the Environmental Impact Assessment (EIA) and the Environmental Management Plan (EMP). Training will be tailored to address the unique challenges and risks associated with seismic survey operations and will include the following key components:

Environmental Awareness and Responsibilities

Training sessions will focus on raising awareness about the environmental impacts of seismic survey activities and the importance of adhering to the EMP and EIA. Personnel

will be educated on the broader environmental context, including the sensitivity of the coastal and marshy areas within the project site.

Specific Mitigation Measures and Monitoring Procedures

Personnel will receive detailed instructions on the specific mitigation measures outlined in the EMP. This includes training on operational controls, waste management protocols, and mitigation outlined in the EMP for the adverse effect on surroundings. Monitoring techniques will be covered to ensure that all staff can effectively contribute to environmental monitoring efforts.

Trainings identified in EMP are given below:

- Site orientation course
- Training for emergency response and preparedness
- Training for awareness of significance of the Wildlife Sanctuary, Flora and fauna there
- Training for familiarization with site environmental controls.
- Specific environmental training for relevant employees e.g. installing erosion and sedimentation controls, daily checks to maintain controls, cleaning up spills, waste minimization etc.
- A firefighting system shall be installed at camp site, 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, hospital 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.

7.9 Emergency Response Plan and Spill Management

The Emergency Response Plan (ERP) is crucial for ensuring quick and effective action in the event of unexpected incidents during seismic survey activities. Proper contingency planning is essential to mitigate the risks of uncontrolled material leaks, fires, explosions, occupational accidents, environmental contamination, natural disasters, and external threats such as terrorism or vandalism. Without a robust ERP, delayed or inadequate responses can result in significant environmental damage and threats to public safety.

Given the potential risks associated with proposed project activities, training will emphasize emergency response procedures.

This includes:

Detailed training on handling spills of hazardous materials, including the use of spill kits and containment strategies.

- Procedures for safe and efficient evacuation in case of natural emergencies such as flood and tornadoes.

- Basic first aid training to equip personnel with the skills to manage injuries until professional medical help arrives.

Health and Safety Practices

Ensuring the health and safety of all personnel is paramount. Training will cover:

- Personal Protective Equipment (PPE): Proper use and maintenance of PPE to protect against occupational hazards.
- Safe Handling of Equipment: Procedures for the safe operation of seismic survey equipment, including dynamite and air guns.
- Workplace Ergonomics: Best practices to prevent musculoskeletal injuries from repetitive tasks and heavy lifting.

Wildlife and Habitat Protection

Given the proximity to sensitive ecological areas, training will include guidelines for minimizing disturbance to local wildlife and habitats. This will cover:

- Behavioral Protocols: Instructions on avoiding interference with wildlife and respecting designated buffer zones.
- Reporting Procedures: How to report any encounters with wildlife or environmental incidents promptly.

Induction Training and Orientation

Before commencing work, all personnel will undergo induction training to familiarize them with the project's environmental objectives and specific requirements. This will include:

- Project Overview: Introduction to the project scope, objectives, and key environmental considerations.
- Site-Specific Training: Detailed orientation about the specific environmental and safety procedures relevant to the project site.
- Roles and Responsibilities: Clarification of individual roles and responsibilities regarding environmental management.

Operational and Natural Risks

Key operational risks include uncontrolled material leaks, fires, explosions, and occupational accidents resulting from non-compliance with safety protocols or equipment failures. Natural risks such as earthquakes, typhoons, and lightning can also impact the site, causing damage to property and posing safety threats to personnel. External risks, including vandalism or terrorism, necessitate stringent security measures and coordination with local law enforcement.

Response Procedures and Communication:

The ERP outlines specific procedures for different types of emergencies. This includes containment and cleanup of spills, firefighting measures, first aid for injuries, and

evacuation plans for natural disasters. Effective communication protocols ensure that all personnel are promptly informed and can respond efficiently. Regular training and emergency drills are conducted to ensure readiness and compliance with safety standards.

7.9.1 Minimum Distances

The EIA specifies minimum distances to be maintained from environmental features including communities, water sources, wildlife sensitive areas and archaeological / cultural / religious sites etc. These minimum distances are provided in the Environmental Management and Monitoring Plan. PPL and the contractors will ensure that these minimum distances are adhered to during the execution of the project. Highlighting the minimum distances of the seismic activities from various environmental features in the project area is shown Table 7.1 (a) and (b).

Table 7.1 (a): Minimum Distance from Sensitive Receptors

Item	Distance
New Access Tracks	50 m from all surface water sources 100 m from archeological significant and cultural sites (including graveyard, religious sites and shrine) 100 m from villages (if and where possible)
Campsite	Preferably 500 m from villages/town/city Preferably 300 m from dhands and canals
Up-holes	30 m from water wells 50 m from houses (including mud houses and huts etc.) 50 m from permanent surface water bodies e.g. dhands 50 m from reptile hole/nest/den 100 m from tank/dug well. Hand pumps 50 m from archeological significant and cultural sites (including graveyards, religious sites and shrines)
Shot holes	50 m from water wells 50 m from houses 100 m from tank/dug well. Hand pumps 50 m from archeologically significant and cultural sites (including graveyards, religious sites and shrines)
Note: Shot holes / Upholes should be properly packed after inserting the dynamite to prevent blowout after detonation.	

Table 7.1 (b) Minimum distance of area / facility with sensitive receptor

Area / Facility	Distance (m)		
	Settlement	Community water well	Archaeological / cultural site
Construction camp	500	300	300
Soak pits	Not applicable	- Should not be less than 100 m from surface/ groundwater resources. - A separate assessment is required if it builds within 100 – 300m from ground / surface water resources - Ideal location if it builds more than 300 m away from ground/ surface water resources.	Not applicable

7.9.2 Monitoring

PPL and the contractors will ensure that monitoring of the project activities is carried out according to the monitoring plan given in the EMP throughout the project. A tentative frequency of monitoring mitigation measures during seismic operations is provided in Table below.

Table 7.2: A tentative frequency of monitoring mitigation measures during operations

Item	Frequency
Line Inspection	Prior to start work on any seismic line
Access track inspection	Prior to start work on any access track development
Camp construction	At the time of camp construction
Waste disposal along access tracks and survey lines	Daily during routine field visits
Water use	Once every week
Recycling contractors	At the time of approval and then once during the operation
Access tracks and road travel	Daily during routine field visits

Preparation of survey lines	During survey of seismic lines
Shot holes/ up holes drilling shooting and recording	On a routine basis on selected seismic lines
Vehicles- camp inspection	Twice a week as a minimum
Handling of fuels, oils and chemicals	Once during camp construction Twice a week during camp operation
General controls	Daily during routine field visits
Restoration	During restoration

7.9.3 Communication and Documentation

PPL and the contractors will ensure that the communication and documentation requirements specified in the EMP are fulfilled during the operations.

7.9.4 Decommissioning and Site Restoration

PPL will be responsible for the decommissioning / dismantling and final site restoration of work areas according to the requirements of the EIA.

7.10 Mitigation Management Matrix

The Mitigation Management Matrix in Table 7.3 outlines the specific mitigation measures for the 2D and 3D seismic activities in the Gambat-II Block. This matrix will serve as a crucial management and monitoring tool for ensuring the effective implementation of these mitigation measures. While individual responsibilities for executing and monitoring these measures are delegated to specific personnel, the primary and overall responsibility for ensuring full compliance with the Environmental Management Plan (EMP) resides with PPL and they will oversee all activities to guarantee that environmental standards are consistently met throughout the project's duration.

- The mitigation measures recommended in the EIA.
- The person/organization directly responsible for adhering to or executing the required mitigation measures.
- The parameters, which will be monitored to ensure compliance with the mitigation measures.
- The timing at which the mitigation or monitoring has to be carried out. Table 7.3-7.5 show the mitigation management matrix for seismic operation. It is highlighted that although responsibilities for executing and monitoring mitigation measures have been delegated to different persons/organizations, PPL will hold the primary and overall responsibility for ensuring full implementation of the EMP.

Table 7.3: Mitigation Matrix for Seismic Activities

No.	Mitigation Measures	Execution	Monitoring	Action	Timing
1. Landscape and Soil Erosion					
1.1	Land surveying techniques will be employed to map sensitive areas, and access routes will be planned to avoid these zones.	SC	PPL	Review survey maps and access route plans	Before seismic operations
1.2	Existing roads and pathways will be used wherever possible to minimize land disturbance and prevent unnecessary soil compaction.	SC	PPL	Verify access route selection	Before seismic operations
1.3	Camps will be constructed on existing flat land to minimize soil disturbance.	SC	PPL	Inspect camp layout and land conditions	Before camp construction
1.4	Access tracks, including those used by tankers and trucks, will be monitored and maintained. The width of new or improved access tracks will be limited to 9–10 meters.	SC	PPL	Measure track width and assess condition	During construction and operations
1.5	The access track will be properly compacted during construction and maintained through watering and compaction as needed.	SC	PPL	Inspect track surface regularly	During construction and seismic activities
1.6	Areas along access tracks and campsites will be visually monitored.	SC	PPL	Conduct regular site inspections	During entire operation
1.7	Sections showing signs of erosion will be stabilized through watering and compaction.	SC	PPL	Implement stabilization measures immediately	As soon as erosion is observed
1.8	Improvement or construction of stream crossings will ensure proper slope adjustment and compaction for a stabilized and sealed surface.	SC	PPL	Inspect crossings and verify compaction	During the project activities
1.9	Dumping of gravel on or near active construction access tracks will not be allowed.	SC	PPL	Conduct spot checks and enforce restrictions	Throughout the project activities
1.10	Erosion control measures, such as geotextiles, ripraps, and retaining walls, will be implemented in high-risk areas.	SC	PPL	Verify installation of erosion controls	During the project activities
1.11	Soil conservation techniques, including contour plowing and terracing, will be applied on slopes. Vegetation clearing will be minimized, and tree cutting will be avoided.	SC	PPL	Monitor slope treatment and vegetation management	During site preparation
1.12	Seismic lines in undulating areas will follow natural contours where possible. Where line cutting is necessary, it will be done with minimal disturbance to the terrain.	SC	PPL	Check seismic line routes against topography	During seismic line planning and cutting

Table 7.3: Mitigation Matrix for Seismic Activities

No.	Mitigation Measures	Execution	Monitoring	Action	Timing
1.13	Photographic documentation will be used to monitor soil conditions throughout project activities.	SC	PPL	Collect and archive geo-tagged images periodically	During entire operation
1.14	Septic tanks and soak pits will be constructed for black and grey water disposal, provided the groundwater table is at least 4 feet below the bottom of the soak pit.	SC	PPL	Verify groundwater depth before construction	Before camp setup
1.15	Septic tanks will be of sufficient capacity, constructed from concrete with inlet/outlet baffles to prevent infiltration. A two-pipe system will be used for black and grey water separation.	SC	PPL	Check design specifications and inspect construction	Before and during construction
1.16	Soak pits will be located at least 300 meters from local water sources.	SC	PPL	Measure distance from water sources	Prior to construction
1.17	Sprinkling of sewage is prohibited. If a soak pit is filled, a new one will be prepared, or excess wastewater will be directed to the nearest municipal drain.	SC	PPL	Monitor soak pit levels and arrange alternate disposal if needed	During entire operation
1.18	Grey water may be sprinkled only if it meets SEQS limits.	SC	PPL	Test grey water quality and approve before sprinkling	During operation
1.19	Septic tanks and soak pits will be restored after use by backfilling with at least one meter of soil cover. Concrete structures may be broken and buried below the rooting zone (1–1.5 meters).	SC	PPL	Supervise backfilling and verify depth	During site restoration
1.20	Contaminated bricks and materials from black/grey water facilities will be removed from the site and not distributed locally for reuse.	SC	PPL	Ensure proper waste disposal through certified contractor	During decommissioning
1.21	Vehicle speeds will be regulated and monitored to avoid excessive dust emissions.	SC	PPL	Set and enforce speed limits; conduct random checks	Throughout the entire operation
1.22	Off-road travel should be avoided as much as possible and observance of this should be monitored during the operation.	SC	PPL	Conduct spot checks and provide corrective instructions	During seismic activities
1.23	Periodic trainings will be provided to drivers on mitigation measures related to off-road travel and speeds limits.	SC	PPL	Organize training sessions and maintain attendance records	Before and during seismic operations

Table 7.3: Mitigation Matrix for Seismic Activities

No.	Mitigation Measures	Execution	Monitoring	Action	Timing
1.24	Movement of equipment will be restricted to work areas only to avoid unnecessary disturbance to soils in the project area.	SC	PPL	Monitor equipment routes and enforce access control	Throughout the operation
2. Soil and Water Contamination					
2.1	A comprehensive spill prevention and response plan will be developed, detailing hazardous waste storage, spill prevention protocols, response actions by waste type, training requirements, response equipment, and official notification procedures.	SC	PPL	Review and approve plan; ensure training materials are prepared	Before camp setup
2.2	All personnel will undergo regular training and spill response drills	SC	PPL	Conduct training sessions and record participation	Before and during operation
2.3	Fuel and chemical storage areas will include secondary containment of at least 110% of the largest tank capacity. These will be made of concrete, brick masonry bunds, or HDPE-lined systems with sump pits to collect spills.	SC	PPL	Inspect containment systems during construction and after setup	During camp setup
2.4	Spill detection systems will be installed in all hazardous material storage areas.	SC	PPL	Check installation and functionality	Inventory spill kits at regular intervals
2.5	Absorbent materials, shovels, and plastic bags will be available at all handling sites to manage spills.	SC	PPL	Inventory spill kits at regular intervals	Before and throughout operation
2.6	Soak pits will be built in absorbent soil and located 300 m away from a surface water source or ground water well.	SC	PPL	Verify location and soil type prior to construction	Initial phase of the project
2.7	Soak pits will be constructed such that surface runoff cannot enter into the pits.	SC	PPL	Inspect berms, slopes and diversion structures	During and after project activities
2.8	Soak pits will be designed to accommodate wastewater generated during the total duration of the operation.	SC	PPL	Review capacity and usage plan	Prior to operation
2.9	All spills will be immediately contained and neutralized using appropriate agents.	SC	PPL	Maintain records of all spill incidents and response actions	Throughout the operation
2.11	Soil remediation methods such as bioremediation or soil washing will be employed.	SC	PPL	Engage environmental specialists and verify site condition post-remediation	As needed after contamination is detected

Table 7.3: Mitigation Matrix for Seismic Activities

No.	Mitigation Measures	Execution	Monitoring	Action	Timing
2.12	Contaminated soil will be collected and disposed of through SEPA-approved waste contractors	SC	PPL	Verify waste contractor approval and monitor disposal	During and post-operation
2.13	A contingency plan should be in place for moderate to major spills.	SC	PPL	Develop and review contingency plan, ensure awareness among staff	Before operation and reviewed periodically
2.14	Fuel and oil storage tanks will be clearly labeled, inspected daily, and repaired immediately in case of leaks.	SC	PPL	Conduct daily inspections, repair immediately if leaks are detected	Daily, throughout operation
2.15	Fuel storage is a temporary activity and will be dismantled post-construction or seismic work.	SC	PPL	Ensure fuel storage is removed after project completion	Post-seismic work
2.16	Fuel transfer (e.g., to bulldozers) will use drip pans to prevent spills.	SC	PPL	Monitor for use of drip pans and inspect fuel transfer areas	Ongoing during fuel transfer activities
2.17	Vehicles will be inspected daily for leaks and removed from service until fixed if leaks are detected.	SC	PPL	Inspect vehicles daily and maintain log of inspections	Daily, throughout operation
2.18	Vehicle servicing and washing will be carried out only in designated, concrete-paved areas within campsites.	SC	PPL	Designate, inspect and monitor servicing areas	Ongoing throughout operation
2.19	Bentonite mud (for drilling for seismic) will be prepared in earthen pits. Used mud will be dried in the same pit and then backfilled with a 1m soil cover.	SC	PPL	Inspect pit construction and ensure correct disposal process	During project
2.20	Sensitive zones (e.g., Takkar Wildlife Sanctuary, Mehrano wildlife refuge and Khat Dhoro) should have additional geotextile barriers installed beneath mud pits to prevent seepage into soil and groundwater.	SC	PPL	Check installation of geotextile barriers and monitor for seepage	During project

Table 7.3: Mitigation Matrix for Seismic Activities

No.	Mitigation Measures	Execution	Monitoring	Action	Timing
2.21	Used oil will be provided to OGRA-licensed oil reclamation plants or disposed of through SEPA-certified waste contractors.	SC	PPL	Maintain documentation and monitor oil handover/disposal	During and after vehicle/equipment servicing
2.22	Waste from vehicle maintenance will be handed over to approved recycling/disposal contractors.	SC	PPL	Log and verify contractor certifications	As waste is generated
2.24	Food waste will be buried onsite or handed over to a certified contractor; open disposal is prohibited.	SC	PPL	Monitor disposal practices and contractor use	Daily
2.25	Combustible packaging waste without reuse will be stored in designated areas and disposed of through certified contractors.	SC	PPL	Inspect storage areas and disposal logs	Weekly
2.26	Recyclable materials like glass, tin, and metal will be sent to recycling contractors.	SC	PPL	Track quantities and contractor details	Ongoing
2.27	Medical waste will be stored separately and incinerated through SEPA-approved contractors.	SC	PPL	Segregate, label, and record waste transfer	As generated
2.28	Septic tank systems with soak pits will be used for sewage disposal. Soak pits will be built in absorbent soils, away from water bodies, and designed for total wastewater volume.	SC	PPL	Inspect construction and monitor for overflows	Before and during use
2.29	Buffer zones of native vegetation will be established around soak pits to naturally filter potential contaminants.	SC	PPL	Ensure planting and maintenance of buffer zones	Early project phase
2.30	Runoff from campsites will be controlled to prevent contamination of nearby water bodies.	SC	PPL	Inspect runoff channels and install diversion measures	During construction and camp operations
2.31	If soak pits are filled, greywater (meeting SEQS standards) may be sprinkled on access tracks, avoiding water accumulation.	SC	PPL	Test greywater quality; monitor sprinkling practices	As required
2.32	Sewage generated at the campsites will be disposed of in septic tanks and soak pits.	SC	PPL	Routine inspection of sewage systems	Continuous
2.33	Sprinkling of sewage is strictly prohibited. Excess sewage will be sent to municipal drains with written approval and SEQS compliance.	SC	PPL	Monitor compliance and maintain records of approvals	If/when soak pits are full

Table 7.3: Mitigation Matrix for Seismic Activities

No.	Mitigation Measures	Execution	Monitoring	Action	Timing
2.34	Regular environmental monitoring will be conducted in high-risk zones to detect early signs of soil or water contamination. Reports will be reviewed monthly to inform adaptive management strategies.	SC	PPL	Conduct sampling and analysis; update plans based on reports	Monthly
2.35	During fuel and oil transfer operations such as re-fueling vibroseis/bulldozers through a dedicated fuel vehicle, drips and spills will be avoided and drip pans will be used.	SC	PPL	Train personnel and monitor fuel transfers	Ongoing during refueling
3. Climate & Ambient Air Quality					
3.1	All generators, compressors, vehicles, and other equipment used during seismic activities will be well-maintained to minimize emissions and ensure compliance with SEQS standards.	SC	PPL	Check maintenance logs	During the entire operation
3.2	Emission control devices will be required on seismic activity and construction equipment, and the use of low-sulfur fuels will be mandated to reduce air pollutants.	SC	PPL	Inspect fuel sources and equipment installations	Pre-operation and ongoing
3.3	Vehicles will be restricted, and route optimization protocols will be implemented to reduce fuel consumption and associated emissions.	SC	PPL	Post signage and monitor driver compliance	Throughout seismic activities
3.4	Vehicle speeds will be strictly regulated and monitored on-site and on access roads to control dust generation.	SC	PPL	Enforce speed limits with spot checks	Daily
3.5	Dust suppression techniques (e.g., regular water spraying) will be used on unpaved and unvegetated surfaces, particularly during activities such as clearing, excavation, grading, backfilling, and blasting.	SC	PPL	Schedule water spraying and adjust based on weather	During dry and high-activity periods
3.6	Water mist cannons and sprinklers will be installed and used on dusty work areas and roads as needed.	SC	PPL	Operate based on visible dust and work intensity	As needed
3.7	Only treated or non-potable water will be used for dust suppression to avoid depletion of community water sources.	SC	PPL	Ensure sourcing documentation and water quality checks	Ongoing
3.8	Construction materials and stockpiled soil will be covered to prevent fugitive dust emissions.	SC	PPL	Use tarps or enclosures; inspect during wind events	During storage and high wind periods

Table 7.3: Mitigation Matrix for Seismic Activities					
No.	Mitigation Measures	Execution	Monitoring	Action	Timing
3.9	Soil loads in dump trucks will be kept below the truck's freeboard, kept moist if dusty, covered with tarpaulins, and minimized in drop height when loaded.	SC	PPL	Conduct loading area inspections	Daily during hauling
3.10	Leveling and widening of access roads will be followed immediately by watering and, where needed, compaction to control dust.	SC	PPL	Coordinate with construction schedule	Immediately post-leveling
3.11	Sensitive wildlife areas will be buffered by vegetation belts or natural screens where possible to trap dust and reduce airborne particulates.	SC	PPL	Identify and map buffer areas; monitor effectiveness	Before and during operations
3.12	Campsites will be located at least 500 meters from communities to reduce exposure to dust and emissions.	SC	PPL	Confirm camp placement on GIS maps	During site planning
3.13	The area of vegetation clearance will be minimized to limit surface exposure and dust generation.	SC	PPL	Define clearance zones and monitor with aerial images	Planning and implementation stages
3.14	Open burning of waste and combustible materials at the project site is strictly prohibited.	SC	PPL	Enforce through supervision and penalties	At all times
3.15	Workers will be trained on proper handling of construction materials and debris during construction and dismantling phases to minimize fugitive emissions.	SC	PPL	Conduct toolbox talks and refresher training	Prior to and during project phases
3.16	Ambient air quality and emissions from point sources will be monitored regularly to ensure compliance with SEQS.	SC	PPL	Set up air quality monitoring stations; log and review data	Monthly or as prescribed by regulations
3.17	Adaptive management strategies (e.g., temporary activity halts or rerouting) should be implemented when pollutant levels exceed threshold values in critical habitats.	SC	PPL	Monitor air quality data and review against SEQS thresholds; coordinate with ecological experts	As needed based on air quality monitoring results
4. Noise Pollution					
4.1	Generators, vehicles, machinery, and other equipment will be well-maintained to minimize noise emissions.	SC	PPL	Monitor noise levels	During the entire operation
4.2	All equipment will be fitted with sound-control devices and, where feasible, placed within acoustic enclosures or shelters to reduce sound propagation.	SC	PPL	Check distances from communities	Prior to construction of camps

Table 7.3: Mitigation Matrix for Seismic Activities

No.	Mitigation Measures	Execution	Monitoring	Action	Timing
4.3	Stationary noise-generating equipment (e.g., pumps, generators) will be positioned as far as possible from communities and other sensitive receptors.	SC	PPL	Train drivers, inspect equipment, record non-compliances	During the entire operation
4.4	Pressure horns will be strictly prohibited, and the use of vehicle horns will be minimized.	SC	PPL	Enforce compliance through site rules	During the entire operation
4.5	Temporary and permanent noise barriers will be erected using materials with high sound absorption properties, especially around high-noise equipment and along site perimeters.	SC	PPL	Monitor installation and effectiveness	During the entire operation
4.6	Bubble curtains will be used during underwater seismic activities to protect marine life from noise pollution.	SC	PPL	Inspect deployment records	During underwater operations
4.7	High-noise activities will be scheduled during late mornings or early afternoons, when they are least likely to disturb nearby communities or wildlife.	SC	PPL	Align scheduling with noise plan	During seismic works
4.8	In wildlife zones, high-noise activities will be avoided during early mornings and dusk to prevent disruption of peak activity periods for birds and nocturnal mammals.	SC	PPL	Coordinate with wildlife specialists	During operations in wildlife zones
4.9	Where feasible, combine multiple noisy activities (e.g., excavation and earthmoving) into single periods to reduce frequency and duration of noise events.	SC	PPL	Update daily work plans	Ongoing
4.10	Heavy truck traffic will be routed away from residential areas and sensitive receptors.	SC	PPL	Review traffic routes and maps	Daily
4.11	Movement of project vehicles and personnel will be restricted to designated work areas.	SC	PPL	Enforce and monitor access	Always
4.12	Maintain a buffer distance of at least 500 meters between campsites and nearby communities.	SC	PPL	Verify during site selection	Before construction
4.13	Engage with local communities to communicate construction schedules and noise mitigation plans.	SC	PPL	Conduct outreach meetings	Before and during activities
4.14	Implement wildlife protection measures, including the creation of quiet zones and avoiding protected areas and critical habitats during sensitive periods.	SC	PPL	Install signs and restrict access	During seismic activities

Table 7.3: Mitigation Matrix for Seismic Activities

No.	Mitigation Measures	Execution	Monitoring	Action	Timing
4.15	Timing of seismic operations will be coordinated with wildlife experts to avoid breeding, nesting, and migratory seasons for key species.	SC	PPL	Review biodiversity calendar	Pre-operation and ongoing
4.16	Noise monitoring equipment will be deployed to regularly assess levels and ensure compliance with SEQS or other applicable standards.	SC	PPL	Review logs and reports	Monthly
4.17	Workers exposed to high noise levels will be provided with personal protective equipment (PPE) such as earplugs and earmuffs, and clear communication protocols will be enforced to mitigate noise interference.	SC	PPL	Track distribution and training	Throughout project
5. Socioeconomic, cultural and archaeological environmental Impact					
5.1	Develop alternative access routes for the farmers workers to ensure they can continue their activities without interference from project operations.	SC	PPL	Maintain register of access complaints	During entire operation
5.2	Commit to regular maintenance and repair of local roads to minimize damage from heavy project-related traffic.	SC	PPL	Track repairs and grievance logs	Ongoing
5.3	Implement traffic management strategies, including designated truck routes and restricted driving hours, to reduce safety hazards and privacy disruptions for local residents.	SC	PPL	Review route plans and logs	Throughout operation
5.4	Appoint a community liaison officer to keep residents informed about project activities, timelines, and any changes that may affect them.	SC	PPL	Maintain outreach records	Prior to operation
5.5	Install protective barriers around sensitive areas to prevent contamination from project activities.	SC	PPL	Inspect placement and integrity	During operation
5.6	Local sources of drinking water will not be exploited without taking steps listed in water use mitigation measures,	SC	PPL	Monitor water source logs	Ongoing
5.7	The access road will be watered regularly to minimize dust emissions (if required),	SC	PPL	Monitor weather and apply as needed	Dry/windy days
5.8	Drivers will be trained in responsible and safe driving practices, a speed limit shall be set and maintained; in	SC	PPL	Check logs, issue IDP cards	Throughout operation

Table 7.3: Mitigation Matrix for Seismic Activities

No.	Mitigation Measures	Execution	Monitoring	Action	Timing
	addition, vehicle logbooks will be maintained and inspected for compliance,				
5.9	Labor from local communities will be recruited equitably, avenues for conflict resolution will be open, and the employment procedures will be transparent,	SC	PPL	Check employment and complaint records	Continuous
5.10	Use of local firewood for cooking by contractor staff to be prohibited,	SC	PPL	Conduct surprise inspections	Continuous
5.11	The vehicle speed for traveling along the access road will be limited,	SC	PPL	Enforce with speed guns/signs	Daily
5.12	The campsite site and other sites for sensitive activities will be located at a safe distance from residential communities; thereby mitigating the effect of noise and emissions,	SC	PPL	GIS mapping and field verification	Planning stage
5.13	Generators and vehicles will be regularly maintained to minimize emissions,	SC	PPL	Schedule maintenance	Ongoing
5.14	Damage to any artifacts (if present) will be prohibited and any construction activities near these areas will be monitored by PPL,	SC	PPL	Conduct site inspections	Always
5.15	A safe distance will be maintained from sites of archaeological significance (if present),	SC	PPL	GPS-check positioning	Pre-construction
5.16	The road will be re-aligned to maintain safe distance from the edge of any graveyard (if found),	SC	PPL	Field inspections	Before construction
5.17	All community grievances will be addressed and resolved accordingly,	SC	PPL	Review grievance redress mechanism	Throughout
5.18	If any archeological site is discovered during the survey / construction, PPL shall be liable to halt all the work activities, demarcate the area & notify the department.	SC	PPL	Notify dept. and document incident	Immediately upon discovery
5.19	Develop alternative access routes for the farmers workers to ensure they can continue their activities without interference from project operations.	SC	PPL	Field check with GPS	Pre-survey and during ops
5.20	Commit to regular maintenance and repair of local roads to minimize damage from heavy project-related traffic.	SC	PPL	GIS validation and field check	Planning stage

Table 7.3: Mitigation Matrix for Seismic Activities

No.	Mitigation Measures	Execution	Monitoring	Action	Timing
5.21	Implement traffic management strategies, including designated truck routes and restricted driving hours, to reduce safety hazards and privacy disruptions for local residents.	SC	PPL	Maintain register of access complaints	During entire operation
5.22	Appoint a community liaison officer to keep residents informed about project activities, timelines, and any changes that may affect them.	SC	PPL	Track repairs and grievance logs	Ongoing
5.23	Install protective barriers around sensitive areas to prevent contamination from project activities.	SC	PPL	Review route plans and logs	Throughout operation
5.24	Local sources of drinking water will not be exploited without taking steps listed in water use mitigation measures,	SC	PPL	Maintain outreach records	Prior to operation
5.25	The access road will be watered regularly to minimize dust emissions (if required),	SC	PPL	Inspect placement and integrity	During operation
5.26	Drivers will be trained in responsible and safe driving practices, a speed limit shall be set and maintained; in addition, vehicle logbooks will be maintained and inspected for compliance,	SC	PPL	Monitor water source logs	Ongoing
5.27	Labor from local communities will be recruited equitably, avenues for conflict resolution will be open, and the employment procedures will be transparent,	SC	PPL	Monitor weather and apply as needed	Dry/windy days
5.28	Use of local firewood for cooking by contractor staff to be prohibited,	SC	PPL	Check logs, issue IDP cards	Throughout operation
5.29	The vehicle speed for traveling along the access road will be limited,	SC	PPL	Check employment and complaint records	Continuous
5.30	The campsite site and other sites for sensitive activities will be located at a safe distance from residential communities; thereby mitigating the effect of noise and emissions,	SC	PPL	Conduct surprise inspections	Continuous
5.31	Generators and vehicles will be regularly maintained to minimize emissions,	SC	PPL	Enforce with speed guns/signs	Daily
5.32	Damage to any artifacts (if present) will be prohibited and any construction activities near these areas will be monitored by PPL,	SC	PPL	GIS mapping and field verification	Planning stage

Table 7.3: Mitigation Matrix for Seismic Activities

No.	Mitigation Measures	Execution	Monitoring	Action	Timing
5.33	A safe distance will be maintained from sites of archaeological significance (if present),	SC	PPL	Schedule maintenance	Ongoing
5.34	The road will be re-aligned to maintain safe distance from the edge of any graveyard (if found),	SC	PPL	Conduct site inspections	Always
5.35	All community grievances will be addressed and resolved accordingly,	SC	PPL	GPS-check positioning	Pre-construction
5.36	If any archeological site is discovered during the survey / construction, PPL shall be liable to halt all the work activities, demarcate the area & notify the department.	SC	PPL	Field inspections	Before construction
5.47	All project facilities, seismic lines and access roads will maintain the following minimum distances from cultural, Religious and archaeological sites; unless community demands greater distance from e.g. graveyards or mosques.	SC	PPL	Review grievance redress mechanism	Throughout
	- Seismic lines – 50 m	SC	PPL	Notify dept. and document incident	Immediately upon discovery
	- Access roads – 100 m	SC	PPL	Field check with GPS	Pre-survey and during ops
	- Camp sites – 100 m	SC	PPL	GIS validation and field check	Planning stage
6. Fire Safety Measures					
6.1	Ensure all fire safety measures comply with relevant NFPA standards, such as NFPA 10 for portable fire extinguishers, NFPA 30 for flammable and combustible liquids, and NFPA 72 for fire detection and alarm systems.	SC	PPL	Review design/specs	During planning and operations
6.2	Install fire detection and alarm systems in all critical areas. Conduct regular testing and maintenance as per NFPA 72.	SC	PPL	Maintain testing log	Monthly
6.3	Equip the site with adequate firefighting equipment, including portable fire extinguishers, fire hoses, and water supply systems. Ensure the equipment is regularly inspected and maintained.	SC	PPL	Inspection register	Weekly
6.4	Provide comprehensive fire safety training to all personnel, including the use of firefighting equipment and emergency evacuation procedures. Conduct regular fire drills.	SC	PPL	Record attendance and outcomes	Quarterly

Table 7.3: Mitigation Matrix for Seismic Activities

No.	Mitigation Measures	Execution	Monitoring	Action	Timing
6.5	Conduct regular fire risk assessments to identify potential fire hazards and implement measures to mitigate these risks.	SC	PPL	Document and implement controls	Biannually or as needed
7. Occupational Health and Safety					
7.1	Provide proper closed footwear with anti-slip soles, conduct regular site inspections to address hazard. Use clear and visible signage to indicate wet or slippery areas. Implement temporary barriers and warning signs during wet conditions.	SC	PPL	Daily inspections	Always
7.2	Equip workers with appropriate PPE, train them on safe handling and storage practices, and ensure proper ventilation when using chemicals.	SC	PPL	Toolbox talks and PPE checks	Weekly
7.3	Use hearing protection, implement a hearing conservation program with regular tests, and limit exposure to high-noise areas.	SC	PPL	Conduct audiometry tests	Semi-annual
7.4	Provide ergonomic tools and equipment, train workers on proper lifting techniques, and rotate tasks to minimize repetitive motion injuries. Provide training on proper lifting techniques and ergonomics to prevent musculoskeletal injuries. Include practical demonstrations and assessments.	SC	PPL	Include practical drills	During onboarding and refreshers
7.5	Ensure operators are trained and certified, conduct regular maintenance and safety checks, and maintain a safe distance policy for non-essential personnel.	SC	PPL	Review certifications	Prior to deployment
7.6	Provide weather-appropriate clothing and gear, set up shelters for extreme conditions, and monitor weather forecasts to adjust work schedules.	SC	PPL	Daily weather reviews	Seasonal or as needed
7.7	Develop detailed emergency response plans for various scenarios, including medical emergencies and chemical spills. Conduct regular emergency response drills with all personnel to ensure readiness.	SC	PPL	Conduct simulated scenarios	Quarterly
7.8	Provide comprehensive training and conduct regular drills to ensure all personnel are prepared for emergencies, including first aid and evacuation procedures.	SC	PPL	Maintain training records	During mobilization and semi-annually

Table 7.3: Mitigation Matrix for Seismic Activities

No.	Mitigation Measures	Execution	Monitoring	Action	Timing
8. Site Restoration					
8.1	All machinery, equipment, and temporary structures will be removed from the site, and equipment will be decontaminated before removal.	SC	PPL	Ensure compliance	During the entire operation
8.2	All waste will be transported to appropriate disposal or recycling facilities, with waste segregated into hazardous and non-hazardous categories.	SC	PPL	Ensure compliance	During the entire operation
8.3	Compacted soil will be aerated, and organic matter or soil conditioners will be applied to restore soil structure and fertility.	SC	PPL	Ensure compliance	During the entire operation
8.4	Native vegetation will be replanted, erosion control measures such as mulching and planting cover crops will be implemented, and newly planted areas will be protected until vegetation is fully established.	SC	PPL	Ensure compliance	During the entire operation
8.5	Altered drainage channels will be reconstructed, wetlands will be restored, artificial barriers to water flow will be removed, and water quality will be monitored.	SC	PPL	Ensure compliance	During the entire operation
8.6	Wildlife corridors will be created, artificial habitats will be installed, and wildlife activity will be monitored to ensure effective habitat restoration. Regular site inspections will be conducted to adapt restoration strategies as needed, and local communities and stakeholders will be engaged in monitoring efforts.	SC	PPL	Ensure compliance	During the entire operation
8.7	Seismic line restoration will include the removal of all cables, geophones, station units, flags, stakes, and waste materials from the lines, and all mud pits will be backfilled.	SC	PPL	Ensure compliance	During the entire operation
8.8	The soak pit will be restored after wastewater removal or handling, and will be covered and backfilled with at least 1 meter of native soil.	SC	PPL	Ensure compliance	During the entire operation

Table 7.3: Mitigation Matrix for Seismic Activities

No.	Mitigation Measures	Execution	Monitoring	Action	Timing
8.9	Contaminated bricks from black/grey water pits and other structures will not be given to locals for any purpose and will be handled as per hazardous waste protocols.	SC	PPL	Ensure compliance	During the entire operation

Abbreviation:
SC=Seismic Contractor, PPL= Pakistan Petroleum Limited,

Table 7.4: Impact on Ecology, flora and fauna

No.	Mitigation Measures	Execution	Monitoring	Action	Timing
1.1	Vehicle speeds will be regulated and monitored to avoid excessive dust emissions.	CC, SC, PPL	PPL	Monitor speed limits, Check compliance	During entire operation
1.2	Access tracks will be avoided from passing through patches of dense vegetation.	PPL, CC	PPL	Check compliance	During construction
1.3	Off-road travel, required at sections of the road where construction work is in progress, will be minimized and if required will be allowed only after approval from PPL.	PPL	PPL	Check compliance	During entire project
1.4	Prior to commencement of any exploration activity, awareness trainings will be provided to contractor's management and field crew on matters related to the requirements of the EMP in this regard.	PPL	PPL	Check compliance	Before the commencement of activities
1.5	All mitigation measures to minimize noise levels, dust emissions, air emissions, and waste management required by the EIA will be adhered to.	CC	PPL	Check compliance	During the entire operation
1.6	Construction work near areas which show small mammal and reptile populations will commence after a soft start up and will be randomly monitored.	CC	PPL	Check compliance	During construction activity



1.7	Vehicle speeds on access road will be controlled to avoid incidental mortalities of reptiles. Any such incident will be reported to the PPL HSE Advisor. Vehicle speeds will be monitored.	PPL, SC, CC	PPL	Monitor speed limits	During entire project
1.8	Cutting of trees/bushes will be minimized.	CC	PPL	Check compliance	During Construction activity
1.9	Movement of all project personnel will be restricted to work areas.	PPL, SC, CC	PPL	Check compliance	During entire project
1.10	Movement of project vehicles will be restricted only to the project access road or to routes approved by the PPL HSE Advisor.	PPL, SC, CC	PPL	Check compliance	During entire project
1.11	Night work will be prohibited; night traveling will not be allowed unless absolutely necessary.	PPL, CC	PPL	Check Compliance	During entire project
1.12	Campsites will be located preferably 500m from perennial water bodies.	PPL, CC	PPL	Check compliance	Before construction
1.13	During seismic operation clearing of vegetation will be minimized by minimizing the width of the vibroseis tracks, minimizing the preparation of new access tracks, and keeping the width of new access tracks to the minimum required.	SC, PPL	PPL	Check compliance	During seismic survey
1.14	Crew personnel while working along seismic lines will concentrate within a corridor of 4m.	PPL, SC	PPL	Check compliance	During the Seismic survey
1.15	Water contaminated during the field activities will not be released on the open land, as this may be harmful to vegetation and wildlife. All such effluents will be directed to the appropriate disposal points, e.g., lined evaporation pits.	PPL, SC	PPL	Check Compliance	During entire project
1.18	Special attention should be paid to safety of reptiles while working in their Habitat area. Their burrow should not be damaged during seismic activities. After the completion of seismic survey the area should be restored to as much close to the original condition as possible.	SC, SC, PPL	PPL	Check Compliance	During and after the activity

1.19	Natural drains that carry rainwater from the area should not be blocked or diverted. Where necessary, after work, the flow of these drains should be brought back to its original position.	SC, PPL	PPL	Check Compliance	During survey
1.20	Avoid unnecessary digging and tree cutting. Where it is necessary to cut down trees and remove vegetation, the proponent should set up tree plantation programs as a mitigation measure.	PPL	PPL	Check Compliance	During construction and seismic survey
1.21	Do not dump left over food / food waste in the open	CC, DC	PPL	Monitor collection and disposal of food waste	During the entire operation
1.22	Wastewater from the camp site will be collected in soak pit and septic and then disposed in local municipal sewage system after permission from relevant authority. Record of disposal should be maintained. Chemical contaminated water from the drilling site should not be drained in the project area without treatment.	PPL, SC	PPL	Check Compliance	During the seismic survey
1.23	Prohibit unnecessary use of horns.	PPL	PPL	Check Compliance	During entire activity
1.24	In the rainy season, vehicle movement should be reduced. Blockages in the flow of rain water in major canals should be removed to prevent flooding in the surrounding.	PPL	PPL	Check Compliance	During rainy season
1.25	Any wild animal or their cub should not be caught to make pet.	SC, SC, PPL	PPL	Check Compliance	During entire activity
1.26	A Wildlife Expert to be involved during the project activities. No team should go into the field without a wildlife monitor. The Wildlife Monitor should have the power of suspending the operation in case any action observed that could damage the ecosystem or wildlife.	PPL	PPL	Ensure that a wildlife expert visits the project area on monthly basis for ecological survey. Check Compliance	During entire operation
1.28	Avoid use of dynamite for seismic survey near Nara canal and its surrounding water bodies to protect aquatic wildlife.	SC, PPL	PPL	Check Compliance	During seismic survey



1.29	Nests of birds present in the grass lands should not be destroyed.	SC, PPL	PPL	Check Compliance	During seismic survey
1.31	Otter (a water animal) is present in the Nara canal. It should be protected.	SC, PPL	PPL	Check Compliance	During seismic survey
1.32	The dens and burrows of wildlife should be protected and seismic survey should be conducted at safe distance from them.	SC, PPL	PPL	Check Compliance	During seismic survey
1.33	Maintain safe distance from the breeding locations of birds and mammals. The wildlife, especially their offspring should not be threatened.	CC, SC, PPL	PPL	Check Compliance	During construction and seismic survey
1.34	Sightings of wildlife in the project area should be reported.	CC, SC, PPL	PPL	Check Compliance	During entire activity
1.35	Wildlife may come in contact with the project personnel. They should not be chased or scared.	CC, SC, PPL	PPL	Check Compliance	During entire activity

7.11 Environmental Monitoring Program

7.11.1 Objectives of environmental monitoring

The environmental monitoring program will fulfill the following objectives.

- Compliance monitoring: to check compliance of the contractors and PPL with the EMP on a daily basis.
- Effects monitoring: to monitor impacts of the operation in which there has been a level of uncertainty in prediction, such as impacts on wildlife and to recommend mitigation measures if the impacts are assessed to be in excess of or different from those assessed in the EIA.
- Post project Monitoring: to monitor residual impacts and complete restoration of sites.

7.11.2 Compliance Monitoring

Compliance monitoring will be carried out to ensure compliance with the requirements of the EIA and to document and report all non-compliances. The Mitigation Management Matrix provided in the EMP will be used as a management and monitoring tool, inspection may be done using checklist provided in the EMP. The contractors HSER will be responsible for monitoring the compliance of their organization with the relevant EMP requirements. PPL will also monitor the contractor's compliance and will also ensure that during each activity a system and plan is in place for effective compliance monitoring. The HSE representative will make regular checks on the contractor's works; keep records of all non-compliances observed during the execution of the project activities; and the details of all remedial actions taken to mitigate the project impacts.

7.11.3 Effects Monitoring

The effects monitoring requirement for seismic activities has been detailed in Table 7.6. PPL will involve independent monitoring team to carry out the required effects monitoring during seismic activities.

7.11.4 Post project Monitoring

The objective of this monitoring will be to determine the level of residual impacts of the project activities on physical, biological and socio-economic receptors of the project area. The monitoring may be carried out within one month after the end of all activities in the project area. As part of the post-project monitoring restoration of sites will also be checked.

7.12 Communication and Documentation

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 PPL's HSE seismic contractor (SC). Any issues that require attention of PPL's higher management will be communicated to them for action. The PPL's HSE Advisor SC will also prepare a weekly environmental report. Copies of the report will be provided to the PPL SC higher management respectively.

Monthly 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 incidences 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 introduction, details of activities, resource use, environmental non-compliances, H&S records, socioeconomic issues (if any), photographic records, approvals, inspection and audits, change managements (if any) and trainings etc.

Effects Monitoring Reports

The results of effects monitoring surveys (on wildlife, use of water resources, communities etc.) will be compiled by the independent monitoring consultant in the form of a report. This section on effect monitoring will be included in the monthly and final environmental monitoring report. The report as a minimum will include:

- Objectives and methodology
- Person(s) involved in the survey
- Areas surveyed
- Results of the monitoring exercise along with raw data collected on field
- Conclusion on the effects of the project activities

Social Complaints Register

The PPL 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. All community complaints received will be sent to the PPL management for further action. Appropriate compensations will be provided to the grieved residents of the project area.

Photographic Record

PPL will ensure that a photographic record including the following is maintained:

- All areas used before, during and after exploration;
- Key non-compliances; and
- Key project activities.

Final Monitoring Report

The project proponent will prepare a post project report describing the details of the project activities, natural resources use by the project, machinery & equipment, any changes from the operation for which approval was obtained, the degree to which the recommendations of the EIA were adhered to during the operation, list of HSE non-compliances, HSE meetings and trainings etc. The report can make use of the HSE reports prepared during the operation for that purpose.

The main contents of final report will include the introduction, details of activities, resource use, HSE non-compliances, HSE records, Communication and documentation, approvals change managements (if any), trainings and drills, socioeconomic issues (if any), inspection and audits, photographic records etc.

The report will be submitted to the Sindh EPA. Any findings and recommendations relating to the operation that may improve future similar operations will also be reported.

7.13 Change Management Plan

The Change Management Plan outlines the procedures for managing changes in operations, records, and the Environmental Management Plan (EMP) throughout the seismic survey project. This plan ensures that all changes are systematically evaluated, documented, and implemented in a manner that maintains project integrity and compliance with regulatory requirements.

Change in Operation

Changes in operational procedures or activities may arise due to new technological advancements, regulatory updates, or unforeseen environmental conditions.

To manage these changes effectively:

- Assess the potential impacts of the proposed change on project objectives, safety, and environmental performance.
- Inform all personnel and contractors about the change and provide necessary training to ensure safe and effective implementation.
- Record the change in operational procedures, including the rationale, expected benefits, and any associated risks.

Change in Record Register

Maintaining accurate and up-to-date records is essential for tracking project progress and ensuring compliance with environmental and safety regulations. To manage changes in the record register:

- Clearly identify the type of change required (e.g., new data entry, correction of existing records, or removal of outdated information).
- Ensure that changes are authorized by the designated personnel, such as the project manager or Site incharge.
- Update the record register promptly and accurately, maintaining a clear audit trail of all changes.
- Periodically review records to ensure completeness, accuracy, and compliance with regulatory requirements.

Change in EMP

The Environmental Management Plan (EMP) is a dynamic document that may require updates to address new risks, regulatory changes, or improvements in environmental management practices. To manage changes in the EMP:

- Evaluate the need for changes based on monitoring results, audit findings, or feedback from stakeholders.
- Engage with relevant stakeholders, including regulatory bodies, local communities, and project personnel, to review and discuss proposed changes.
- Revise the EMP to incorporate approved changes, ensuring that new measures are clearly defined and integrated into existing procedures.

- Distribute the updated EMP to all relevant parties and provide training as needed to ensure proper implementation.

7.14 Environmental Training

Environmental training will form part of the environmental management system. The training will be directed towards all personnel for general environmental awareness.

7.14.1 Objectives

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

7.14.2 Roles and Responsibilities

The contractors will be primarily responsible for providing environmental training to all project personnel on potential environmental issues of the project. The contractors will be responsible to arrange trainings and ensure the presence of targeted staff.

7.14.3 Training Program

The environmental awareness, EIA and EMP training to be carried out by contractors and PPL's HSE for the staff mentioned in Table 7.5.

Table 7.5: Suggested Training Program for seismic activities	
Staff	Contents
Drivers	Road safety Road restrictions Vehicle restrictions Waste disposal Wildlife sanctuary and wildlife sensitivities
Survey crew	Wildlife sensitivities Identification of sensitive areas Communication of environmental problems to appropriate officer Waste disposal
Bull dozer operation	Wildlife sensitivities Identification and avoidance of sensitive areas Waste disposal Communication of environmental problems to appropriate officer
Mechanics and vehicle repair Personnel	Environmental control of vehicles and equipment Waste disposal
Camp staff	Camp operation Waste disposal Wildlife sanctuary and wildlife sensitivities
Restoration and clean up team	Restoration requirements Wildlife sanctuary and wildlife sensitivities

7.14.4 Training log

A training log will be maintained by the contractors. The training log will include:

- Topic
- Date, time and location

- Trainer
- Participants

7.14.5 Training Need Assessment

In addition to the training specified in the training log special/ additional trainings will be provided during the project activity. The criteria to assess the need of training will be based on the following:

- When a specified percentage of staff is newly inducted in the project
- When any non-compliance is repeatedly reported refresher training will be provided regarding that issue.
- When any incident / accident of minor or major nature occurs
- Arrival of new contractor / sub-contractor
- Start of any new process / activity

7.14.6 Training Material

The contractors will develop and prepare training material regarding environmental awareness, sensitivity of the area, EIA, EMP and restrictions to be followed during the project. Separate training material will be prepared for each targeted staff.

7.15 Site Restoration Plan

The following activities will be carried out during site restoration:

- Demobilization of all equipment and machinery;
- Disposal of waste material;
- Backfilling of all soak pits and septic tanks;
- Dismantling and removal of fence or barriers surrounding the camp area;
- General restoration of the site area including landscaping and restoration of
- drainage where required.

After completion of the seismic activity all machinery, equipment, cables, phones etc. will be removed and site will be restored to original condition as far as possible. Any concrete structure built during the project will be removed (if no longer useful), fencing will be removed, and the area will be leveled. All pits will be backfilled with at least 1 m of top soil cover.

Table 7.6: Environmental Monitoring Plan during seismic survey

S. No.	Monitoring Aspects	Monitoring locations	Parameters	Frequency	Responsibility	Documentation
1	Ambient Air Quality Monitoring	Project site, camp site and ambient air monitoring locations (Covered in baseline), as work progress	SO ₂ , NO, NO ₂ , SPM, PM ₁₀ , PM _{2.5} , O ₃ , Pb, CO	Once at each location	PPL	Laboratory test Reports
2	Exhaust Emissions and Monitoring	Vehicles, Generators, Fuel operated Machinery,	Smoke, CO, Noise for vehicle CO, NO _x , SO ₂ and PM for engines / generator	Start of the exploration activities and then once in a year	PPL	Laboratory test Reports
3	Waste water	Campsite	Effluent Flow, Temperature, pH, COD, BOD ₅ , TSS, TDS, Oil & Grease, Chloride and Phenolic Compounds	Quarterly (if discharged wastewater into any nullah/ water bodies) SEPA certified Lab	PPL	Laboratory test Reports
4	Noise	Project site, camp site and at same location where ambient air monitoring will be done as per S. No 1	Noise Level (dBA)	Once at each location	PPL	Record of observations; Internally / externally
5	Solid Waste	Project site	Solid waste collection, storage, transportation and disposal	During routine monitoring	PPL	Complete waste generation record, waste disposal record & disposal certificate)
6	Occupational Safety	Survey sites, campsite, project roads	HSE Records, Incidents and injuries	During routine monitoring	Contractor	Record of observations.

8 Conclusion

Pakistan is an energy deficient country; a large portion of country's energy demands are met through expensive imports. It is, therefore, an urgent need to explore for additional energy reserves and the proposed project would have a positive impact on socioeconomic conditions as it would provide more job opportunities to the local people and generate opportunities for more business.

Pakistan Petroleum Limited (PPL) is one of the largest state-owned company of Pakistan. PPL holds major share in supply of Natural Gas in the country. Besides this, the company also holds large share in the production and supply of crude oil, Natural Gas and Liquefied Petroleum Gas.

The Company commissioned EMC Pakistan (Pvt) Limited to undertake an extensive Environmental Impact Assessment (EIA) study that examined the current environmental, social, cultural, and physiographical setting on the ground. To ensure compliance of both the study and formulation of the reporting, all relevant national and international legislations were followed and adhered to. Key areas covered in the report include a comprehensive project description, project area baseline information, guiding legal and regulatory framework and alternatives to the proposed project.

The EIA report adheres to the requirements of the Sindh Environmental Protection Act 2014 and Sindh Environmental Protection Agency (Environmental Assessment) Regulations 2021, ensuring that all potential environmental impacts are thoroughly assessed and appropriate mitigation measures are recommended.

Potential impacts of seismic activities on the physical, biological, socio-economic and cultural environment of area are assessed through this study and mitigation measures shall be adopted to alleviate the impacts on the environment.

The report outlines an EMP to ensure effective implementation of the mitigation measures. The EMP includes a comprehensive framework for environmental management, detailing the roles and responsibilities of PPL, contractors, and the Sindh EPA. It also emphasizes the importance of training, documentation, and emergency response planning.

The EIA study concludes that the proposed activities will not lead to significant adverse environmental impacts. Careful implementation of the EMP will ensure that potential impacts are managed and minimized and the project proponents meet all statutory requirements. The implementation of the EMP, coupled with continuous monitoring and community engagement, will be key to the project's success and sustainability.

ANNEXURES



Annexure-I: PPL QHSE Policy





Quality, Health, Safety & Environment Policy

Pakistan Petroleum Limited (PPL) is a frontline oil and gas exploration and production company in the country. At PPL, management is committed to maintaining and continually improving Quality, Health, Safety and Environment (QHSE) standards in all spheres of our business activities.

We firmly believe that implementation of QHSE Management System augment continual improvement in all business processes and add value to external stakeholders.

Function, Asset and Department Heads are accountable to ensure QHSE and legal compliance in their respective areas of responsibility and demonstrate pivotal leadership role in promoting QHSE culture within the organization. Whereas, all employees and contractor's staff are responsible to implement QHSE requirements in their own benefit as well as of colleagues, contractors, visitors and community.

To carry out this Policy, PPL shall:

- Define SMART QHSE objectives and targets aligned with organizational goals and monitor performance for continual improvement.
- Conduct risk assessments, incident reporting & investigations and occupational health surveillance to identify preventive measures and capture improvement opportunities.
- Fulfill its QHSE legal and other compliance obligations.
- Reward and recognize QHSE proactive efforts and initiatives of individuals.
- Protect environment and ensure minimum environmental footprint of its business activities.
- Ensure that seat belt is fastened on all seats of vehicle by employees, contractors, and visitors.
- Permit smoking in designated areas only at PPL Fields and Locations.
- Continually improve QHSE standards by adopting new techniques, approaches and best industry practices addressing various business processes.

Working safely is a condition of employment at PPL.

Imran Abbasy
Managing Director and Chief Executive Officer

پالیسی برائے معیار، صحت، تحفظ و ماحول



پاکستان پیٹرولیم لمیٹڈ (پی پی ایل) تیل و گیس کی صنعت سے وابستہ اہم ملکی ادارہ ہے۔ پی پی ایل انتظامیہ نے خود کو اس بات کا پابند کیا ہے کہ معیار، صحت، تحفظ و ماحول کے اصولوں کو اپنے تمام کاروباری معاملات میں مد نظر رکھے گی اور مستقبل بہتر بنائے گی۔ ادارہ اس بات پر کامل یقین رکھتا ہے کہ تمام کاروباری کاموں میں QHSE کا انتظامی نظام مستقل بہتری کے عمل کو مضبوط اور بیرونی شراکت داروں/اداروں کے ساتھ تعلقات کی قدر میں اضافہ کرتا ہے۔

شعبہ و اثاثہ جات کے سربراہ QHSE اور قانونی تقاضوں کے اطلاق کو یقینی بنانے کے لئے جوابدہ ہیں اور اپنے فیصلہ کن قائدانہ کردار کے توسط سے ادارے میں QHSE کے رواج کو اجاگر کرتے ہیں۔ ادارہ، ٹھیکیدار اور ان کے ملازمین اپنے، مہمانوں اور ملحقہ آبادی کے فائدے کے لئے QHSE کے تقاضوں کو لاگو کرنے کے ذمہ دار ہیں۔

اس پالیسی کے نفاذ کے لئے پی پی ایل مندرجہ ذیل اقدامات کرے گی:

- ادارے کے مقاصد سے منسلک QHSE اہداف مقرر کرے گی اور مستقل بہتری کے لئے کارکردگی کا جائزہ لے گی۔
- ممکنہ حادثات کا تعین، غیر محفوظ واقعات کا اندراج و تحقیق اور ملازمین کی صحت کا جائزہ لے گی تاکہ ان کے تدارک اور مسلسل بہتری کے اقدامات کو بروئے کار لائے گی۔
- QHSE کے قانونی اور دیگر ذمہ داریوں کو پورا کرے گی۔
- افراد کی QHSE کے لئے کئے گئے نئے اقدامات اور کوششوں کا اعتراف کرے گی۔
- ملازمین، ٹھیکیداران اور مہمانان سے گاڑی کی تمام نشستوں پر سیٹ بیلٹ کے استعمال کو یقینی بنائے گی۔
- تمام فیلڈز اور دیگر کام کی جگہوں پر سگریٹ نوشی کو مخصوص مقامات تک محدود کرے گی۔
- کاروباری کاموں میں QHSE کے معیار کو مسلسل بہتر کرنے کے لئے نئے طور طریقوں اور صنعت میں رائج احسن اقدامات کو اپنائے گی۔

محفوظ طریقے سے کام کرنا پی پی ایل میں ملازمت کی لازمی شرط ہے۔

عمران عباسی
مینجنگ ڈائریکٹر و چیف ایگزیکٹو آفیسر

Annexure-II: Environmental Analysis Reports

Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-A
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-1	27°24'34.4"N 68°49'39.3"E

SEQS-PARAMETERS									
Date	Time	NO (µg/m ³)	NO ₂ (µg/m ³)	SO ₂ (µg/m ³)	CO (mg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	SPM (µg/m ³)	Lead (µg/m ³)
13.01.2025	07:00	18.8	17.7	28.6	1.58	98	43	291	BDL
	07:30	18.7	17.6	26.5	1.62	101	45	294	
	08:00	18.4	17.2	28.1	1.63	103	47	298	
	08:30	21.8	19.6	27.4	1.65	105	49	299	
	09:00	21.5	19.0	21.4	1.68	107	50	301	
	09:30	21.3	19.5	20.4	1.71	109	52	305	
	10:00	23.0	21.7	29.5	1.74	111	53	306	
	10:30	23.1	21.4	22.3	1.75	112	55	309	
	11:00	23.8	21.0	27.2	1.78	115	56	313	
	11:30	23.9	22.3	29.6	1.80	117	58	315	
	12:00	25.7	22.2	29.5	1.82	119	59	316	
	12:30	25.4	22.5	28.7	1.83	121	61	317	
	13:00	27.0	24.4	27.9	1.85	125	63	320	
	13:30	27.1	24.8	28.5	1.88	129	65	321	
	14:00	27.6	25.9	28.4	1.92	132	63	325	
	14:30	26.2	25.5	20.2	1.93	133	66	329	
	15:00	26.4	25.6	20.6	1.96	135	67	332	
MIN		18.4	17.2	20.2	1.58	98	43	291	
MAX		27.6	25.9	29.6	1.96	135	67	332	
AVG		23.4	21.6	26.16	1.77	116.0	55.8	311.2	
SEQS		40	80	120	5	150	75	500	1.5
LDL-Limits		0.0	0.0	0.0	0.0	10	2.5	1.0	-



Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-A
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-1	27°24'34.4"N 68°49'39.3"E

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m ³	08 Hours	1.77	5.0	0.01	Non-Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m ³	08 Hours	23.4	40.0	0.0	Chemiluminescence
Nitrogen Dioxide (NO ₂)	µg/m ³	08 Hours	21.6	80.0	0.0	
Sulphur Dioxide (SO ₂)	µg/m ³	08 Hours	26.16	120.0	0.0	Ultraviolet Fluorescence Method
Ozone (O ₃)	µg/m ³	01 Hour	17.5	130.0	0.0	Non-Dispersive UV Absorption Method
Particulate Matter (PM ₁₀)	µg/m ³	08 Hours	116.0	150.0	10.0	β Ray Absorption Method
Particulate Matter (PM _{2.5})	µg/m ³	08 Hours	55.8	75.0	2.5	
Suspended Particulate Matter (SPM)	µg/m ³	08 Hours	311.2	500.0	1.0	
Lead (Pb)	µg/m ³	08 Hours	BDL	1.5	0.01	ASS Method

SEQS= Sindh Environmental Quality Standards.

µg/m³= Micrograms per Cubic Meter

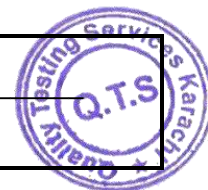
mg/m³= Milligrams per Cubic Meter

LDL=Least Detection Limit

BDL=Below Detection Limits

Remarks: All the tested parameters are within SEQs Limits for Ambient Air Quality.

Sample Analyzed By: <u>Hassan Ali</u>	Signature of Laboratory Incharge: Name : <u>Haseeb Arshad</u>
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Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-B
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-2	27°21'50.1"N 68°44'42.8"E

SEQS-PARAMETERS									
Date	Time	NO (µg/m ³)	NO ₂ (µg/m ³)	SO ₂ (µg/m ³)	CO (mg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	SPM (µg/m ³)	Lead (µg/m ³)
13.01.2025	07:00	12.3	15.1	20.9	1.32	112	30	282	BDL
	07:30	12.2	15.6	20.6	1.33	115	32	285	
	08:00	12.8	15.5	20.4	1.35	118	33	287	
	08:30	13.7	15.4	20.5	1.38	110	35	289	
	09:00	13.4	16.2	21.1	1.39	113	36	283	
	09:30	13.2	16.0	21.3	1.41	116	38	285	
	10:00	13.6	16.2	21.9	1.42	118	41	288	
	10:30	15.0	18.6	22.8	1.44	110	42	280	
	11:00	15.1	18.2	22.0	1.45	111	44	282	
	11:30	15.6	18.9	22.4	1.47	112	40	285	
	12:00	15.7	19.8	24.7	1.49	114	38	288	
	12:30	16.7	19.7	24.5	1.51	115	36	283	
	13:00	16.4	19.0	24.4	1.53	117	34	286	
	13:30	16.0	21.5	23.3	1.56	116	32	288	
	14:00	14.5	21.4	23.2	1.58	112	33	281	
	14:30	14.1	21.2	23.1	1.60	110	30	286	
	15:00	14.5	21.9	23.0	1.63	117	28	289	
MIN		12.2	15.1	20.4	1.32	110	28	280	
MAX		16.7	21.9	24.7	1.63	118	44	289	
AVG		14.4	18.2	22.3	1.46	113.88	35.4	285.12	
SEQS		40	80	120	5	150	75	500	1.5
LDL-Limits		0.0	0.0	0.0	0.0	10	2.5	1.0	-



Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-B
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-2	27°21'50.1"N 68°44'42.8"E

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m ³	08 Hours	1.46	5.0	0.01	Non Dispersive Infra Red (NDIR)
Nitrogen oxide (NO)	µg/m ³	08 Hours	14.4	40.0	0.0	Chemiluminescence
Nitrogen Dioxide (NO ₂)	µg/m ³	08 Hours	18.2	80.0	0.0	
Sulphur Dioxide (SO ₂)	µg/m ³	08 Hours	22.3	120.0	0.0	Ultraviolet Fluorescence Method
Ozone (O ₃)	µg/m ³	01 Hour	17.5	130.0	0.0	Non Dispersive UV Absorption Method
Particulate Matter (PM ₁₀)	µg/m ³	08 Hours	113.8	150.0	10.0	β Ray Absorption Method
Particulate Matter (PM _{2.5})	µg/m ³	08 Hours	35.4	75.0	2.5	
Suspended Particulate Matter (SPM)	µg/m ³	08 Hours	285.1	500.0	1.0	
Lead (Pb)	µg/m ³	08 Hours	BDL	1.5	0.01	ASS Method

SEQS= Sindh Environmental Quality Standards.

µg/m³= Micrograms per Cubic Meter

mg/m³= Milligrams per Cubic Meter

LDL=Least Detection Limit

BDL=Below Detection Limits

Remarks: All the tested parameters are within SEQS Limits for Ambient Air Quality.

Sample Analyzed By: <u>Hassan Ali</u>	Signature of Laboratory Incharge: <u>Haseeb Arshad</u>
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Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-C
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-3	27°18'01.9"N 68°40'37.5"E

SEQS-PARAMETERS									
Date	Time	NO (µg/m ³)	NO ₂ (µg/m ³)	SO ₂ (µg/m ³)	CO (mg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	SPM (µg/m ³)	Lead (µg/m ³)
14.01.2025	07:00	14.0	17.9	9.6	1.41	92	36	320	BDL
	07:30	14.8	17.8	9.5	1.43	94	38	313	
	08:00	14.5	17.8	9.6	1.46	95	40	307	
	08:30	16.2	19.7	10.2	1.48	97	42	310	
	09:00	16.6	19.4	10.4	1.50	99	44	332	
	09:30	16.3	19.9	10.0	1.53	90	45	325	
	10:00	17.4	21.5	12.6	1.54	92	46	306	
	10:30	17.0	21.0	12.3	1.56	93	48	298	
	11:00	17.7	21.5	12.3	1.58	94	50	282	
	11:30	19.4	21.3	13.8	1.60	95	52	313	
	12:00	19.5	22.1	13.7	1.62	98	53	335	
	12:30	19.0	22.2	13.0	1.63	90	51	379	
	13:00	20.3	22.0	13.8	1.64	92	50	313	
	13:30	20.2	20.8	11.6	1.66	93	47	296	
	14:00	20.1	20.7	11.4	1.68	95	45	290	
	14:30	18.2	20.6	11.1	1.70	97	44	243	
	15:00	18.7	20.5	11.2	1.72	99	41	306	
MIN		14	17.8	9.5	1.41	90	36	243	BDL
MAX		20.3	22.2	11.1	1.72	99	53	379	
AVG		17.5	20.35	21.9	1.57	94.41	45.3	309.88	
SEQS		40	80	120	5	150	75	500	1.5
LDL-Limits		0.0	0.0	0.0	0.0	10	2.5	1.0	-



Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-C
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-3	27°18'01.9"N 68°40'37.5"E

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m ³	08 Hours	1.57	5.0	0.01	Non Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m ³	08 Hours	17.5	40.0	0.0	Chemiluminescence
Nitrogen Dioxide (NO ₂)	µg/m ³	08 Hours	20.35	80.0	0.0	
Sulphur Dioxide (SO ₂)	µg/m ³	08 Hours	21.9	120.0	0.0	Ultraviolet Fluorescence Method
Ozone (O ₃)	µg/m ³	01 Hour	16.4	130.0	0.0	Non Dispersive UV Absorption Method
Particulate Matter (PM ₁₀)	µg/m ³	08 Hours	94.4	150.0	10.0	β Ray Absorption Method
Particulate Matter (PM _{2.5})	µg/m ³	08 Hours	45.3	75.0	2.5	
Suspended Particulate Matter (SPM)	µg/m ³	08 Hours	309.8	500.0	1.0	
Lead (Pb)	µg/m ³	08 Hours	BDL	1.5	0.01	ASS Method

SEQS= Sindh Environmental Quality Standards.

µg/m³= Micrograms per Cubic Meter

mg/m³= Milligrams per Cubic Meter

LDL=Least Detection Limit

BDL=Below Detection Limits

Remarks: All the tested parameters are within SEQs Limits for Ambient Air Quality.

Sample Analyzed By: <u>Hassan Ali</u>	Signature of Laboratory Incharge: <u>Haseeb Arshad</u>
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Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-D
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-4	27°17'28.4"N 68°38'43.4"E

SEQS-PARAMETERS									
Date	Time	NO (µg/m ³)	NO ₂ (µg/m ³)	SO ₂ (µg/m ³)	CO (mg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	SPM (µg/m ³)	Lead (µg/m ³)
15.01.2025	07:00	15.1	12.5	35.9	2.32	122	44	360	BDL
	07:30	15.8	12.6	35.3	2.33	124	46	363	
	08:00	15.5	12.2	35.2	2.34	125	47	365	
	08:30	15.4	14.0	35.9	2.35	126	49	368	
	09:00	17.3	14.6	36.8	2.37	128	41	370	
	09:30	17.2	14.4	36.4	2.39	120	43	372	
	10:00	17.6	16.5	36.5	2.40	122	45	373	
	10:30	17.0	16.1	38.0	2.42	133	47	375	
	11:00	18.9	16.9	38.6	2.44	125	40	377	
	11:30	18.8	18.6	38.1	2.46	116	48	379	
	12:00	18.4	18.4	39.8	2.48	128	44	381	
	12:30	19.0	18.5	39.4	2.50	130	42	382	
	13:00	19.2	19.1	39.5	2.52	123	40	385	
	13:30	19.6	19.0	39.0	2.53	126	49	388	
	14:00	20.5	17.3	37.1	2.55	120	47	390	
	14:30	20.1	17.2	37.2	2.56	128	46	392	
	15:00	20.4	17.6	37.3	2.58	126	45	393	
MIN		15.1	12.2	35.2	2.32	116	40	360	
MAX		20.5	19.1	39.8	2.58	133	49	393	
AVG		17.9	16.1	37.4	2.44	124.82	44.88	377.24	
SEQS		40	80	120	5	150	75	500	1.5
LDL-Limits		0.0	0.0	0.0	0.0	10	2.5	1.0	-



Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-D
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-4	27°17'28.4"N 68°38'43.4"E

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m ³	08 Hours	2.44	5.0	0.01	Non Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m ³	08 Hours	17.9	40.0	0.0	Chemiluminescence
Nitrogen Dioxide (NO ₂)	µg/m ³	08 Hours	16.1	80.0	0.0	
Sulphur Dioxide (SO ₂)	µg/m ³	08 Hours	37.4	120.0	0.0	Ultraviolet Fluorescence Method
Ozone (O ₃)	µg/m ³	01 Hour	16.9	130.0	0.0	Non Dispersive UV Absorption Method
Particulate Matter (PM ₁₀)	µg/m ³	08 Hours	124.8	150.0	10.0	β Ray Absorption Method
Particular Matter (PM _{2.5})	µg/m ³	08 Hours	44.8	75.0	2.5	
Suspended Particulate Matter (SPM)	µg/m ³	08 Hours	377.24	500.0	1.0	
Lead (Pb)	µg/m ³	08 Hours	BDL	1.5	0.01	ASS Method

SEQS= Sindh Environmental Quality Standards.

µg/m³= Micrograms per Cubic Meter

,mg/m³= Milligrams per Cubic Meter

LDL=Least Detection Limit

BDL=Below Detection Limits

Remarks: All the tested parameters are within SEQS Limits for Ambient Air Quality.

Sample Analyzed By: <u>Hassan Ali</u>	Signature of Laboratory Incharge: <u>Haseeb Arshad</u>
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Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-E
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-5	27°11'36.8"N 68°39'11.3"E

SEQS-PARAMETERS									
Date	Time	NO ($\mu\text{g}/\text{m}^3$)	NO ₂ ($\mu\text{g}/\text{m}^3$)	SO ₂ ($\mu\text{g}/\text{m}^3$)	CO (mg/m^3)	PM ₁₀ ($\mu\text{g}/\text{m}^3$)	PM _{2.5} ($\mu\text{g}/\text{m}^3$)	SPM ($\mu\text{g}/\text{m}^3$)	Lead ($\mu\text{g}/\text{m}^3$)
16.01.2025	07:00	13.6	20.5	20.9	3.56	131	43	221	BDL
	07:30	13.3	20.3	20.5	3.58	132	45	225	
	08:00	13.0	20.2	20.1	3.60	134	47	229	
	08:30	15.7	22.9	21.2	3.63	136	48	232	
	09:00	15.4	22.6	21.5	3.66	138	50	233	
	09:30	15.5	22.8	21.3	3.69	130	53	235	
	10:00	17.8	23.7	22.2	3.71	133	54	238	
	10:30	17.5	23.4	22.6	3.72	134	52	240	
	11:00	17.0	24.0	22.2	3.74	136	50	243	
	11:30	19.9	24.5	23.9	3.76	137	52	244	
	12:00	19.5	24.3	23.8	3.78	139	47	246	
	12:30	19.4	22.2	23.7	3.79	130	48	248	
	13:00	21.0	22.9	24.4	3.80	131	44	251	
	13:30	21.6	22.8	24.0	3.83	133	40	253	
	14:00	21.1	20.4	22.6	3.84	134	38	255	
	14:30	21.2	20.2	22.1	3.82	135	36	256	
	15:00	21.5	20.6	22.5	3.80	132	34	260	
MIN		13.0	20.2	20.1	3.56	130	34	221	
MAX		21.6	24.5	24.4	3.84	139	54	260	
AVG		17.8	22.2	22.3	3.72	133.82	45.7	241.5	
SEQS		40	80	120	5	150	75	500	1.5
LDL-Limits		0.0	0.0	0.0	0.0	10	2.5	1.0	-



Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-E
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-5	27°11'36.8"N 68°39'11.3"E

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m ³	08 Hours	3.72	5.0	0.01	Non Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m ³	08 Hours	17.8	40.0	0.0	Chemiluminescence
Nitrogen Dioxide (NO ₂)	µg/m ³	08 Hours	22.2	80.0	0.0	
Sulphur Dioxide (SO ₂)	µg/m ³	08 Hours	22.3	120.0	0.0	Ultraviolet Fluorescence Method
Ozone (O ₃)	µg/m ³	01 Hour	17.5	130.0	0.0	Non Dispersive UV Absorption Method
Particulate Matter (PM ₁₀)	µg/m ³	08 Hours	133.8	150.0	10.0	β Ray Absorption Method
Particular Matter (PM _{2.5})	µg/m ³	08 Hours	45.7	75.0	2.5	
Suspended Particulate Matter (SPM)	µg/m ³	08 Hours	241.5	500.0	1.0	
Lead (Pb)	µg/m ³	08 Hours	BDL	1.5	0.01	ASS Method

SEQS= Sindh Environmental Quality Standards.

µg/m³= Micrograms per Cubic Meter

mg/m³= Milligrams per Cubic Meter

LDL=Least Detection Limit

BDL=Below Detection Limits

Remarks: All the tested parameters are within SEQS Limits for Ambient Air Quality.

Sample Analyzed By: <u>Hassan Ali</u>	Signature of Laboratory Incharge: <u>Haseeb Arshad</u>
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Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-F
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-6	27°02'47.9"N 68°40'09.6"E

SEQS-PARAMETERS									
Date	Time	NO ($\mu\text{g}/\text{m}^3$)	NO ₂ ($\mu\text{g}/\text{m}^3$)	SO ₂ ($\mu\text{g}/\text{m}^3$)	CO (mg/m^3)	PM ₁₀ ($\mu\text{g}/\text{m}^3$)	PM _{2.5} ($\mu\text{g}/\text{m}^3$)	SPM ($\mu\text{g}/\text{m}^3$)	Lead ($\mu\text{g}/\text{m}^3$)
17.01.2025	07:00	13.7	14.2	7.8	1.56	120	23	281	BDL
	07:30	13.8	14.0	7.4	1.58	124	23	282	
	08:00	13.2	14.9	7.2	1.60	123	24	283	
	08:30	14.6	15.8	9.5	1.63	125	25	285	
	09:00	14.5	15.7	9.9	1.65	126	26	286	
	09:30	14.4	16.4	9.5	1.66	127	28	289	
	10:00	15.0	16.0	10.0	1.67	129	29	292	
	10:30	15.6	16.6	10.5	1.69	121	32	293	
	11:00	15.2	17.5	10.4	1.70	121	32	295	
	11:30	16.6	17.1	11.2	1.72	122	33	296	
	12:00	16.0	17.4	11.3	1.72	125	34	298	
	12:30	16.9	19.4	11.6	1.73	122	35	202	
	13:00	17.8	19.8	12.9	1.75	120	36	205	
	13:30	17.4	19.4	12.8	1.77	128	38	206	
	14:00	17.5	20.6	10.7	1.78	127	40	207	
	14:30	16.1	20.5	10.4	1.80	125	41	210	
	15:00	16.2	20.1	10.5	1.82	122	43	213	
MIN		13.2	14	7.2	1.58	120	23	281	
MAX		17.8	20.6	12.9	1.82	129	43	213	
AVG		15.5	17.3	10.1	1.70	123.94	32	295.6	
SEQS		40	80	120	5	150	75	500	1.5
LDL-Limits		0.0	0.0	0.0	0.0	10	2.5	1.0	-



Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-F
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-6	27°02'47.9"N 68°40'09.6"E

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m ³	08 Hours	1.70	5.0	0.01	Non Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m ³	08 Hours	15.5	40.0	0.0	Chemiluminescence
Nitrogen Dioxide (NO ₂)	µg/m ³	08 Hours	17.3	80.0	0.0	
Sulphur Dioxide (SO ₂)	µg/m ³	08 Hours	10.1	120.0	0.0	Ultraviolet Fluorescence Method
Ozone (O ₃)	µg/m ³	01 Hour	19.5	130.0	0.0	Non Dispersive UV Absorption Method
Particulate Matter (PM ₁₀)	µg/m ³	08 Hours	123.9	150.0	10.0	β Ray Absorption Method
Particular Matter (PM _{2.5})	µg/m ³	08 Hours	32	75.0	2.5	
Suspended Particulate Matter (SPM)	µg/m ³	08 Hours	295.6	500.0	1.0	
Lead (Pb)	µg/m ³	08 Hours	BDL	1.5	0.01	ASS Method

SEQS= Sindh Environmental Quality Standards.

µg/m³= Micrograms per Cubic Meter

mg/m³= Milligrams per Cubic Meter

LDL=Least Detection Limit

BDL=Below Detection Limits

Remarks: All the tested parameters are within SEQS Limits for Ambient Air Quality.

Sample Analyzed By: <u>Hassan Ali</u>	Signature of Laboratory Incharge: <u>Haseeb Arshad</u>
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Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-G
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-7	27°04'54.2"N 68°44'34.2"E

SEQS-PARAMETERS									
Date	Time	NO (µg/m ³)	NO ₂ (µg/m ³)	SO ₂ (µg/m ³)	CO (mg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	SPM (µg/m ³)	Lead (µg/m ³)
18.01.2025	07:00	18.6	14.9	54.4	3.36	158	64	334	BDL
	07:30	18.5	14.5	54.5	3.38	150	65	336	
	08:00	18.9	14.4	54.0	3.40	153	67	339	
	08:30	20.8	15.1	54.6	3.42	155	60	342	
	09:00	20.7	15.5	55.2	3.44	156	62	344	
	09:30	20.4	15.3	55.8	3.45	158	64	346	
	10:00	21.0	16.0	55.7	3.47	150	66	348	
	10:30	21.5	16.6	56.4	3.50	159	68	351	
	11:00	21.2	16.2	56.5	3.52	164	60	353	
	11:30	22.0	15.9	56.0	3.53	155	62	355	
	12:00	22.6	15.8	56.3	3.56	157	63	358	
	12:30	22.9	15.7	55.6	3.58	159	65	360	
	13:00	23.8	16.4	55.2	3.61	151	66	362	
	13:30	23.8	16.0	55.9	3.62	153	64	364	
	14:00	24.7	16.6	54.6	3.63	155	62	369	
	14:30	24.4	17.2	54.2	3.65	160	60	372	
	15:00	24.1	17.5	54.4	3.66	154	67	376	
MIN		18.5	14.4	54.0	3.36	150	64	334	
MAX		24.7	17.5	56.5	3.66	164	66	376	
AVG		21.7	15.8	55.25	3.51	155.71	66.5	353.6	
SEQS		40	80	120	5	150	75	500	1.5
LDL-Limits		0.0	0.0	0.0	0.0	10	2.5	1.0	-



Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-G
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-7	27°04'54.2"N 68°44'34.2"E

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m ³	08 Hours	3.51	5.0	0.01	Non Dispersive Infra Red (NDIR)
Nitrogen oxide (NO)	µg/m ³	08 Hours	21.7	40.0	0.0	Chemiluminescence
Nitrogen Dioxide (NO ₂)	µg/m ³	08 Hours	15.8	80.0	0.0	
Sulphur Dioxide (SO ₂)	µg/m ³	08 Hours	55.25	120.0	0.0	Ultraviolet Fluorescence Method
Ozone (O ₃)	µg/m ³	01 Hour	17.4	130.0	0.0	Non Dispersive UV Absorption Method
Particulate Matter (PM ₁₀)	µg/m ³	08 Hours	* 155.7	150.0	10.0	β Ray Absorption Method
Particulate Matter (PM _{2.5})	µg/m ³	08 Hours	66.5	75.0	2.5	
Suspended Particulate Matter (SPM)	µg/m ³	08 Hours	353.6	500.0	1.0	
Lead (Pb)	µg/m ³	08 Hours	BDL	1.5	0.01	ASS Method

SEQS= Sindh Environmental Quality Standards.

µg/m³= Micrograms per Cubic Meter

mg/m³= Milligrams per Cubic Meter

LDL=Least Detection Limit

BDL=Below Detection Limits

Remarks: The tested parameters are within SEQS Limits for Ambient Air Quality, Except PM-10.

Sample Analyzed By: <u>Hassan Ali</u>	Signature of Laboratory Incharge: <u>Haseeb Arshad</u>
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Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-H
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-8	27°04'47.9"N 68°27'13.3"E

SEQS-PARAMETERS									
Date	Time	NO (µg/m ³)	NO ₂ (µg/m ³)	SO ₂ (µg/m ³)	CO (mg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	SPM (µg/m ³)	Lead (µg/m ³)
19.01.2025	07:00	14.7	12.7	53.2	3.31	150	55	381	BDL
	07:30	14.2	12.4	53.6	3.32	153	56	383	
	08:00	14.4	12.2	53.0	3.33	155	59	385	
	08:30	15.0	13.3	53.5	3.35	156	51	389	
	09:00	15.6	13.6	54.2	3.36	159	53	390	
	09:30	15.2	13.9	54.3	3.38	150	55	393	
	10:00	16.6	13.8	54.2	3.40	152	56	395	
	10:30	16.9	14.7	54.8	3.41	153	54	398	
	11:00	16.0	14.4	54.7	3.43	155	55	302	
	11:30	17.8	14.2	55.9	3.44	156	58	305	
	12:00	17.7	14.6	55.8	3.45	158	50	306	
	12:30	17.4	15.0	54.4	3.42	150	52	308	
	13:00	16.0	15.5	56.5	3.40	152	53	312	
	13:30	16.6	15.1	56.0	3.38	153	51	315	
	14:00	16.2	13.4	56.5	3.35	155	50	317	
	14:30	15.1	13.4	55.1	3.33	158	58	319	
	15:00	15.4	13.9	55.2	3.30	150	57	323	
MIN		14.2	12.2	53	3.3	150	55	381	BDL
MAX		17.8	15.5	56.5	3.45	150	53	323	
AVG		15.9	13.8	54.7	3.37	155	55.3	301.3	
SEQS		40	80	120	5	150	75	500	1.5
LDL-Limits		0.0	0.0	0.0	0.0	10	2.5	1.0	-



Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-H
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-8	27°04'47.9"N 68°27'13.3"E

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m ³	08 Hours	3.37	5.0	0.01	Non Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m ³	08 Hours	15.9	40.0	0.0	Chemiluminescence
Nitrogen Dioxide (NO ₂)	µg/m ³	08 Hours	13.8	80.0	0.0	
Sulphur Dioxide (SO ₂)	µg/m ³	08 Hours	54.7	120.0	0.0	Ultraviolet Fluorescence Method
Ozone (O ₃)	µg/m ³	01 Hour	15.1	130.0	0.0	Non Dispersive UV Absorption Method
Particulate Matter (PM ₁₀)	µg/m ³	08 Hours	* 155	150.0	10.0	β Ray Absorption Method
Particular Matter (PM _{2.5})	µg/m ³	08 Hours	55.3	75.0	2.5	
Suspended Particulate Matter (SPM)	µg/m ³	08 Hours	301.3	500.0	1.0	
Lead (Pb)	µg/m ³	08 Hours	BDL	1.5	0.01	ASS Method

SEQS= Sindh Environmental Quality Standards.

µg/m³= Micrograms per Cubic Meter

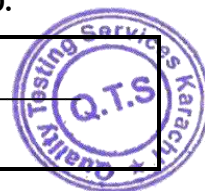
mg/m³= Milligrams per Cubic Meter

LDL=Least Detection Limit

BDL=Below Detection Limits

Remarks: All the tested parameters are within SEQs Limits for Ambient Air Quality, Except PM-10.

Sample Analyzed By: <u>Hassan Ali</u>	Signature of Laboratory Incharge: <u>Haseeb Arshad</u>
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Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-I
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-9	27°15'45.6"N 68°49'51.8"E

SEQS-PARAMETERS									
Date	Time	NO (µg/m ³)	NO ₂ (µg/m ³)	SO ₂ (µg/m ³)	CO (mg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	SPM (µg/m ³)	Lead (µg/m ³)
20.01.2025	07:00	15.9	13.3	45.2	3.41	133	32	351	BDL
	07:30	15.4	13.6	45.6	3.42	135	35	354	
	08:00	15.3	13.2	45.1	3.45	138	36	355	
	08:30	17.6	14.6	45.0	3.44	130	38	358	
	09:00	17.2	14.4	46.2	3.47	131	39	360	
	09:30	17.1	14.0	46.4	3.49	133	41	362	
	10:00	18.0	15.1	46.2	3.51	135	42	364	
	10:30	18.5	15.8	47.9	3.52	138	45	363	
	11:00	18.0	15.7	47.3	3.54	130	44	365	
	11:30	19.9	16.9	47.9	3.56	131	47	366	
	12:00	19.8	16.5	48.4	3.58	133	48	367	
	12:30	19.7	18.1	48.2	3.60	135	50	369	
	13:00	20.4	18.0	49.6	3.63	138	52	371	
	13:30	20.2	17.2	49.1	3.64	130	50	373	
	14:00	20.6	17.5	49.0	3.65	133	47	375	
	14:30	18.2	15.1	48.4	3.58	131	45	377	
	15:00	18.4	15.6	48.3	3.70	138	41	378	
MIN		15.3	13.2	45.0	3.41	133	32	351	
MAX		20.6	18.1	49.6	3.70	133	52	378	
AVG		18.2	15.5	47.2	3.54	138.8	42.9	365.1	
SEQS		40	80	120	5	150	75	500	1.5
LDL-Limits		0.0	0.0	0.0	0.0	10	2.5	1.0	-



Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-I
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-9	27°15'45.6"N 68°49'51.8"E

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m ³	08 Hours	3.54	5.0	0.01	Non Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m ³	08 Hours	18.2	40.0	0.0	Chemiluminescence
Nitrogen Dioxide (NO ₂)	µg/m ³	08 Hours	15.5	80.0	0.0	
Sulphur Dioxide (SO ₂)	µg/m ³	08 Hours	47.2	120.0	0.0	Ultraviolet Fluorescence Method
Ozone (O ₃)	µg/m ³	01 Hour	16.9	130.0	0.0	Non Dispersive UV Absorption Method
Particulate Matter (PM ₁₀)	µg/m ³	08 Hours	138.8	150.0	10.0	β Ray Absorption Method
Particulate Matter (PM _{2.5})	µg/m ³	08 Hours	42.9	75.0	2.5	
Suspended Particulate Matter (SPM)	µg/m ³	08 Hours	365.1	500.0	1.0	
Lead (Pb)	µg/m ³	08 Hours	BDL	1.5	0.01	ASS Method

SEQS= Sindh Environmental Quality Standards.

µg/m³= Micrograms per Cubic Meter

mg/m³= Milligrams per Cubic Meter

LDL=Least Detection Limit

BDL=Below Detection Limits

Remarks: All the tested parameters are within SEQs Limits for Ambient Air Quality.

Sample Analyzed By: <u>Hassan Ali</u>	Signature of Laboratory Incharge: <u>Haseeb Arshad</u>
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Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-J
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-10	27°29'14.9"N 68°33'06.3"E

SEQS-PARAMETERS									
Date	Time	NO (µg/m³)	NO ₂ (µg/m³)	SO ₂ (µg/m³)	CO (mg/m³)	PM ₁₀ (µg/m³)	PM _{2.5} (µg/m³)	SPM (µg/m³)	Lead (µg/m³)
21.01.2025	07:00	21.4	16.5	20.9	1.50	102	54	260	BDL
	07:30	21.2	16.8	20.6	1.52	106	56	263	
	08:00	21.6	16.6	20.2	1.54	108	58	265	
	08:30	22.3	17.5	22.5	1.55	110	59	268	
	09:00	22.0	17.4	22.4	1.56	112	62	270	
	09:30	22.9	17.3	22.3	1.58	113	63	271	
	10:00	24.5	18.6	24.6	1.60	115	65	273	
	10:30	24.4	18.0	24.2	1.63	117	64	275	
	11:00	24.0	18.5	24.0	1.66	119	68	277	
	11:30	25.9	19.4	25.4	1.68	121	70	278	
	12:00	25.8	19.8	25.6	1.71	122	71	280	
	12:30	25.6	19.6	25.2	1.72	124	68	283	
	13:00	28.5	20.5	27.9	1.74	125	65	285	
	13:30	28.4	20.4	27.8	1.76	128	64	289	
	14:00	29.0	21.2	26.5	1.78	131	60	290	
	14:30	29.2	21.5	26.4	1.80	135	58	293	
	15:00	29.4	21.9	26.6	1.83	138	54	295	
MIN		21.2	16.5	20.2	1.5	102	54	260	BDL
MAX		29.4	21.9	27.9	1.83	138	71	295	
AVG		25.0	18.9	24.2	1.65	119.2	62.3	277.3	
SEQS		40	80	120	5	150	75	500	1.5
LDL-Limits		0.0	0.0	0.0	0.0	10	2.5	1.0	-



Ambient Air Quality Test Report

Project Name:	EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL	Test Report No:	QTS/PPL/25/1829-J
		Sample Duration:	08hrs
Sample Description:	Ambient Air Quality Test	Location: AA-10	27°29'14.9"N 68°33'06.3"E

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m ³	08 Hours	1.65	5.0	0.01	Non Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m ³	08 Hours	25.0	40.0	0.0	Chemiluminescence
Nitrogen Dioxide (NO ₂)	µg/m ³	08 Hours	18.9	80.0	0.0	
Sulphur Dioxide (SO ₂)	µg/m ³	08 Hours	24.2	120.0	0.0	Ultraviolet Fluorescence Method
Ozone (O ₃)	µg/m ³	01 Hour	19.8	130.0	0.0	Non Dispersive UV Absorption Method
Particulate Matter (PM ₁₀)	µg/m ³	08 Hours	119.2	150.0	10.0	β Ray Absorption Method
Particular Matter (PM _{2.5})	µg/m ³	08 Hours	62.3	75.0	2.5	
Suspended Particulate Matter (SPM)	µg/m ³	08 Hours	277.3	500.0	1.0	
Lead (Pb)	µg/m ³	08 Hours	BDL	1.5	0.01	ASS Method

SEQS= Sindh Environmental Quality Standards.

µg/m³= Micrograms per Cubic Meter

mg/m³= Milligrams per Cubic Meter

LDL=Least Detection Limit

BDL=Below Detection Limits

Remarks: All the tested parameters are within SEQS Limits for Ambient Air Quality.

Sample Analyzed By: <u>Hassan Ali</u>	Signature of Laboratory Incharge: <u>Haseeb Arshad</u>
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Lab Report Ref. No: QTS/PPL/1836

Reporting Date: 03/02/2025

Project: EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL

SAMPLE DESCRIPTION

Sample ID: Noise Level Test

Sample Description: Ambient Noise

No. of samples: 20

Sample Collected/Submitted by: EMC/QTS representative

Sampling Date: 13/01/2025 To 21/01/2025

NOISE TEST REPORT

S.NO.	LOCATION/SOURCE	SEQS Limits : 55 dB(A) *Leq			
		Noise Level Readings			
		Coordinates	Minimum	Maximum	Average
1	Noise Level ,N-1	28°13'03.9"N 69°12'52.8"E	50.4	51.6	51.0
2	Noise Level ,N-2	28°13'13.8"N 69°12'48.0"E	49.2	50.1	49.6
3	Noise Level ,N-3	27°21'27.4"N 68°46'00.5"E	48.1	49.4	48.7
4	Noise Level ,N-4	27°19'09.4"N 68°47'48.5"E	52.5	53.1	52.8
5	Noise Level ,N-5	27°19'09.6"N 68°47'52.7"E	50.9	51.5	51.2
6	Noise Level ,N-6	27°12'59.1"N 68°39'03.8"E	51.4	52.8	52.1
7	Noise Level ,N-7	27°11'36.5"N 68°38'35.3"E	52.2	53.2	52.7
8	Noise Level ,N-8	27°11'36.5"N 68°38'35.3"E	50.9	52.7	51.8
9	Noise Level ,N-9	27°29'54.8"N 68°39'41.0"E	49.1	50.1	49.6
10	Noise Level ,N-10	27°24'42.5"N 68°35'18.7"E	48.7	49.9	49.3
11	Noise Level ,N-11	27°14'34.2"N 68°32'54.8"E	50.3	51.1	50.7
12	Noise Level ,N-12	26°58'57.3"N 68°32'09.7"E	51.4	51.9	51.6
13	Noise Level ,N-13	26°58'11.6"N 68°34'34.5"E	49.6	50.1	49.8
14	Noise Level ,N-14	27°13'57.6"N 68°47'39.8"E	51.4	52.8	52.1
15	Noise Level ,N-15	27°29'09.0"N 68°54'36.4"E	50.7	51.7	51.2
16	Noise Level ,N-16	27°04'53.0"N 68°34'21.9"E	52.3	52.6	52.4
17	Noise Level ,N-17	27°09'34.1"N 68°46'30.6"E	50.9	51.7	51.3

18	Noise Level ,N-18	27°21'47.9"N 68°35'57.4"E	49.4	50.3	49.8
19	Noise Level ,N-19	27°26'11.1"N 68°44'27.5"E	52.4	53.1	52.7
20	Noise Level ,N-20	27°30'44.2"N 68°47'47.7"E	50.7	51.6	51.1

SEQS= Sindh Environmental Quality Standard

*dB (A) Leq:= Time weighted average of the level of sound in decibel on scale which is relatable to human hearing.

Terms & Conditions:

This report is not valid for any negotiations

Report is valid for current batch(sample)

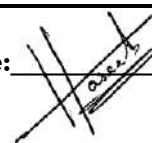
This report is intended only for your guidance & not for legal purpose or for advertisement.

Comments:

The Noise level from the source is within acceptable level as describe in SEQs.

Sample Analyzed by: Hassan Ali

Signature of Laboratory In charge:
Name : Haseeb Arshad




Lab Report Ref. No. : QTS/PPL/1837-A

Reporting Date: 03/02/2025

Project: **EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL**

SAMPLE DESCRIPTION

Sample ID: Ground water 01
Sample Type: Liquid
Sampling Coordinates: 27°18'01.8"N 68°40'37.5"E
Sample Collected/Submitted by: QTS representative
Sampling Date: 13/01/2025

ANALYTICAL TEST REPORT

S.NO.	PARAMETERS TO BE ANALYZED	STANDARD	UNITS	RESULTS	TEST METHOD
		SSDWQ			
1	pH value	6.5-8.5	-	7.56	USEPA 150.1
2	Total Dissolved Solids(TDS)	<1000	mg/L	3,770	Hach 8160
3	Total Hardness(as CaCO ₃)	<500	mg/L	2,000	Hach 8213
4	Turbidity	<5	NTU	1.1	Turbidity meter
5	Nitrate(NO ₃)	≤50	mg/L	0.5	Hach 8039
6	Nitrite(NO ₂)	≤3	mg/L	2	Hach 8153
7	Phenolic compounds(as phenol)	<0.002	mg/L	BDL	USEPA 420.1
8	Chloride(as Cl ⁻)	<250	mg/L	950	Hach 8206
9	Fluoride(as F ⁻)	≤1.5	mg/L	NIL	USEPA 340.1
10	Taste	Non objectional/ acceptable	Physical	Acceptable	Physical
11	Odour	Non objectional/ acceptable	Physical	Acceptable	Physical
12	Arsenic	≤ 0.05	mg/L	BDL	APHA-3120 B
13	Barium	0.7	mg/L	22	Hach 8014
14	Copper	2	mg/L	0.014	Physical
15	Manganese	≤ 0.5	mg/L	0.5	Hach 8034
16	Zinc	5	mg/L	0.13	USEPA 3500 Zn B
17	Residual Chlorine	0.2-0.5 at consumer end, 0.5-1.5 at source	mg/L	0.022	Hach - 8167
18	Chromium	≤0.05	mg/L	0.012	ASTM D-1687
19	Cyanide	≤0.05	mg/L	BDL	Hach 8027

MICROBIOLOGICAL TEST REPORT

20	Total Coliform	0cfu/100ml	cfu		APHA-SM9221B
21	Fecal Coliform	0cfu/100ml	cfu	NIL	APHA-SM9221F
22	Escherichia Coli(E-Coli)	0cfu/100ml	cfu	NIL	APHA-SM9221F

SSDWQ = Sindh Standards for Drinking Water Quality

USEPA = United State Environmental Protection Agency method

Hach USA, method

BDL= Below Detection Limit

ND= Not Detected

Term & Condition:

- This report is not valid for any negotiations
- Report is valid for current batch(sample)
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- This report is intended only for your guidance & not for legal purpose or for advertisement

Sample Analyzed by: **AFAQ AHMED**

Signature of Laboratory In charge: _____
Name: **Haseeb Arshad**



Lab Report Ref. No. : QTS/PPL/1837-B

Reporting Date: 03/02/2025

Project: **EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL**

SAMPLE DESCRIPTION

Sample ID: Ground water 02
Sample Type: Liquid
Sampling Coordinates: 27°16'44.5"N 68°39'03.4"E
Sample Collected/Submitted by: QTS representative
Sampling Date: 13/01/2025

ANALYTICAL TEST REPORT

S.NO.	PARAMETERS TO BE ANALYZED	STANDARD SSDWQ	UNITS	RESULTS	TEST METHOD
1	pH value	6.5-8.5	-	7.50	USEPA 150.1
2	Total Dissolved Solids(TDS)	<1000	mg/L	497	Hach 8160
3	Total Hardness(as CaCO ₃)	<500	mg/L	375	Hach 8213
4	Turbidity	<5	NTU	1.5	Turbidity meter
5	Nitrate(NO ₃)	≤50	mg/L	0.14	Hach 8039
6	Nitrite(NO ₂)	≤3	mg/L	2	Hach 8153
7	Phenolic compounds(as phenol)	<0.002	mg/L	BDL	USEPA 420.1
8	Chloride(as Cl ⁻)	<250	mg/L	53.5	Hach 8206
9	Fluoride(as F ⁻)	≤1.5	mg/L	0.17	USEPA 340.1
10	Taste	Non objectional/ acceptable	Physical	Acceptable	Physical
11	Odour	Non objectional/ acceptable	Physical	Acceptable	Physical
12	Arsenic	≤ 0.05	mg/L	BDL	APHA-3120 B
13	Barium	0.7	mg/L	7	Hach 8014
14	Copper	2	mg/L	0.015	Physical
15	Manganese	≤ 0.5	mg/L	0.33	Hach 8034
16	Zinc	5	mg/L	0.16	USEPA 3500 Zn B
17	Residual Chlorine	0.2-0.5 at consumer end, 0.5-1.5 at source	mg/L	0.021	Hach - 8167
18	Chromium	≤0.05	mg/L	0.017	ASTM D-1687
19	Cyanide	≤0.05	mg/L	BDL	Hach 8027

MICROBIOLOGICAL TEST REPORT

20	Total Coliform	0cfu/100ml	cfu	2	APHA-SM9221B
21	Fecal Coliform	0cfu/100ml	cfu	NIL	APHA-SM9221F
22	Escherichia Coli(E-Coli)	0cfu/100ml	cfu	NIL	APHA-SM9221F

SSDWQ = Sindh Standards for Drinking Water Quality

USEPA = United State Environmental Protection Agency method

Hach USA, method

BDL= Below Detection Limit

ND= Not Detected

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Sample Analyzed by: **AFAQ AHMED**

Signature of Laboratory In charge: _____
Name: Haseeb Arshad



Lab Report Ref. No. : QTS/PPL/1837-C

Reporting Date: 03/02/2025

Project: **EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL**

SAMPLE DESCRIPTION

Sample ID: Ground water 03
Sample Type: Liquid
Sampling Coordinates: 26°58'30.9"N 68°34'57.7"E
Sample Collected/Submitted by: QTS representative
Sampling Date: 13/01/2025

ANALYTICAL TEST REPORT

S.NO.	PARAMETERS TO BE ANALYZED	STANDARD SSDWQ	UNITS	RESULTS	TEST METHOD
1	pH value	6.5-8.5	-	7.28	USEPA 150.1
2	Total Dissolved Solids(TDS)	<1000	mg/L	773	Hach 8160
3	Total Hardness(as CaCO ₃)	<500	mg/L	500	Hach 8213
4	Turbidity	<5	NTU	0.11	Turbidity meter
5	Nitrate(NO ₃)	≤50	mg/L	0.4	Hach 8039
6	Nitrite(NO ₂)	≤3	mg/L	2	Hach 8153
7	Phenolic compounds(as phenol)	<0.002	mg/L	BDL	USEPA 420.1
8	Chloride(as Cl ⁻)	<250	mg/L	107	Hach 8206
9	Fluoride(as F ⁻)	≤1.5	mg/L	0.44	USEPA 340.1
10	Taste	Non objectional/ acceptable	Physical	Acceptable	Physical
11	Odour	Non objectional/ acceptable	Physical	Acceptable	Physical
12	Arsenic	≤ 0.05	mg/L	BDL	APHA-3120 B
13	Barium	0.7	mg/L	12	Hach 8014
14	Copper	2	mg/L	0.011	Physical
15	Manganese	≤ 0.5	mg/L	0.24	Hach 8034
16	Zinc	5	mg/L	0.13	USEPA 3500 Zn B
17	Residual Chlorine	0.2-0.5 at consumer end, 0.5-1.5 at source	mg/L	0.022	Hach - 8167
18	Chromium	≤0.05	mg/L	0.011	ASTM D-1687
19	Cyanide	≤0.05	mg/L	BDL	Hach 8027

MICROBIOLOGICAL TEST REPORT

20	Total Coliform	0cfu/100ml	cfu	2	APHA-SM9221B
21	Fecal Coliform	0cfu/100ml	cfu	NIL	APHA-SM9221F
22	Escherichia Coli(E-Coli)	0cfu/100ml	cfu	NIL	APHA-SM9221F

SSDWQ = Sindh Standards for Drinking Water Quality

USEPA = United State Environmental Protection Agency method

Hach USA, method

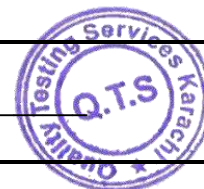
BDL= Below Detection Limit

ND= Not Detected

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Sample Analyzed by: **AFAQ AHMED**

Signature of Laboratory In charge:
Name: **Haseeb Arshad**


Lab Report Ref. No: QTS/PPL/1838-A

Reporting Date: 03/02/2025

Project: EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL

SAMPLE DESCRIPTION

Sample ID: Surface Water 01
Sample Type: Grab Sample
Sampling Coordinates: 27°17'36.27"N 68°38'40.35"E
Sample Collected/Submitted by: QTS
representative Sampling Date: 13/01/2025

ANALYTICAL TEST REPORT

S.NO.	PARAMETERS TO BE ANALYZED	UNITS	RESULTS	TEST METHOD
1	pH value	-	7.57	USEPA 150.1
2	Chemical Oxygen Demand (COD)	mg/L	96	Hach 8000
3	Biochemical Oxygen Demand (BOD) ₅ at 20°C	mg/L	44	Hach method
3	Total Suspended Solids (TSS)	mg/L	12	Hach 8006
4	Total Dissolved Solids (TDS)	mg/L	10,200	Hach 8160
5	Oil & Grease	mg/L	0.21	APHA 5520-D
6	Fluoride (as F ⁻)	mg/L	0.02	USEPA 340.1
7	Chloride (as Cl ⁻)	mg/L	2,350	Hach 8206
8	Total Hardness (as CaCO ₃)	mg/L	4,490	Hach 8213
9	Turbidity	NTU	14	Turbidity meter

USEPA=United State Environmental Protection Agency method

Hach USA, method

BDL=Below Detection Limit

APHA-SM = American Public Health Association- Standard Methods for Water & Waste water Examination

- This report is not valid for any negotiations
- Report is valid for current batch(sample)
- The remaining portion of the sample will be discarded after 07 days unless otherwise instructed

Sample Analyzed by: AFAQ AHMED

Signature of Laboratory In charge: _____
Name: Haseeb Arshad



Lab Report Ref. No: QTS/PPL//1838-B

Reporting Date: 03/02/2025

Project: **EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL**

SAMPLE DESCRIPTION

Sample ID: Surface Water 02
Sample Type: Grab Sample
Sampling Coordinates: 27°29'54.8"N 68°36'11.7"E
Sample Collected/Submitted by: QTS representative
Sampling Date: 13/01/2025

ANALYTICAL TEST REPORT

S.NO.	PARAMETERS TO BE ANALYZED	UNITS	RESULTS	TEST METHOD
1	pH value	-	7.44	USEPA 150.1
2	Chemical Oxygen Demand (COD)	mg/L	56	Hach 8000
3	Biochemical Oxygen Demand (BOD) ₅ at 20°C	mg/L	33	Hach method
3	Total Suspended Solids (TSS)	mg/L	2	Hach 8006
4	Total Dissolved Solids (TDS)	mg/L	5,270	Hach 8160
5	Oil & Grease	mg/L	0.11	APHA 5520-D
6	Fluoride (as F ⁻)	mg/L	0.24	USEPA 340.1
7	Chloride (as Cl ⁻)	mg/L	977	Hach 8206
8	Total Hardness (as CaCO ₃)	mg/L	2,470	Hach 8213
9	Turbidity	NTU	4	Turbidity meter

USEPA=United State Environmental Protection Agency method

Hach USA, method

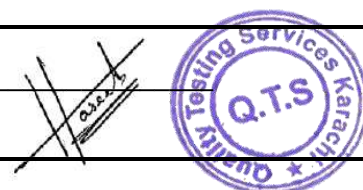
BDL=Below Detection Limit

APHA-SM = American Public Health Association- Standard Methods for Water & Waste water Examination

- This report is not valid for any negotiations
- Report is valid for current batch(sample)
- The remaining portion of the sample will be discarded after 07 days unless otherwise instructed

Sample Analyzed by: **AFAQ AHMED**

Signature of Laboratory In charge:
Name: Haseeb Arshad



Lab Report Ref. No: QTS/PPL//1838-C

Reporting Date: 03/02/2025

Project: **EIA recon survey & ecological survey, social consultation and environmental monitoring for Gambat-II PPL**

SAMPLE DESCRIPTION

Sample ID: Surface Water 03
Sample Type: Grab Sample
Sampling Coordinates: 27°17'26.8"N 68°30'58.1"E
Sample Collected/Submitted by: QTS representative
Sampling Date: 13/01/2025

ANALYTICAL TEST REPORT

S.NO.	PARAMETERS TO BE ANALYZED	UNITS	RESULTS	TEST METHOD
1	pH value	-	7.64	USEPA 150.1
2	Chemical Oxygen Demand (COD)	mg/L	21	Hach 8000
3	Biochemical Oxygen Demand (BOD) ₅ at 20°C	mg/L	9	Hach method
3	Total Suspended Solids (TSS)	mg/L	8	Hach 8006
4	Total Dissolved Solids (TDS)	mg/L	418	Hach 8160
5	Oil & Grease	mg/L	0.18	APHA 5520-D
6	Fluoride (as F ⁻)	mg/L	0.19	USEPA 340.1
7	Chloride (as Cl ⁻)	mg/L	82	Hach 8206
8	Total Hardness (as CaCO ₃)	mg/L	197	Hach 8213
9	Turbidity	NTU	5	Turbidity meter

USEPA=United State Environmental Protection Agency method

Hach USA, method

BDL=Below Detection Limit

APHA-SM = American Public Health Association- Standard Methods for Water & Waste water Examination

- This report is not valid for any negotiations
- Report is valid for current batch(sample)
- The remaining portion of the sample will be discarded after 07 days unless otherwise instructed

Sample Analyzed by: **AFAQ AHMED**

Signature of Laboratory In charge: _____
Name: Haseeb Arshad



Annexure-III: Flood Risk Map Methodology

Flood Risk Map Methodology

1. Data Acquisition and Preparation

Basemap:

A basemap of the region was obtained, which include geographic features like rivers, topography, and administrative boundaries with the proposed project area.

Precipitation Data:

The average rainfall data over 30 years were collected from Climate Research Unit into NetCDF raster format. It was then imported into ArcGIS software using multidimensional tool in Arc Tool box.

Elevation:

The elevation train was also analyzed within the study area, which provide information about the terrain and its influence on water flow. It also helps to identify river courses and flood plain. The Digital Elevation Model was exported from United States Geological Survey and then slope was derived from DEM using the slope tool from spatial analyst.

Soil type:

Soil types provide a crucial data in determining the vulnerability of an area to flooding, its properties significantly influence how water interact with the land surface. While devising flood risk map, soil type was also examined to know about infiltration rate and water holding capacity. The data was exported from Food and Agriculture Organization and was align and reproject to match the coordinate system of other datasets.

Hydrology of area:

Hydrology which predicts the movement of water on earth surface is fundamental to understanding and predicting flood risk map. Since project area is located in an area where there are minor and major creeks, a hydrological analysis is crucial. The data is process by preparing stream density data to align with the spatial reference of datasets in ArcGIS.

Land use and land cover data:

The land use and land cover data are downloaded from Sentinel-2 imagery with a 10 meter resolution. The data is then clipped to our study area using a data management tool and classified into five categories: water, built-up areas, crops, trees, and barren land.

2. Weighted Overlay

In the Weighted Overlay Analysis which is done in ArcGIS where each flood risk factor is assigned a specific weight to reflect its relative importance in determining overall flood risk. The analysis begins by assigning weights to each factor based on its contribution to flood risk assessment. Stream density is given the highest weight of 35%, reflecting the importance of water flow and concentration in flood prone areas acknowledging its significant impact on flood risk. Precipitation follows with a weight of 25%,. Soil data is assigned a weight of 5%, indicating its lesser but still relevant role in influencing flood risk. The Digital Elevation Model (DEM), which provides elevation data, is weighted at 10% due to its role in understanding the topography of the area. Slope, which affects water runoff, is also weighted at 10%. Finally, land use is given a 15% weight, accounting for how different land uses affect flood susceptibility. These weights are then used in the Weighted Overlay tool to combine the reclassified rasters of each factor, creating a comprehensive flood risk map that integrates the varying influences of each factor into a unified risk assessment.

3. Map Development

Symbology: The flood risk raster was assigned unique colors and symbols for each flood risk category to create a visually appealing and informative map.

Legend: A legend is also created to explain the meaning of the different colors and symbols used in the map.

Labels and Text: Text elements, such as titles, subtitles, and credits, were added to the map to provide essential information.

Layout: The map elements were arranged and formatted to create a clear and visually pleasing layout. This may involve adjusting font sizes, colors, and the overall composition of the map.

Export: The final map was exported in a suitable format (e.g., PDF, image) for printing or digital distribution.