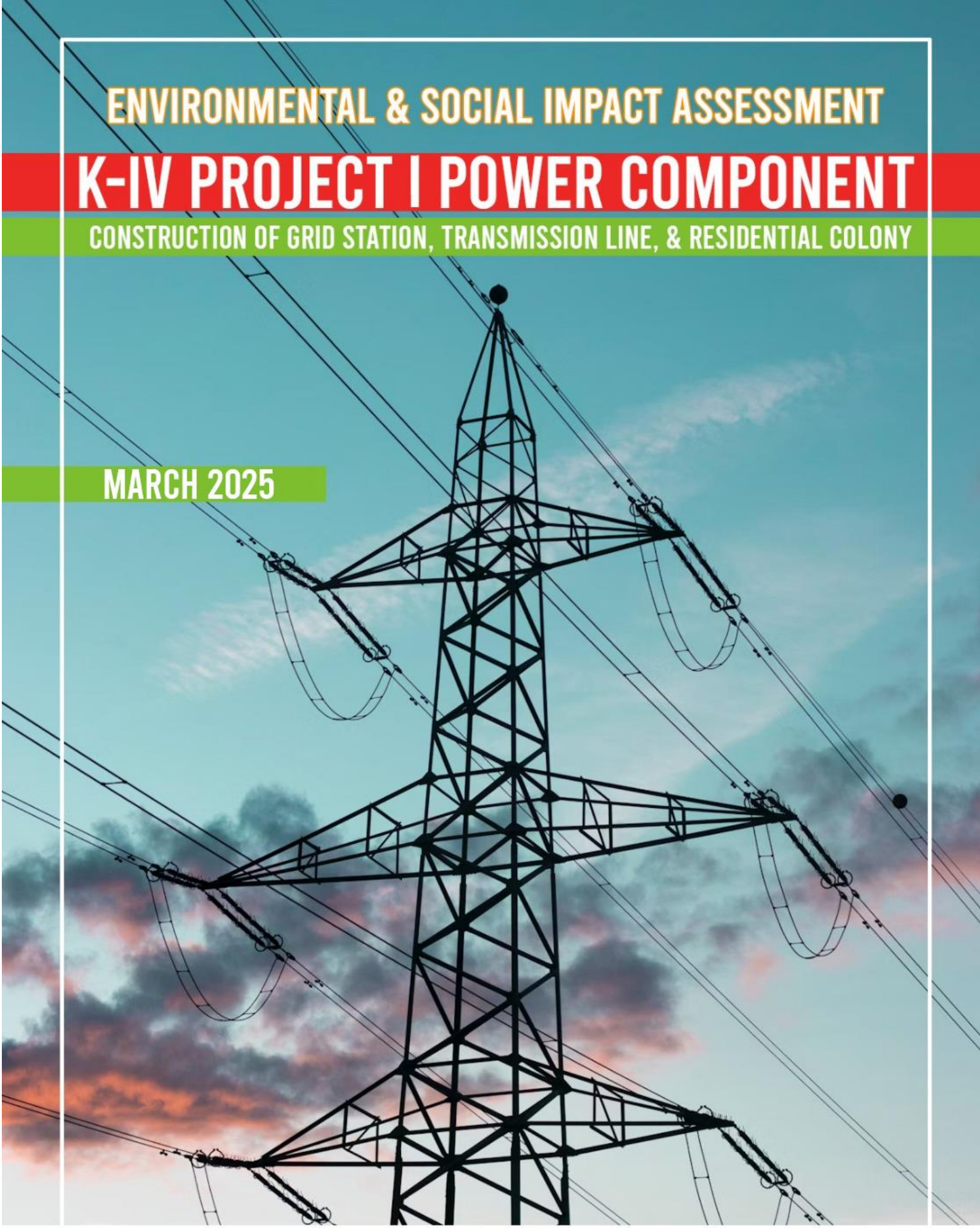
ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT

K-IV PROJECT I POWER COMPONENT

CONSTRUCTION OF GRID STATION, TRANSMISSION LINE, & RESIDENTIAL COLONY



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EMC Pakistan Private Limited

Sindh Transmission & Dispatch Company (Pvt.) Limited

REPORT ISSUE & REVISION RECORD

REVISION RECORD					
Description	**Issue**	**Revision**	**Date**	**Changes made**	**Approved By**
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Executive Summary

ES1 – Introduction

The Sindh Transmission and Dispatch Company (STDC) has initiated the development of the power component for the K-IV water supply project, including a 132 kV transmission line, grid station, and staff colony in Thatta near Keenjhar Lake. This ESIA, prepared by EMC Pakistan Pvt. Ltd., assesses potential environmental and social impacts of the power infrastructure and aligns with Sindh Environmental Protection Agency (SEPA) requirements. Although not funded by international agencies, the ESIA also incorporates World Bank standards for best practice.

ES2 – Project Description

The project is designed to ensure uninterrupted electricity supply to the K-IV pumping complex. It comprises a 26 km double-circuit overhead transmission line from Jhimpir-II Grid Station to the proposed K-IV Grid Station, a staff colony, and supporting infrastructure. Estimated at PKR 12.54 billion, the project is expected to be completed over 14 months. The design emphasizes resilience to flooding, seismic activity, and electrical safety.

ES3 – Legal & Institutional Review

The ESIA adheres to the Sindh Environmental Protection Act (2014) and the Review of Environmental Assessment Regulations (2021). The project is categorized under Schedule III (EIA required) due to its location near the Ramsar-designated Keenjhar Lake Wildlife Sanctuary. The report reviews all relevant national and provincial laws including those on labor, environmental protection, and electricity transmission.

ES4 – Analysis of Alternatives

The report evaluates alternatives for grid station technologies (GIS vs AIS), insulators (silicone vs porcelain), and transmission options (overhead vs underground lines). The selected options prioritize environmental feasibility, technical reliability, and cost efficiency. A "No Project" scenario was also assessed, which would exacerbate Karachi's water crisis.

ES5 – Baseline

The project area is mostly barren and uninhabited, minimizing direct ecological disruption. Baseline surveys captured data on:

- Physical Environment: Topography, geology, climate, air quality, and hydrology.
- Biological Environment: Flora, fauna, protected areas, and bird migratory routes.
- Social Environment: Land use, population, infrastructure, and community health within Thatta district.

ES6 – Impact Assessment & Mitigation Measures

Impacts during construction include air and noise pollution, waste generation, traffic disruption, and community health risks. Operational impacts include EMF exposure, risks to birds, and visual intrusions. All impacts are addressed with detailed mitigation strategies:

- Dust suppression and noise control
- Waste segregation and safe disposal
- Use of bird diverters and EMF monitoring
- Emergency preparedness and OHS protocols

ES7 – Stakeholder Consultations

Consultations were held with government departments and local authorities due to the absence of settlements within the project's Corridor of Influence (COI). Feedback was incorporated into the ESMP to ensure project responsiveness to public concerns and institutional requirements.

ES8 – Environmental & Social Management Plan

The ESMP defines roles for STDC, contractors, and consultants to ensure implementation and compliance. It includes monitoring indicators, training plans, emergency response procedures, and waste management protocols. The ESMP ensures that mitigation measures are tracked, reported, and adapted throughout the project lifecycle.

ES9 – Conclusion

The ESIA concludes that the proposed project is environmentally and socially feasible. With proper implementation of the mitigation measures and ESMP, the project will have a net positive impact, especially by ensuring water access through a reliable power supply. The report recommends timely implementation of safeguards and active monitoring throughout the construction and operational phases.

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1 Introduction

EMC Pakistan (Private) Limited has been tasked by the Sindh Transmission & Dispatch Company to conduct an Environmental and Social Impact Assessment (ESIA) study for the development of the power component for the K-IV Project at Keenjhar Lake in Thatta, Sindh. The project will revolve around providing power to the pumping complex of the currently under development K-IV Project by, developing a grid station next to the pumping complex, a staff colony for people who will work at the grid station, and a 132 kV transmission line between the proposed grid station and the Jhimpir-II Grid station (roughly 26 km length) currently operated by the National Transmission & Dispatch Company (NTDC). At the Jhimpir-II grid station, 50 MW of electricity will be provided by the Hyderabad Electric Supply Company (HESCO) which will then be transmitted to the K-IV grid station for use by the K-IV project. Alongside this, an 11 kV transmission line will also be developed from the K-IV grid station to the WAPDA staff colony for providing electricity to the staff colony. To address the potential environmental and social impacts from the development of this project, this Environmental and Social Impact Assessment (ESIA) has been prepared in accordance with the guidelines of the Sindh Environmental Protection Agency (SEPA) for their scrutiny and approval. Furthermore, whilst not being funded by the World Bank, the policies, and guidelines of the World Bank have also been utilized in the preparation of this assessment to ensure the project is developed in line with International Best Practices.

1.1 Background – Karachi & Water

Located along the shores of the Arabian Sea, Karachi, set over 3500 square kilometers, is Pakistan's gateway and largest metropolitan city, where it serves many purposes including being the provincial Capital of Sindh, being the country's main seaport, and serves as the country's economic and financial center. Much like other port cities and commercial centers in the world, Karachi attracts people from all over the country and beyond. The lure of better economic prospects has seen Karachi experience mass migrations into the city, where in a study carried out by the Japan International Cooperation Agency (JICA) in 2012, termed the Karachi Transportation Improvement Project, the Agency predicted the growth of the city would increase from 18.9 million persons in 2010 to around 31.6 million persons in 2030, almost doubling the population.

This rapidly increasing population of the city has put and will continue to put increasing pressure on the city's infrastructure, especially the existing water supply and sewerage system, which currently fails to provide adequate service to the city and its residents. Water and sanitation are some of the basic amenities and forms part of the fold of necessities that the city of Karachi lacks and is unable to provide to its residents up to the required demands or standards. Currently, the agency in charge, the Karachi Water & Sewerage Corporation (KWSC) is no longer equipped or empowered to deal with the constantly changing ground realities.

The Karachi Joint Water Board was constituted in 1953, which was the first body which was created to expand the Karachi water supply system from the Indus River. It was transferred to the Karachi Development Authority (KDA) in 1957 after its formation. Since the Karachi Metropolitan Corporation (KMC) handled some of the affairs of retailing and distribution of treated water and other responsibilities which were co-shared with 22 other separate agencies, there was a need to unify all of the functions under one body. Hence, in 1981, the Karachi Water & Management Board (KWMB) was created, which was given both distribution and cost recovery powers. KMC was still responsible for its revenue and sewerage maintenance, hence, KWMB was upgraded to KWSC in 1983, where It was placed under the Government of Sindh. Later in 1996, KWSC was separated from KMC and was brought back under mayoral supervision in 2001, until it was separated again under the new Sindh Local Government Act 2013.

Currently, there are four prominent, officially declared, and legal water resources for the city of Karachi. Out of these, three resources are surface water resources including Lake Haleji, Lake Keenjhar and Hub Dam. The fourth water resource is categorized as a groundwater resource; the Dumlottee wells. From these declared sources, the City of Karachi has an allocated quota of 650 Million Gallons per Day (MGD) of water from Keenjhar Lake and 100 MGD from the Hub Dam against a current demand of 1,200 MGD. Currently, only Keenjhar lake is functioning as the consistent source of water for the city, with water from the Hub Dam being unreliable during spells without rains. From these sources, water is collected and treated by conventional water treatment plants and distributed through a system which is at least 40-45 years old with the addition of a few new distribution facilities in the city. From this quota, approximately 210 MGD of water is supplied without treatment[1].

Nevertheless, there is a huge unmet demand for water (550 MGD current capacity versus an estimated demand of 1300 MGD); a high non-revenue water percentage (50-60 percent); very large financial losses (estimated at Pak Rupees (PKR) 569 million/ United States Dollar (US$) 5.4 million per month); and significant outstanding arrears (estimated at PRK 32 billion/US$305 million). Most of KWSC's 1.1 million customers get water through the piped network on an irregular basis, and some just 2-4 hours every day[2]. There is currently no sewage treatment, as the city's treatment facilities are dilapidated and not working, resulting in an estimated 475 MGD of sewage being discharged into the Arabian Sea via the storm water network3.

The K-IV project, also referred to as the Greater Karachi Bulk Water Supply Scheme, has been foreseen as the solution to bridge the gap between the current water supply to the city, and the overall increasing demand. Currently, where the city is only supplied with 550 million Gallons per Day (MGD) of water against a demand of 1300 MGD, the K-IV project has been set up to over time supply 650 MGD of water to ultimately bridge the gap between demand and supply. The project will achieve this through a phase wise development, where it will start off in phase 1 through the supply of 260 MGD, and it is expected that over 2 more phases, be brought up to meet the 650 MGD of water that has been proportioned to the city of Karachi.

With the current project spanning over a length of 110 km, the K-IV corridor will originate at Keenjhar lake where it will then follow the same corridor to pass through Districts Thatta and Malir, ultimately depositing the water into 3 reservoirs on the outskirts of Karachi through steel pipes: Reservoir 1 (R1) near the M9-N5 Link Road, Reservoir 2 (R2) near Gadap Town, and Reservoir 3 (R3) north of Surjani Town. The raw water from Keenjhar lake shall be conveyed to a pumping complex through a gated intake structure and about 400 meters of a Five Cell Reinforced Concrete (RCC) Gravity Box Conduit planned and designed for the final capacity of 650 MGD. The reservoirs will then be connected to filter plants that will also be set up in the same vicinity to treat the raw incoming water. Currently, the Water & Power Development Authority (WAPDA) from the Federal Government is tasked with the development of the K-IV project, where once complete, the project will be handed over to the Governmnt of Sindh, and particularly the Karachi Water & Sewerage Corporation for operations.

Given the importance of the K-IV project, and its reliance on pressurized pumping as an essential requirement to the supply of water to the city of Karachi from Keenjhar lake, an uninterrupted power supply to the project will be essential.

1.2 Project Overview

Given that ultimately the Government of Sindh will be the custodian of the K-IV project, and with the project located in the province of Sindh, STDC has been tasked with the development of the

[1] *Situational Analysis of Water Resources of Karachi, WWF 2019*
[2] *Dawn (2016) Tapping into Trouble. Retrieved from https://herald.dawn.com/news/1152875*
[3] *Situational Analysis of Water Resources of Karachi, WWF 2019*

power component for the project, i.e., the 132 kV transmission line and 132 kV/ 11 kV grid station adjacent to the pumping station at Keenjhar Lake to provide the required power to the K-IV project. For Phase-I of the K-IV Project, 50MW power will be provided to the pumping station from Jhimpir-II power station, network through a proposed loop-in loop-out arrangement. The major components of the project are described further below:

1. **Grid Station**: The design of the grid station includes a layout optimized for operational efficiency and safety. Engineering plans have been developed in detail to ensure that all components are integrated seamlessly where these plans are attached to this report.
2. **Transmission Line**: The project involves the installation of a 132 kV double circuit overhead transmission line, which has been designed based on the approved grid interconnection study report by NTDC/HESCO. The transmission line will utilize lattice towers, with a total of approximately 125 towers planned along the route. The proposed route for the transmission line spans approximately 26 kilometres, where the Right of Way of the route spans 50 feet on both sides of the transmission line. Furthermore, an 11 kV transmission line will also be set up between the grid station and the WAPDA staff colony for providing electricity to the staff colony.
3. **Staff colony:** A staff colony will be built adjacent to the grid station to house personnel during the project's operational phase. The design includes residential blocks, a mosque, and various other structures, providing the operational staff with convenient living spaces near the project site. This arrangement aims to promote a healthy work-life balance by minimizing long commutes to the project site.

A map of the project site is also provided below:

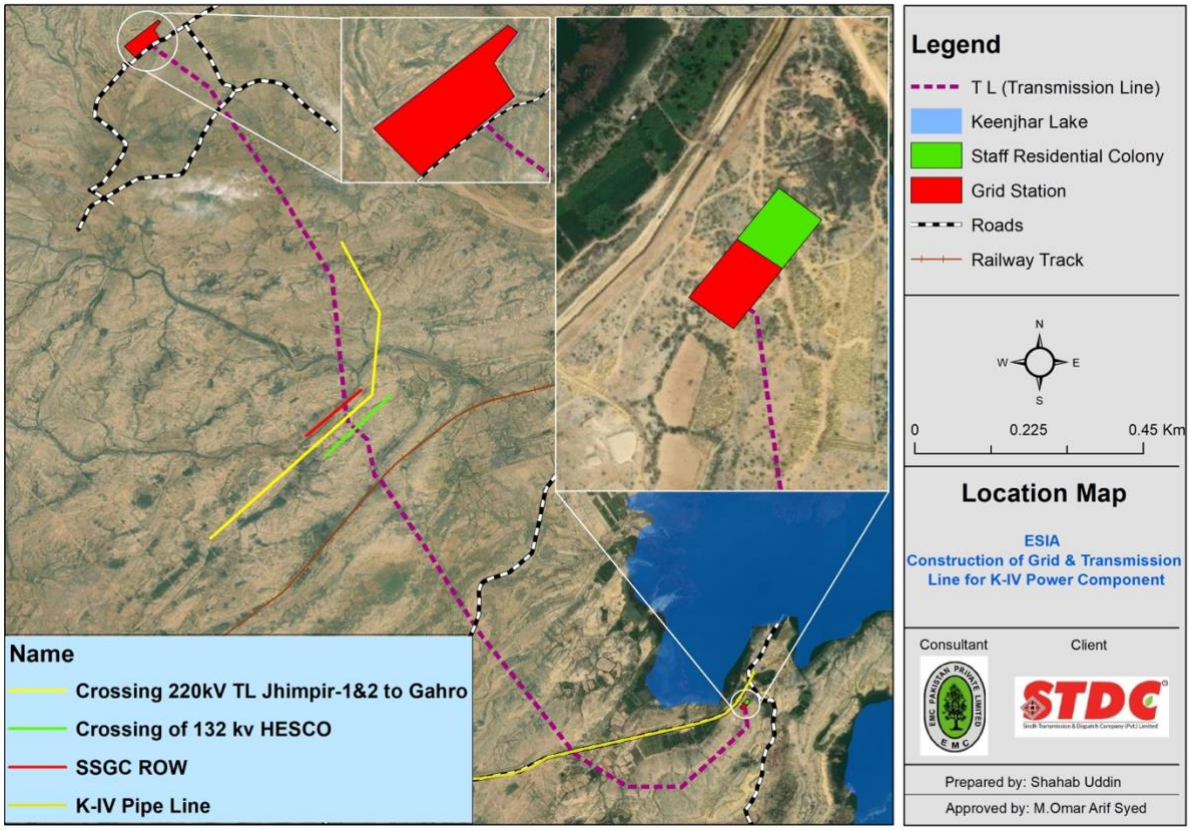


Figure 1.1 - Project Location & Route

The land where this project is proposed comprises of approximately 6.5 acres of unutilized (vacant) land where the STDC Grid Station and residential colony will be situated. North of the proposed

grid station is the pumping complex for K-IV and the WAPDA staff colony. Furthermore, the route along the transmission line's RoW also comprises of mostly barren land, while crossing different infrastructure lines and utilities such as a Sui Southern Gas Company (SSGC) pipeline, a railway line, a 220 kV transmission line, and a 132 kV HESCO transmission line.

1.3 Project Proponent[4]

The proponent for this project will be the Sindh Transmission & Dispatch Company, where STDC is a provincial energy transmission entity estbalished under the Government of Sindh, where it focuses on developing and managing electric power transmission infrastructure in the region. Pertinent details on the proponent are provided below:

Overview

- **Ownership** - The company is wholly owned by the Sindh Government and is registered under the Securities & Exhange Commission of Pakistan (SECP)
- **Purpose** – Address the need for high-voltage electric power transmission, ensuring reliable energy distribution

Vision & Strategy

- Aims to become a leading national enterprise with global aspirations
- Committed to safe, efficient, and environmentally friednly infrastructure projects
- Holds ISO certifications for quality management, environmental management, and occupational health and safety

Licensing & Operations

- Licensed by the National Electric Power Regulatory Authority (NEPRA) as a provincial grid company, allowing it to build and manage grid stations and transmission lines in the Sindh region
- Involves projects such as high-voltage lines and grid stations in Jhimpir for evacuating power from wind farms and other renewable energy sources

1.4 Need for ESIA

The Sindh Environmental Protection Act -2014 is the governing environmental law for the proposed project, with the Sindh Environmental Protection Agency (SEPA) as the governing authority for environmental matters pertaining to the project.

The need for this ESIA is warranted as per Section 17 of the Sindh Environmental Protection Act, 2014, which states:

> *"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 approval in respect thereof."*

Furthermore, the Review of Environmental Assessment Regulations 2021 of SEPA also provides the necessary details pertaining to the preparation, submission, and review of different environmental assessments, including ESIA reports. The categorization of the proposed project falls under the following category defined in the regulations:

[4] Sindh Energy Department

Schedule III – Projects Requiring an EIA
Category J – Environmentally Sensitive Areas
All projects situated in environmentally sensitive areas being identified by the Agency

The proposed project is located near Keenjhar Lake, which is designated as a Wildlife Sanctuary under the Sindh Wildlife Protection, Preservation, Conservation, and Management Rules, 2022. Furthermore, Keenjhar lake is also categorized as a Ramsar site under international conventions, citing it as a wetland of international importance, consequently, triggering the need for a detailed Environmental and Social Impact Assessment (ESIA) to be carried out for the proposed project.

1.5 Objective of ESIA

The prime objective of the ESIA study is to identify and assess the anticipated impacts and risks of the proposed project, and to accordingly recommend adequate mitigation measures to prevent/ minimize the identified impacts on the surrounding physical, biological, and social environment. This is done through adopting changes and practices, which ameliorate the environmental and social performance of a project during its different stages (pre-construction, construction, and operation).

More specifically, other associated objectives of this ESIA are to:

- Facilitate STDC in ensuring the environmental and social sustainability of the project.
- Establish a baseline of the existing environmental and social conditions in the project area prior to project initiation, by collecting secondary and primary data/ information on physical, biological, and socio-economic conditions.
- Identify potentially significant environmental and social impacts (positive and negative) during the different stages of the project.
- Conduct, record, and report public consultations and participation with major stakeholders; and
- Devise an Environmental and Social Management Plan (ESMP) for all stages of the project as a tool for the implementation of the suggested measures, along with a monitoring and evaluation mechanism with adequate resources including capacity building of the implementing agencies.

1.6 Approach & Methodology

The detailed approach & methoodlogy used for this ESIA is given below:

1.6.1 Literature Review

Before mobilization, a desktop study was conducted, involving the collection and review of guidelines, data, and reports relevant to the project. This included: (a) an examination of applicable environmental legislation (b) analysis of Google Earth satellite imagery; (c) relevant design information provided by the client and design consultant; and (e) references to ESIA documents from similar projects.

This review encompasses various aspects, including previous studies, regional environmental data, socio-economic analyses, and documentation of similar projects in Pakistan and internationally.

1.6.2 Review of Environmental Laws an Institutional Requirements

A thorough review of environmental laws and institutional requirements is essential to ensure compliance with legal frameworks governing environmental and social impacts in Pakistan. This review includes national, provincial, and local regulations that pertain to the construction and operation of the K-IV Power component. All such laws and legislations related to the proposed project have been discussed in detail in chapter 3 of this ESIA.

1.6.3 Delineation of Corridor of Influence (COI)/ Area of Impact/ Influence (AOI)

The delineation of the corridor of influence is a crucial step in the ESIA process, defining the spatial area where the project may have direct or indirect environmental and social impacts. This corridor encompasses not only the physical footprint of the project but also the surrounding areas that may be largely affected by its activities.

The Corridor of Influence (COI) for this project includes the main project site(s) and associated facilities, such as contractor camps, temporary material storage areas, and vehicle parking areas, where project impacts are expected to occur. Environmental and social risks and impacts were assessed for all relevant stages of the project cycle, including pre-construction, construction, and operational phases. For this project, the COI has been defined as 50 ft on either side of the RoW of the pipeline. This 100-ft buffer was chosen based on the expectation that any significant environmental and social impacts would likely arise within this designated area, and in line with international best practices. A depiction of this is also provided below:

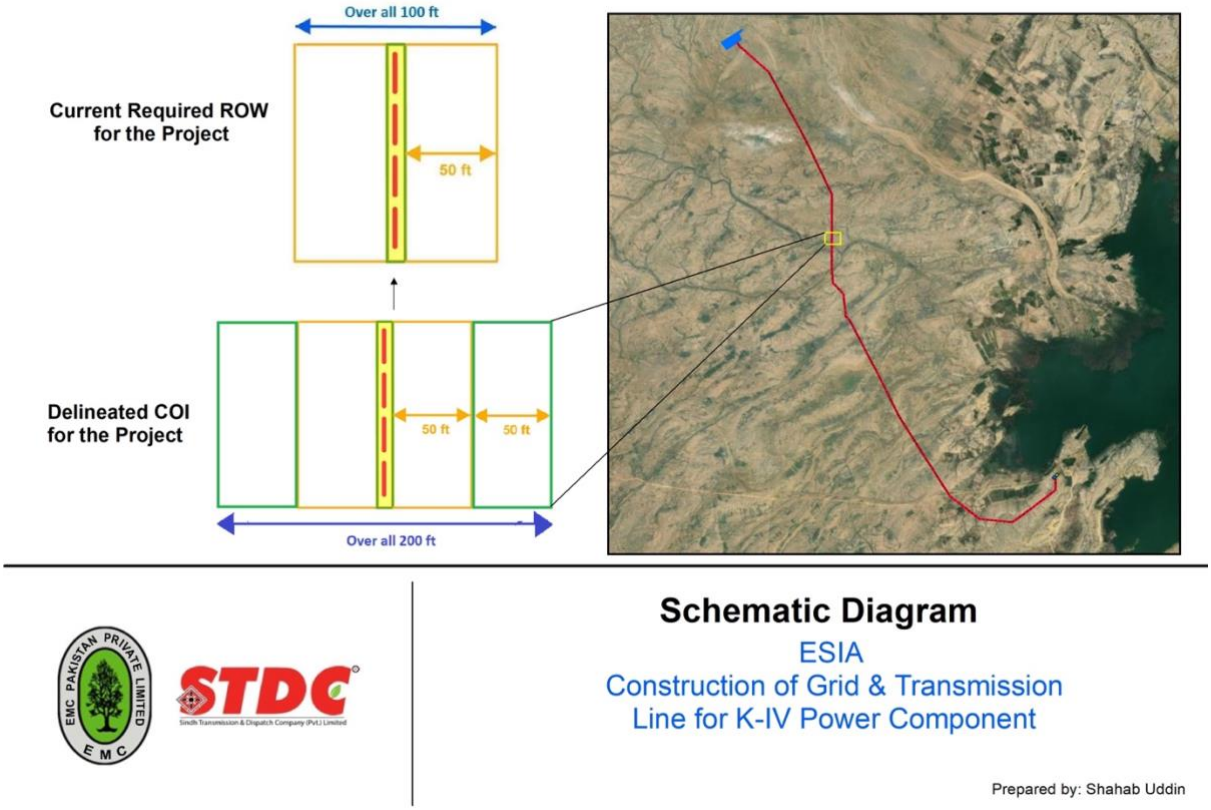


Figure 1.2 - Corridor of Influence for Project

Furthermore, given that the project relies on a mostly linear corridor, the COI/AOI terms have been used interchangably in the report.

1.6.4 Analysis of Alternatives

The ESIA process mandates for the assessment of each potential alternative available for the project that could be developed to meet the objectives, and from this assessment, to recommend the most environemntally, socially, and economically feasible option.

To select the most viable design for the project, and route for the transmission line, the analysis of different alternatives was carried out. In addition, the No Project Option (NPO) was also discussed with reference to the increasing requirement for water and associated infrastructure for the city of Karachi.

1.6.5 Environmental & Social Baseline Surveys for the Project

Baseline surveys are essential for establishing the current environmental and social conditions within the project area. These surveys provide a reference point against which potential impacts can be assessed, enabling the identification of significant changes resulting from project activities. Prior to the start of field activities, comprehensive checklists, proformas, and maps were developed covering the following main parameters:

A) Physical Environment

The information required for the establishment of the physical baseline included the following parameters:

- Land Resources (including land use pattern, soil composition, soil erosion, etc.)
- Water Resources & Flow Patterns (including available surface and groundwater resources, and natural streams, hydrology, spring water, water supply, water contamination sources,etc.)
- Climate data (including temperature, rainfall, humidity, wind speed, and direction, etc.)
- Ambient air quality and noise levels monitoring data

B) Ecological Environment

Information collected through primary (field surveys) and secondary data sources for the establishment of the ecological baseline included the following main parameters:

- Flora (trees, shrubs, herbs, grasses, and overall vegetation including valuable or rare trees and their losses due to implementation of the project, etc.)
- Fauna/ Wildlife (mammals, repitles, amphibians, avifauna)
- Agriculture and livestock
- Protected Areas, Natural Parks, Game Reserves, Wildlife Sanctuaries or any other ecologically sensitive areas
- Migratory Birds corridors
- Endangered species (flora and fauna)

C) Socio-Economic Environment

- Identifying significant cultural and historical sites within the project area, ensuring that potential impacts on heritage are recognized and addressed.
- Mapping existing land uses within the project area, including agriculture, residential areas, and natural habitats, to assess potential conflicts with project activities.
- Identifying key stakeholders, including community leaders, local organizations, and government authorities, to facilitate effective engagement throughout the ESIA process.

1.6.6 Stakeholder Consultation

Extensive stakeholder identification and consultations were also conducted for the project. The project stakeholders were identified during the inception/ scoping stage and meetings were conducted with them to receive feedback on the anticipated environmental and social issues related to the project impacts and suggested mitigation measures. Given that there were no settlements or structures identified within the COI, meetings were carried out with relevant departments to discuss the issues/ constraints and get their views and feedback to mitigate the potential environmental and social impacts associated with the implementation and operation of the project. Letters were also written to the concerned departments through the clients for communication and feedback on the project.

1.6.7 Impact Assessment & Mitigation Measures

The impact assessment process for the K-IV Power component project involved evaluating potential environmental and social impacts, identifying both negative and positive effects to develop appropriate mitigation measures aimed at minimizing adverse outcomes. Baseline data, stakeholder consultations, and expert input were analyzed to identify impacts associated with project activities such as construction, operation, and decommissioning. Each identified impact was assessed for significance, considering factors like magnitude, duration, and likelihood of occurrence, which helped prioritize the impacts requiring mitigation.

The assessment also included a detailed evaluation of the nature, extent, location, timing, and duration of potential impacts. Severity was determined by correlating the impacts to the project's location, design, construction, and operational stages, taking into account the sensitivity of the receptor. Based on predictions and public consultations, the ESIA team screened adverse environmental and social impacts for inclusion in mitigation measures and the Environmental and Social Management Plan (ESMP).

1.6.8 Environmental & Social Management Plan

An ESMP has also been prepared to ensure the adequacy and effectiveness of the proposed measures by clearly identifying the roles and responsibilities of the agencies responsible for implementation, monitoring, and auditing of ESMP activities, existing and suggested framework, necessary approvals, training needs and the required further studies. It includes an organizational setup, a monitoring mechanism, monitoring plan along with frequency of monitoring activities, and method for data collection and environmental monitoring, ecological and social component/ social mitigation measures were introduced as part of the ESMP.

1.7 Report Organization

This report contains nine chapters, where the contents of each chapter are described as follows:

- **Chapter 1** – "Introdction" describes introduction, location of proejct, objective, purpose of the ESIA, along with the methodology.
- **Chapter 2** – "Project Description" furnishes an overall description of the project, including its background, features, and key components, timeframe, and cost.
- **Chapter 3** – "Review of Pertinent Legislations" elaborates upon the current legal framework including natioanl and provincial requirements which are applicable to the proposed project in the context of the environment and sustainable development
- **Chapter 4** – "Analysis of Alternatives" provides details on alternate technologies, routes, and opertions considered for the proposed interventions

- **Chapter 5** – "Description of the Environment" comprises a detailed narrative of the existing "baseline" conditions of the project area, with respect to its physical, biological, and socio-economic environment
- **Chapter 6** – "Anticipated Impacts & Mitigation Measures" elaborates upon the likely impacts of the project on the physical, biological, and socio-economic environment during the construction and operational stages, and proposes measures to mitigates the adverse impacts
- **Chapter 7** – "Stakeholder Consultations" provides a summary of the consultations carried out with relevant stakeholders for the proejct along with their suggestions and obervations on the project
- **Chapter 8** – "Environmnetal & Social Management Plan" outlines the mechanism to be adopted for the implementation of measures and monitoring of environment during all stages of project implementation
- **Chapter 9** – "Conclusion & Recommendations" summarizes the findings of the assessment and provides recommendations accordingly.

2 Project Description

This chapter provides a detailed overview of the project including the details of the project type, design considerations, construction aspects, procedures, and ultimately its operations and maintenance.

2.1 Need for Project

Currently, there is a huge unmet demand for water (550 MGD current capacity versus an estimated demand of 1300 MGD); a high non-revenue water percentage (50-60 percent); very large financial losses (estimated at Pak Rupees (PKR) 569 million/ United States Dollar (US$) 5.4 million per month); and significant outstanding arrears (estimated at PRK 32 billion/US$305 million). Most of KWSC's 1.1 million customers get water through the piped network on an irregular basis, and some just 2-4 hours every day[5]. There is currently no sewage treatment, as the city's treatment facilities are dilapidated and not working, resulting in an estimated 475 MGD of sewage being discharged into the Arabian Sea via the storm water network[6].

The K-IV project, also referred to as the Greater Karachi Bulk Water Supply Scheme, has been foreseen as the solution to bridge the gap between the current water supply to the city, and the overall increasing demand. Currently, where the city is only supplied with 550 million Gallons per Day (MGD) of water against a demand of 1300 MGD, the K-IV project has been set up to over time supply 650 MGD of water to ultimately bridge the gap between demand and supply. The project will achieve this through a phase wise development, where it will start off in phase 1 through the supply of 260 MGD, and it is expected that over 2 more phases, be brought up to meet the 650 MGD of water that has been proportioned to the city of Karachi.

With the current project spanning over a length of 110 km, the K-IV corridor will originate at Keenjhar lake where it will then follow the same corridor to pass through Districts Thatta and Malir, ultimately depositing the water into 3 reservoirs on the outskirts of Karachi through steel pipes: Reservoir 1 (R1) near the M9-N5 Link Road, Reservoir 2 (R2) near Gadap Town, and Reservoir 3 (R3) north of Surjani Town. The raw water from Keenjhar lake shall be conveyed to a pumping complex through a gated intake structure and about 400 meters of a Five Cell Reinforced Concrete (RCC) Gravity Box Conduit planned and designed for the final capacity of 650 MGD. The reservoirs will then be connected to filter plants that will also be set up in the same vicinity to treat the raw incoming water. Currently, the Water & Power Development Authority (WAPDA) from the Federal Government is tasked with the development of the K-IV project, where once complete, the project will be handed over to the Governmnt of Sindh, and particularly the Karachi Water & Sewerage Corporation for operations.

Given the importance of the K-IV project, and its reliance on pressurized pumping as an essential requirement to the supply of water to the city of Karachi from Keenjhar lake, an uninterrupted power supply to the project will be essential in ensuring the viability of the K-IV project as a whole, underscoring the need for this development.

2.2 Project Cost

The estimated total cost for the construction of the grid and transmission line for the K-IV Power Component is approximately **12.54 billion PKR.** This budget encompasses the various aspects of the project, including materials procurement, labor, and construction services.

[5] *Dawn (2016) Tapping into Trouble. Retrieved from https://herald.dawn.com/news/1152875*
[6] *Situational Analysis of Water Resources of Karachi, WWF 2019*

A significant portion of the budget will be allocated to the establishment of the grid station, which requires advanced technology and equipment such as transformers, circuit breakers, and SCADA systems etc. for efficient power management. In addition, funds will be used for necessary permits, environmental assessments, and compliance with local regulations to ensure that the project aligns with government and utility agency standards.

The allocated budget for each component of the project is as follows:

Table 2.1 - Tentative Breakdown of Budget for Project

Project Component	Allocated Budget (PKR)
Staff Colony	640 million
132 kV Transmission Line	2.7 billion
Grid Station	8.5 billion
11 kV Transmission Line	700 million

2.3 Project Timeline

In line with the activities defined above, the time required for construction and commissioning of the infrastructure is estimated to span **14 months**.

2.4 Project Location

The proposed project is situated in District Thatta, near Keenjhar lake, where a grid station will be established at the K-IV site to supply power to the K-IV pumping complex and the staff/officer residential colony.

An 132 kV overhead transmission line will also be established under the project, which will be connected to the Gantry-Grid Station (Jhimpir-II), with approximately 125 lattice towers strategically placed along the designated route. The Right of Way (ROW) for the project spans 50 feet, where the transmission line route primarily traverses Sindh government land. The alignment also crosses a railway track running from west to east. Additionally, the overhead transmission line intersects with the 132 kV HESCO and 220 kV NTDC lines. An 11 kV transmission line will also be established between the K-IV grid station and the WAPDA staff colony to provide electricity to the staff colony.

A residential colony will also be built adjacent to the grid station to house personnel during the project's operational phase as part of the project. The design includes residential blocks, a mosque, and various other structures, providing the operational staff with convenient living spaces near the project site. This arrangement aims to promote a healthy work-life balance by minimizing long commutes to the project site

The grid station is planned at the K-IV site, accessible via the N-5 link road, while the other end of the transmission line, near the Jhimpir-II power station, can be reached via the Jhimpir-Thatta road. However, accessing certain sections of the ROW, particularly near the railway track, poses challenges.

The location of the project is also depicted in the figure below:

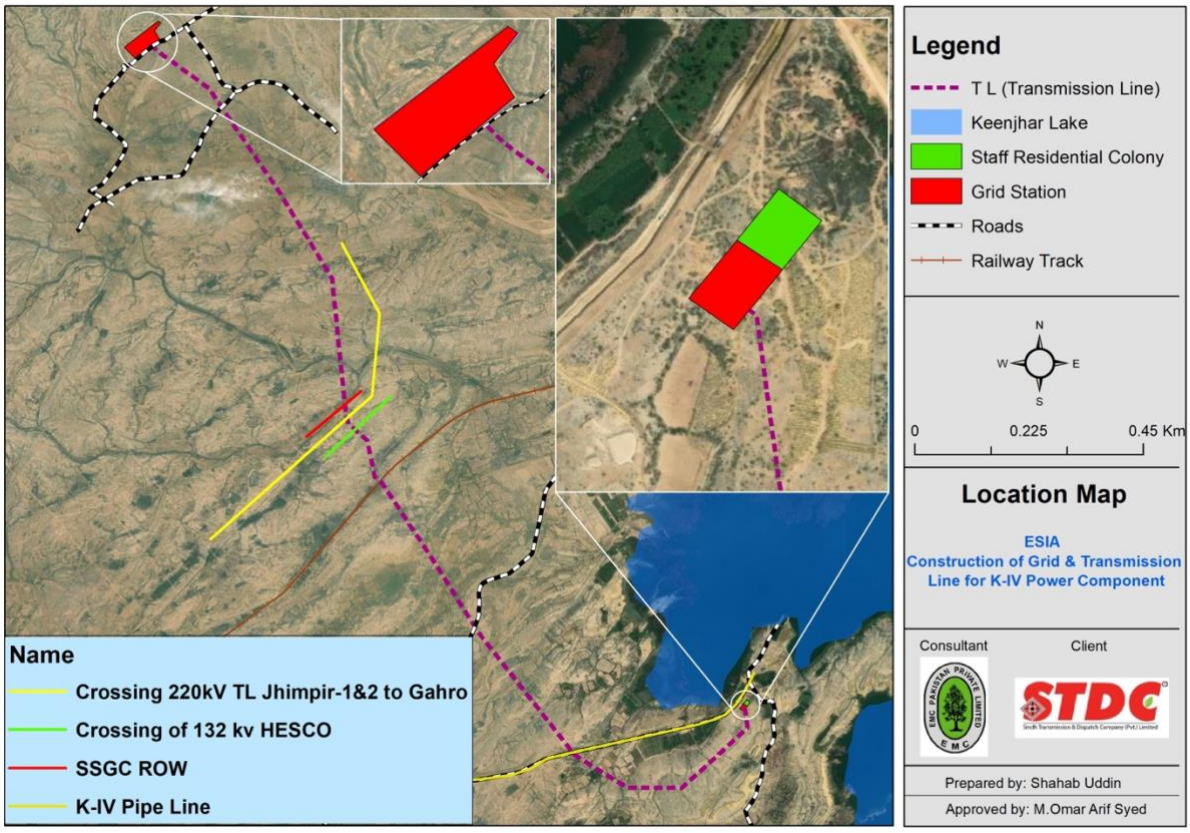


Figure 2.1 - Project Location

The initial point of the overhead transmission line is at **Gantry-GS (Jhimpir-II).** Between the two grid stations**,** approximately 125 lattice towers will be strategically placed at intervals, with various tower types including ZM60, ZM30, D1C, EA, and EG, distributed along the route to ensure optimal support for the conductors and compliance with safety standards along the route from the starting point to the ending point**.** The route also includes crossings over key infrastructure, such as roads and waterways, with specific points indicated in the data (e.g., WPP Road Crossing, Pakistan Railway Main Line Crossing). The route culminates at the **Gantry-GS K-IV** marking the endpoint of the transmission line. This layout ensures that the transmission line is effectively integrated into the existing landscape while facilitating the necessary power supply to the K-IV pumping stations.

Further descriptions on the components of the project are provided below:

2.5 Major Components of the Project

2.5.1 Overhead Transmission Line

The main component of this project is the construction and installation of the **26 km long double circuit overhead transmission line**. This line is designed to efficiently transport high-voltage electricity from the Jhimpir-II Grid Station to the 132kV K-IV Grid Station which will also be construct as part of this project, which will then supply power to the K-IV pumping stations. A separate **1 km** (approximately) transmission line will be extended from K-IV grid station to provide power to the WAPDA staff colony. This T/L will provide **11kV** i.e., medium voltage electricity to run multiple operations in the staff colony.

Tower Specifications

A total of approximately 125 towers will be erected along the transmission route, where these towers are specifically designed to withstand various environmental & climatic stresses, including:

- Each tower will be engineered to endure high wind velocities common to the area, ensuring structural integrity and stability.
- In regions prone to seismic activity, towers will be designed with enhanced resilience to withstand earthquakes.

The lattice structure provides strength while minimizing material usage, contributing to a lighter overall design that simplifies transportation and installation. The height and spacing of towers will be optimized based on terrain and line clearance requirements to ensure compliance with regulatory standards.

2.5.1.1 Erection & Testing

Erection of Poles

The erection of the transmission line towers will employ a **mechanical approach**, focusing on precision and safety. Heavy-duty equipment such as tensioners, pullers, and reel rewinders will be utilized to manage the placement and tension of the conductors accurately. This equipment ensures that the conductors are installed with the proper tension to prevent sag and maintain alignment.

The **erection process** for the transmission line towers will follow a **systematic sequence** to ensure structural integrity and operational safety. Erection of pole activity is to be performed by following activities:

- Site Mobilization - During Site mobilization contractor shall shift the necessary tools and machinery at work place.
- Site Preparation - Before starting work, contactor shall inspect all the tools and machinery properly in the presence of supervisor.
- Material (Monopole) Shifting - Contractor shall shift mono poles in parts as per instructions of safety department.
- Foundation preparation - Foundation will be prepared by assessing the geology and terrain of the area to ensure stability and load bearing capability of the site.
- Tower assembly - In this phase, sections of the **lattice towers** are pre-assembled on the ground as pre-assembling of the towers before erection saves time and is more efficient.
- Erection
    - Contractor shall arrange crane near the pole location and Pole Sections to be properly anchored with the crane and then to be suspended in the air.
    - First/Lower Section of the pole to be put on the already installed anchor bolts and tightened.
    - The 2nd section of pole to be put and installed on the first section.
    - After the erection of main body, cross arm shall be erected.
- Inspection - After installation of monopoles contractor shall inspect properly from the supervisor before inspection of Consultant & Client.
- Installation of Accessories - Sign Plates, Anti-birds, Anti-climbing Shall be installed after the completion of stringing activities.

Stringing Works for TL

- Site mobilization of stringing team with proper equipment and machinery under supervision of site engineer.
- Shifting of conductor, Insulators, OPGW and all allied hardware.

- Assembly of insulators with hardware and hanging on cross arms.
- Selection of slack or tension method for pulling as per site conditions. In any case abrasion of conductor with ground shall not be happened.
- Travelers will be installed in such a manner, that the vertical position of conductor / OPGW in sheave to be at same elevation as when clamped in the final position.
- Pulling shall be done as per selected slack or tension method.
- After pulling sagging and dead ending will be done.
- Clipping In and installation of Spacer Dampers.
- Testing of grounding.

Testing & Commissioning

After the completion of works, final checking of the line shall be done to ensure that all foundation works, erection of poles, and stringing have been done according to the specifications. After checking the line shall be tested for insulation. If any defect is found as a result of such a test shall be rectified. Testing and commissioning methods are helpful for finding crushed insulation, stray wire strands corrosive contaminants around the conductors, terminal spacing problems, and tolerance errors in the conductor. Following are the procedures to perform the tests.

1. HIPOT Test Procedure.
2. Continuity Test Procedure.
3. Phase Sequence Test Procedure.
4. OTDR Test Procedure.

1. **HIPOT Test Procedure**
   - HIPOT test makes surety of no current will flow from one point to another point.
   - HIPOT testers usually connected one side of the supply to safety ground (earth ground) and another side of the supply is connected to the conductor being tested.
   - Time duration for the HIPOT test is one minute.
   - To set the current limit, if the actual leakage current of the conductor is known then HIPOT test current can be predicted.
   - Connect the ground lead of the HIPOT tester to a suitable grounding electrode conductor
   - Attach the high voltage led to one of the isolated phase conductors.
   - Switch on the HIPOT tester, set the meter to pre-decide DC voltage, push the test button on meter and after one minute observe the resistance reading.
   - At the end of the one-minute test, switch HIPOT tester from high potential test mode to the voltage measuring mode to confirm that the phase conductor and voltage of HIPOT tester reading zero volts.
   - Repeat this test procedure for all circuit phases conductor, testing phase to ground each phase to phase when test is completed, disconnect the HIPOT tester from circuits and confirm that circuits are clear to be energized.

2. **Continuity Test Procedure.**
   - The continuity test checks the surety of current flows easily from one point to another point.
   - Purpose of continuity test measurement is to check the continuity of protective conductors and main supplementary equipotential bonds.
   - Continuity test also clears dis-connectivity of conductor between jumpering, termination, and joining by phase wise.
   - During the continuity test applied voltage at one point be to be the same at another point.
   - Continuity test measures the resistance between two points in ohms.

3. **Phase sequence test Procedure**
   - After performing the HIPOT test and continuity test conductor phase sequence test is to be applied on each circuit.

- To check the red phase other two (yellow and blue) are grounded.
- Same checking procedure for the next two phases.

4. **OTDR Test Procedure.**
   - To check out the continuity, length, and attenuation of OPGW by using the optical time domain reflectometer is used.
   - OTDR test procedure shows the total distance range of the OPGW drum length from the start point to the ending point.
   - OTDR test results pulse width, dead zones and averaging time.

2.5.1.2 Anti-Climbing Devices & Sign Plates

Anti-climbing devices and sign plates installation procedure will be applied after completion of project punch list and final inspection, where the steps to be followed are described below:

- Sign plates installed inside the line at mid of each pole which shows the phase sequence
- There will be a three-phase sign plates sequence likewise RYB (Red, yellow and blue)
- After installation of phase/sign plates, danger plates will be installed at each location
- Danger plate shows T/Line voltage to avoid climbing on the pole
- Anti-climbing device installed at 8 heights around the pole
- To avoid climbing on pole anti climbing devices are used.

2.5.1.3 Conductor & Ground Wire Details

The transmission line will utilize **AAAC Greely conductors**, which are chosen for their excellent electrical and mechanical properties. These conductors have included high conductivity as the aluminum alloy composition of the conductor offers a balance of strength and weight, allowing longer spans between the towers, providing with reduced sag values. Sag values may vary under different environmental conditions thus, detailed calculations will be performed to determine the sag of the conductors under various environmental conditions, ensuring that clearances are maintained throughout the line's operational lifespan.

Additionally, the **OPGW-48 fiber ground wire** will be integrated into the design. These are installed 9-12 inches deep into the soil. This dual-function wire serves both as a grounding conductor and a communication line, providing several advantages including enhance reliability (fiber optic capability allows for real-time monitoring of the transmission line's condition and potential fault detection) and lightning protection (OPGW also helps mitigate the risk of lightning strikes, protecting both the transmission line and nearby infrastructure).

2.5.2 Grid Station

The **grid station** acts as a critical nexus for the project, managing the distribution of electricity to the pumping complex. The project involves two key grid stations. **132kV Jhimpir-II Grid Station** is functional and will serve as the starting point for the transmission line, connecting to the existing electrical network. **132kV K-IV Grid Station** will be established which will manage the distribution of electricity to the K-IV pumping stations.

The grid station has a **Gas Insulated Switchgear (GIS)** which uses gas (**SF6**) as the primary insulation between live parts and the earthed metal enclosure. GIS has several advantages as it can withstand higher voltages, have high thermal conductivity and can also reduce ionization in the arc.

The proposed layout of the grid station is provided below:

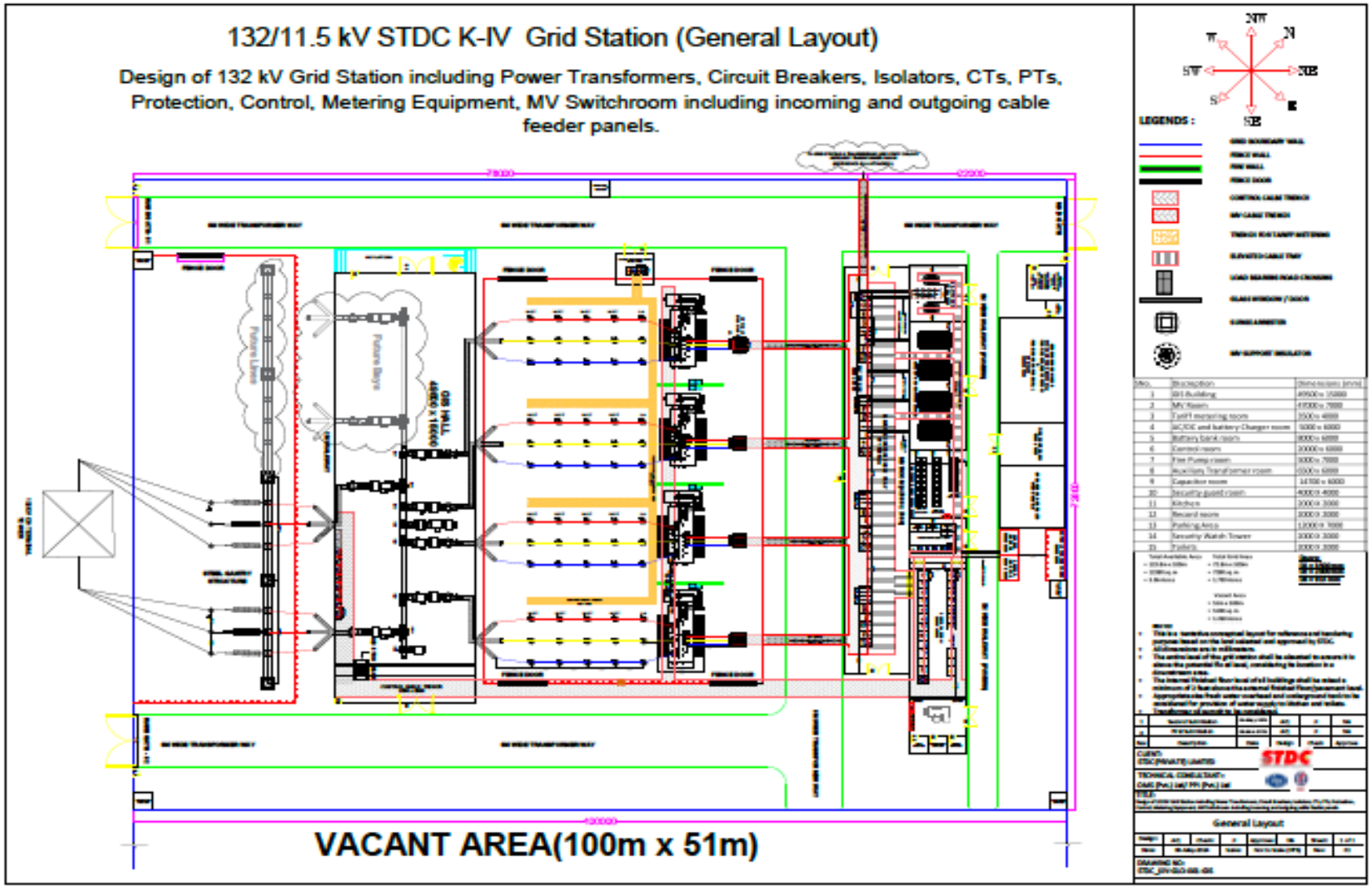


Figure 2.2 – Proposed Layout for K-IV Grid Station

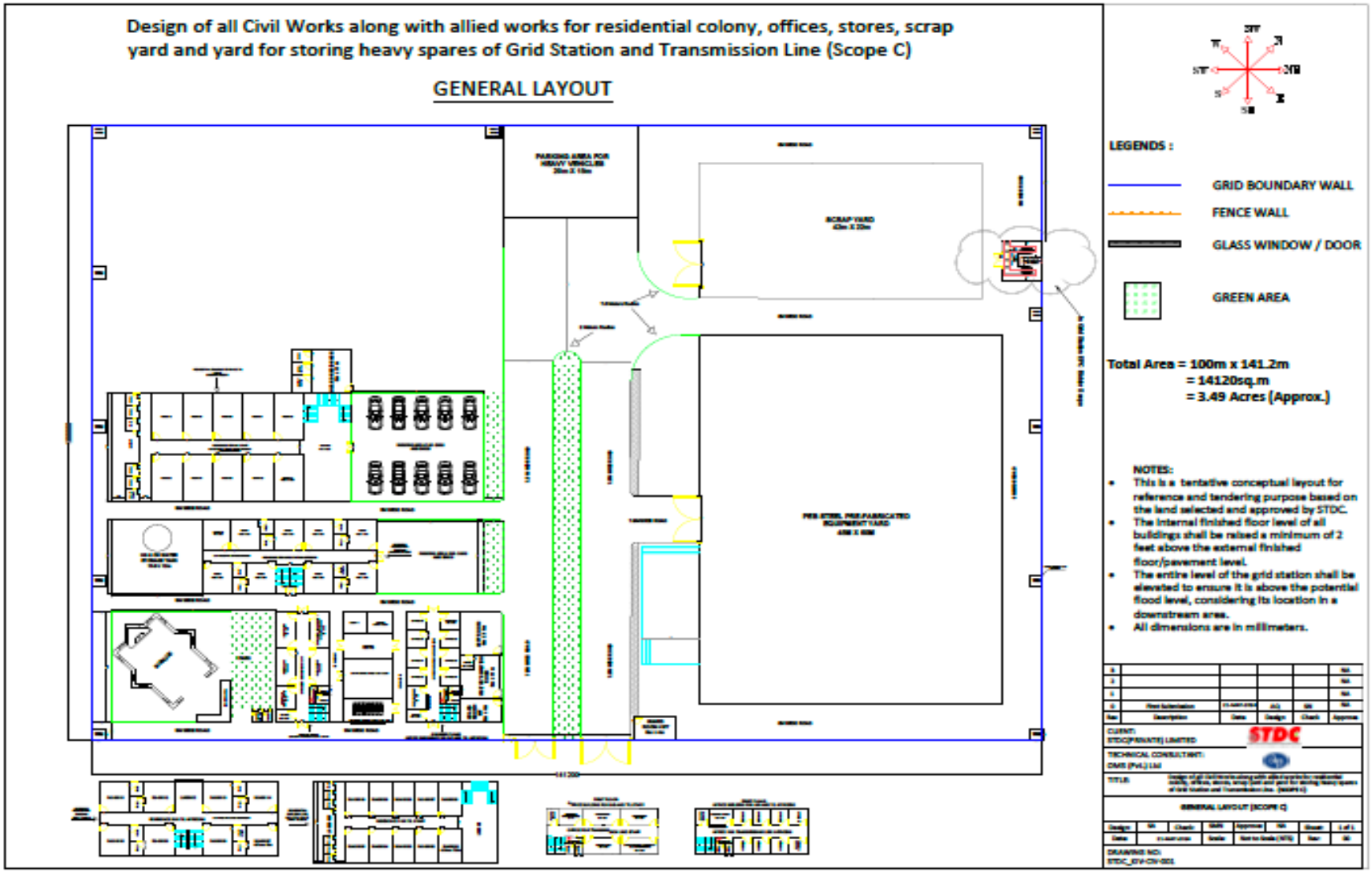


Figure 2.3 - Proposed Layout for Staff Colony

2.5.2.1 Design & Capacity

The **total available area** for the grid station is **3.06 acres**, of which **1.799 acres** have been acquired for the **grid area**, leaving **1.260 acres as vacant land for any future potential development.** The grid station is enclosed by a boundary wall, a fence wall, and a fire wall. Inside the station, there are various rooms and facilities, including the MV room, meeting room, AC/DC battery charging room, control room, fire pump room, transformer room, capacitor room, security guard room, kitchen, record room, parking area, toilets, and a security watchtower.

This layout is a **conceptual design** intended for reference and tendering purposes, based on the land **approved by STDC.** To mitigate flood risks, the entire grid station will be elevated to a level above the potential flood level, given its downstream location. All building floors will be raised at least 2 feet above the external pavement or ground level. Additionally, provisions will be made for appropriately sized fresh water storage tanks (both overhead and underground) to supply the kitchen and toilets, and a transformer oil sump pit will also be incorporated.

2.5.2.2 Equipment at Grid Station

The following equipment will be housed at the K-IV grid station:

- **Supervisory Control and Data Acquisition (SCADA) systems** will be implemented to monitor and control the electrical flow in real-time. This system will provide operators with essential data to manage power distribution effectively, identify issues promptly, and ensure system reliability.
- **Transformers:** Transformers are devices that are used to transform AC input voltage into higher or lower AC output voltage. Transformers ae typically used when a change of voltage is needed to ensure that electrical power can be efficiently transmitted over long distances and then used in homes, businesses, and industries. These are large electrical devices that transfer electrical energy between circuits through electromagnetic induction
- **Circuit Breakers:** Circuit breakers are protective devices used to safeguard electrical circuits from damage caused by overloads or short circuits. These are critical components of grid stations, which ensure the safety and reliability of the electrical grid. They automatically interrupt the flow of electricity when a fault is detected, preventing further damage to equipment and reducing the risk of fire.
- **Isolators:** Isolators are switches used to disconnect electrical equipment from the power supply. Unlike circuit breakers, isolators are used when the system is de-energized. Its primary function is to ensure the safety of personnel and equipment by disconnecting a part of the circuit when it is not in use.
- **CTs (Current Transformers):** Current transformers are used to measure and monitor the electric current in high-voltage circuits. They convert large currents to a smaller, manageable value that can be safely measured by instruments like ammeters or used for protection purposes in electrical systems.
- **PTs (Potential Transformers):** Potential transformers are used to measure high alternating voltages in power systems. They are step-down transformers and help in monitoring and protecting electrical systems by providing accurate voltage readings.
- **Metering Equipment:** Metering equipment is used to measure the consumption of electricity in an electrical system. These meters track usage for billing purposes.
- **MV Switchroom:** An MV (Medium Voltage) switch room is a specialized room where electrical equipment such as switchgear, transformers, and protection devices are installed to manage and distribute medium-voltage power. It ensures the safe operation of the electrical distribution system within a facility.
- **Incoming and Outgoing Cable Feeder Panels:** Feeder panels are electrical distribution panels that manage the incoming and outgoing electrical cables in a system. The incoming

cables bring electricity into a building or facility, while outgoing cables distribute electricity to different parts of the building.

2.5.3 Staff Colony

Proposed over an area of 3.49 acres, the purpose of the staff colony is to provide convenient and comfortable accommodation for employees working on the project during its operational phase. By offering housing in close proximity to the workplace, the colony aims to reduce commute times, allowing staff to dedicate more time to their roles and fostering a better work-life balance. This arrangement not only enhances productivity but also promotes a strong sense of community among employees, encouraging collaboration and teamwork. The layout of the staff colony is provided above in Figure 2.3. The colony, once completed, will consist of separate buildings for residence, office, dining, mosque, scrapyard, and equipment yard.

Residential Buildings

The residential complex includes separate buildings for staff and officers, divided by a 3-meter-wide road. Each building features designated parking areas for both cars and bikes, where further details on the type of buildings is provided below:

For Staff (T/L and G/S)
The staff residence is a two-story structure, comprising a ground floor and an upper floor. Each floor contains ten rooms each accommodating 03 personnel, measuring 4 m x 7.5 m. In addition to the individual rooms, the facility includes laundry areas and a lounge measuring 7 m x 7.5 m. Parking facilities are available on the ground floor.

For Officers
The officers' residence includes living quarters, a kitchen, a water storage tank, and parking space. The ground floor houses the kitchen, water storage tank, and rooms, while the upper floor consists solely of additional rooms. Each room measures 4.5 m x 5 m and features an attached bathroom. The water storage tank has dimensions of 13.5 m x 12 m.

Office Buildings

For Staff
The staff office building is a two-story structure, comprising a ground floor and an upper floor. On the ground floor, there are two toilets, a store room, an office for two security personnel, two fitter's rooms, one helper's room, and an office accommodating two foremen and two supervisors.

The dimensions for each space are as follows: the security office measures 3 m x 4 m, each fitter's room is 3 m x 6 m, the helper's room is also 3 m x 6 m, and the store room measures 3 m x 2 m. The first floor mirrors the layout of the ground floor.

For Officers
The officers' office building consists of two floors. On the ground floor, the layout includes a visitor room, a guard room, two toilets with a handwashing area, a meeting room, a store room, and a CCTV room. The dimensions for each space are as follows: the visitor room measures 6 m x 11 m, the guard room is 6 m x 4 m, the meeting room is 3 m x 4 m, the store room is 3 m x 2 m, and the CCTV room is 6 m x 11 m.

On the first floor, there are eight offices, each measuring 3 m x 3 m, along with two toilets and another store room. This arrangement ensures a functional workspace for officers while accommodating essential facilities.

Other Buildings

The site includes designated areas for heavy vehicle parking, a scrap yard, and an equipment yard. The heavy vehicle parking space measures 20 m x 15 m and is conveniently located adjacent to the scrap yard, separated by a 6 m wide road. The scrap yard itself measures 42 m x 22 m and is flanked by a 6 m wide road on each side, facilitating easy access. Additionally, the equipment yard covers an area of 45 m x 65 m and is situated across from the scrap yard, with a 7.5 m wide road leading to its entrance, providing direct access from the main thoroughfare opposite the residential block. This layout ensures efficient organization and movement of vehicles and equipment on-site.

Facilities

The staff colony also has a mosque, which features an ablution area and two toilets, each measuring 1.5 m x 2 m. This facility provides a space for prayer and religious observance for the staff. Opposite the mosque, there is a park designed for recreational activities, offering residents a place to relax and engage in outdoor pursuits. This combination of facilities enhances the overall living experience in the staff colony, promoting community well-being and spiritual fulfillment.

A dedicated dining building has also been propsoed to provide designated spaces for both officers and staff personnel. The officers' dining area measures 7.5 m x 4 m, while the staff dining area is slightly larger at 7.5 m x 6.5 m, accommodating their needs comfortably. Additionally, the dining building will feature two shops, each measuring 3.75 m x 3.5 m, along with a kitchen that measures 7.5 m x 4 m. This arrangement ensures that both officers and staff have access to quality dining facilities, enhancing their overall experience within the colony.

2.6 Site Development Plan

The proposed project will be developed in a phase wise manner to ensure systematic progress and adherence to timelines and quality standrads, where the project is dividied into the following key phases:

2.6.1 Pre-Construction Phase: Assessments & Approvals

This initial phase involves site assessments, environmental impact studies, and obtaining the necessary permits and approvals from relevant authorities. A detailed survey of the topography along the proposed transmission line route will be conducted, and consultations with local communities will ensure transparency and address any concerns.

2.6.2 Construction Phase: Infrastructure Development

During the construction phase:

- The staff colony will be constructed near the 132kV grid station for workers to stay during operational phase of the project.
- The 132kV grid station will be constructed near K-IV, following the layout provided above
- The installation of the 132kV Double Circuit Overhead Transmission Line will commence after the grid station's foundational work is underway.

Once construction is complete, a comprehensive testing and commissioning process will be undertaken. This includes testing the electrical systems, ensuring compliance with NTDC/HESCO specifications, and conducting safety inspections.

2.6.3 Post-Construction Phase: Transitioning to Operations

After successful testing and commissioning, the project will enter the operational phase. Continuous monitoring of the power supply to the pumping complex will be conducted to ensure stability. Maintenance protocols will be established to address any issues that may arise post-commissioning.

2.7 Site Security Measures

The following measures will be inbuilt into the project to ensure safety and security of the infrastructure being developed:

Access Control

- Install sturdy fencing around substations and key infrastructure points to deter unauthorized entry.
- Utilize gates staffed by security personnel to monitor and control access.
- Implement strict ID checks for all personnel entering the site to ensure only authorized staff are present.

Surveillance and Monitoring

- Deploy high-resolution CCTV cameras to monitor critical areas, including substations and sensitive sections of the transmission line.
- Implement remote monitoring systems for real-time surveillance and alerts for suspicious activity.
- Use motion detectors along less accessible parts of the transmission line to detect unauthorized movement.

Physical Barriers and Markings

- Clearly mark high-risk areas with warning signs indicating high voltage and electrocution dangers.
- Establish buffer zones around transmission towers and substations to restrict unauthorized access.
- Install guardrails near roads or walkways to prevent accidental entry into dangerous zones.

Regular Patrols and Security Personnel

- Employ trained security personnel to conduct regular patrols along the transmission line and at key facilities.
- Establish a schedule for routine security checks and audits to identify and address potential vulnerabilities.

Electrocution Safety Measures

- Ensure all transmission towers and substations have effective grounding systems to prevent electrical surges.
- Use insulated tools and provide personal protective equipment (PPE) to workers handling electrical components.
- Conduct regular training sessions on the dangers of electrocution and safe work practices.

Emergency Response Plan

- Develop detailed emergency response plans for scenarios such as electrocution incidents, natural disasters, and security breaches.
- Provide first aid training to all personnel to ensure effective response to electrical accidents.
- Maintain a list of emergency contacts, including local medical facilities and emergency services, easily accessible on-site.

Public Awareness and Community Engagement

- Conduct outreach programs to educate local communities about the project and associated risks.
- Emphasize the importance of reporting suspicious activities.
- Collaborate with local law enforcement to enhance community surveillance and response capabilities.

Data and Cybersecurity

- Implement cybersecurity measures to protect monitoring and control systems from unauthorized access.
- Regularly update software used for monitoring and control to mitigate vulnerabilities.

Incident Reporting and Analysis

- Establish clear channels for reporting security incidents or safety concerns.
- Conduct thorough investigations after any incidents to identify causes and implement corrective measures.

Disaster Management

Key rules for disaster management include staying calm, assessing the situation, and improvising as necessary to address emergencies effectively. A Detailed disaster management plan is attached in Annex-D. A list of potential disasters is also provided below along with the proposed response:

- **Earthquake Response**: Immediate actions during an earthquake include seeking cover indoors, staying away from structures, and specific remedial actions for evacuation and rescue.
- **Urban Flood Response**: Urban flooding can result from inadequate drainage systems. Immediate actions involve avoiding flooded areas and ensuring drainage of stagnant water.
- **Gas Rupture/Explosion Response**: Immediate measures include contacting the gas company, evacuating, and securing the area.
- **Hazardous Material Incidents:** The response involves identifying materials, evacuating the area, and ensuring safety protocols are followed.

2.8 Project Construction Workforce & Construction Camps

2.8.1 Project Workforce

Estimating manpower demand is essential for effectively deploying personnel for the K-IV Power Component project. This initiative will involve a range of labor types, including professional, administrative, skilled, and unskilled labor.

Based on projections from the design consultant, a peak workforce of more than **100 laborers** is estimated to be required for construction and operation activities. During the construction phase, a total of **60 workers** will be on-site to ensure the construction work proceeds smoothly. Whereas, during the operational phase, **75 workers** will be on-site to ensure the smooth functioning of the grid station and transmission line infrastructure.

A **Code of Ethics**, which includes guidelines for Gender-Based Violence (GBV) awareness, has been established for all laborers. This code will guide their interactions with surrounding communities and among themselves, promoting a respectful and harmonious working environment. Adherence to this Code of Conduct is mandatory for all workers at the construction camps. This code of conduct is attached to this report as appendix.

2.8.2 Construction Camps

Specific construction camp sites have not yet been finalized; however, guidelines herein will ensure that the selection, establishment, and operation of these camps minimize negative impacts on the surrounding environment and communities. The contractor is responsible for identifying suitable construction camp sites, guided by the following criteria:

Land Acquisition & Resettlement

- Establishing contractor camps will not involve land acquisition or potential resettlement issues. If land needs to be rented, the contractor will negotiate terms directly with landowners, ensuring a written rental agreement is signed by both parties.

Distance from Settlements

- Camp sites should be located away from existing residential areas (if any) to minimize disturbances.
- A considerable buffer zone should also be maintained.

Proximity to Project Site

- Camp sites should be chosen close to the project area to ensure convenient access to main roads, facilitating efficient transportation of materials, machinery, and personnel.

Workforce Management

- Camp sites must not pose a threat to domestic or public water supplies, and care should be taken to prevent drainage from the camps from contaminating local water sources.
- The size of each camp site should be adequate to prevent overcrowding and ensure the availability of necessary facilities.
- Precautions should be taken to avoid damage to property, vegetation, irrigation systems, and drinking water supplies.
- Camp sites should be located in areas that are not prone to flooding and away from ecologically sensitive areas, such as wildlife habitats or protected lands.

Approval of Camp Sites

- The contractor, in consultation with the Supervision Consultant (SC), will select the final locations of the contractor camps. These locations will require approval from STDC prior to campsite development

In the absence of specific zoning laws in the area, the ideal scenario for contractors would be to set up camp at a suitable location within the project's designated premises, ensuring minimal disruption and efficient operations throughout the construction phase.

2.9 Utilities Consumption

2.9.1 Water Demand & Source

In this section, the water demand for construction and operational stages is assessed and reported, along with the potential source for this water, where potable water will be required for consumption purposes at the site. Dedicated water supplies will be stored for firefighting purposes and emergency response needs adequately in line with the fire risk at the site during construction and operations.

The source of water during the **construction** phase will be from water tanks. The WHO defines between 50 and 100 litres of water per person per day[7] are needed to ensure that the most basic

[7] UN – Water Decade Programme on Advocacy and Communication and Water Supply and Sanitation Collaborative Council

needs are met, and no health concerns arise. In this case, considering the higher end of the spectrum for the project, where each worker will require 100 litres/day, the water consumption is estimated to be over 6,000 litres /day for 60 construction workers.

Similarly, during **operations**, for 75 personnel, it is estimated that roughly 7,500 litres/day of water will be required. The source of the water will be from water bowsers, where the water will be stored in dedicated tanks for use on site.

2.9.2 Wastewater Generation

The estimated wastewater generation during the **construction phase** for 60 workers is estimated at 4,800 litres/day[8] from the construction camps. Septic tanks will be constructed to provide primary treatment after which the wastewater will be discharged from the site.

The estimated wastewater generation during the **operation phase** for 75 workers is estimated at 6,000 litres/day[9] from the offices and buildings constructed. Proper septic tanks will be constructed for treatment prior to discharged from the site.

2.9.3 Solid Waste Generation

Due to the construction activities, waste will be generated at the construction sites and contractor camps. The excavated materials will be reused where applicable for construction purposes. Solid waste generated during construction and camp operations shall be safely disposed of in the operating landfill site. Considering 0.5 kg/capita/day of solid waste generated, the estimated solid waste generation is considered to be 30 kg/day for 60 workers during the construction phase. Similarly, during the operational phase, the estimated solid waste is considered to be 37.5 kg/ day.

2.9.4 Electricity

To fulfill the electricity requirement at the project site the following sources are used, where the estimated consumption is also reported:

Phases of the project	Electricity Source
Construction Phase	two kVA Diesel generator sets and 03 X15 kW Portable generators
Operational Phase	50 MW Bulk Power supply through NTDC/HESCO connection

[8] Design criteria of Public Health Engineering for Water Supply, Sewerage, and Stormwater Drainage (Domestic sewage generation = 80% of water consumed/ day)
[9] Design criteria of Public Health Engineering for Water Supply, Sewerage, and Stormwater Drainage (Domestic sewage generation = 80% of water consumed/ day)

3 Review of Pertinent Legislations

This chapter provides an overview of the policy framework and legsilation that applies to control the environmental and social ramifications arising from the proposed project implementation and operation. The project needs to comply with all the applicable environmental policies, laws, guidelines, and acts of the Government of Pakistan and the Government of Sindh.

3.1 Environmental & Social Regulatory Authorities in Sindh

The key provincial regulatory authorities that are tasked with implementing the applicable environmental and social policies are listed below:

Table 3.1 - Functions of Sindh's Environmental and Social Regulatory Authorities

Organization	Functions/ Role
Sindh Environmental Protection Agency (SEPA)	• Regulating environmental issues • Reviewing and checking environmental assessment reports prepared as per the legal requirements • Environmental approvals of the project • Ensuring compliance and reviewing the performance of environmental management plans implementation
Sindh Labor & Human Resources Department	Guaranteeing the rights of workers like the right to organize, the right to collective bargaining, participation in the affiars of the implementing agency, health & safety, minimum wags, compensation, etc. are followed in the project
Sindh Social Welfare Department & Women Development Department	• Transformation of the government into an organization that actively practices and promotes gender equality and women empowerment • Mainstreaming gender equality perspectives across public policies, laws, programs, and projects by departments and agencies of the government with a focus on women empowerment • Looking after various margnizalized segments of population such as persons living below the poverty line, people with disabilities, orphans, victims of violence (specially women) to ensure their welfare and support
Employees Old Age Benefit Institute (EOBI)	Ensure that workers are benefitted after retirement from the collected/ raised funds

3.2 Summary of Relevant Strategies, Policies, Acts & Legislations

A summary of the major relevant strategies, policies, Acts, and legislation pertinent to the project in the realm of environment and social is provided below:

Table 3.2 - National Laws & Legislations

Sr. No	Policy/Plan	Description	Relevance to K-IV Power Supply component of the project	Regulatory Requirement from Project
1.	**The Electricity Act, 1910**	The Electricity Act, 1910 is a federal legislation in Pakistan that governs the generation, transmission, and distribution of electricity. It establishes the legal framework for the electricity sector, including licensing requirements, safety standards, and operational regulations. The Act also provides provisions for the regulation of electric supply companies and the rights and duties of consumers. The electricity Act, 1910 is amended through the electricity (Amendment) Ordinance, 1979. Penalty of three years imprisonment or five thousand fines or with both is prescribed for dishonest abstraction or consumption of energy.	The Electricity Act, 1910 is relevant to the K-IV power supply component as it sets the regulatory framework for obtaining necessary licenses and permits for electricity generation and distribution.	Ensure that the project acquires the relevant approvals from the relevant departments for electricity transmission under the project
2.	***Electricity Rules, 1937***	These rules regulate the generation, transmission, supply and use of energy in Pakistan. The Act prescribes the conditions and procedures of issuance of licenses. General precautions for the safety of the public are mentioned. Construction, insulation and earthing of apparatus are prescribed to be done to prevent danger. Additional rules for electric tractions are also given	Relevant to the project as it prescribes conditions for obtaining license and practices to prevent electrical danger.	Ensure that the project acquires the relevant approvals from the relevant departments for electricity transmission under the project
3.	**National Climate Change Policy, 2021**	Pakistan developed its first National Climate Change Policy (NCCP) in 2012, which was updated in 2021. The focus of the NCCP-2021 is on adaptation and mitigation, with a major emphasis on nature-based solutions.	Relevant as it defines the different ways projects must inbuild sustainability into their design and development	Ensure that the project includes precursors for sustainability and sustainable development
4.	**National Climate Change Policy, 2021**	The policy highlights the vulnerabilities of various sectors to climate change and outlines appropriate adaptation measures. These measures cover sectors such as water, agriculture, forestry, coastal areas, biodiversity, and other vulnerable ecosystems. Despite Pakistan's small contribution to global greenhouse gas (GHG) emissions, its role as a responsible member of the global community in combating climate change is emphasized, particularly through mitigation efforts in energy, transport, forestry, and agriculture. Additionally, the policy incorporates disaster preparedness, capacity building, institutional strengthening, technology transfer, and international cooperation as important components.	Focuses on reducing GHG emissions, particularly in the energy and transport sectors, contributing to Pakistan's climate change commitments.	Ensure that the project is developed, prioritizing minimal GHG emissions and employing methods to reduce these to the extent possible

5.	**National Gender Policy Framework, 2022**	Ministry of planning, development and special initiatives, Government of Pakistan has launched National Gender Policy Framework on 8th March 2022 with an objective for year 2022-25 to accelerate progress towards equality between women and men by bringing gender equality goals and women's perspectives to the center of policy related decision making in all sectors. The Government of Pakistan aims to achieve a gender-responsive society where women and men equally contribute to, and benefit from development, and this shall be done through promotion of gender perspective in all policies and programs, understanding the prospective impact on women and men respectively, before rolling out the programs.	The policy is applicable to the project to ensure and encourage inclusion of all genders in all stages of the project and eliminate, discrimination, violence against women and girls in all its manifestations and removal of socio-cultural impediments that hinder travelling to desired places.	Ensure no discrimination is carried out in the employment of persons for the project
6.	**Pakistan Climate Change Act, 2016**	The Prime Minister of Pakistan established Pakistan Climate Change Council which coordinates and supervises the enforcement of the provisions of the Act, monitor implementation of the international agreements relating to climate change, approve and monitor implementation of comprehensive adaptation and mitigation policies, strategies, plans, programs, projects and other measures formulated by the authority to meet Pakistan's international obligations, monitor the implementation of National Adaptation Plan and its constituent provincial and local adaptation action plans, approves guidelines for the protection and conservation of renewable and non-renewable resources, species, habitats and biodiversity adversely affected or threatened by climate change.	The Act is applicable to proposed project as the proposed project involves the solid waste management activities that may contribute to generation of greenhouse gases.	Requires compliance with local EPA and its requirements
7.	**Antiquities Act, 1975**	The Antiquities Act, 1975 (amended in 1990) states the following: "Ancient" is any object that is at least 75 years old. All accidental discoveries of artefacts must be reported to the Federal Department of Archaeology. The Government is the owner of all buried antiquities discovered on any site, whether protected or otherwise. All new construction within a distance of 200 feet from protected antiquities is forbidden. No changes or repairs can be made to a protected monument, even if it is owned privately, without approval of the responsible authorities; and	Although no antiquity site has been identified within the proposed AoI. However, the law will be applicable to the Project mainly due to its two provisions: According to the law, any construction activity within 61 m or 200 ft. of protected antiquities, are prohibited. The provisions of this Act would also be applicable, if any accidental archaeological discoveries may occur during the excavation works for the	Should there be an identified antiquity lying within 200 feet of one of the project sites, then approval must be obtained from the culture and heritage department. Further during project execution, on account of discovery of any archaeological remains, antiquities department to be intimated promptly.

		The cultural heritage laws of Pakistan are uniformly applicable to all categories of sites regardless of their state of preservation and classification as monuments of national or world heritage.	construction of proposed Project.	
8.	**Pakistan Penal Code, 1860**	The Code deals with the offences where public or private property or human lives are affected due to intentional or accidental misconduct of an individual or organization. The Code also addresses control of noise, noxious emissions, and disposal of effluents.	The provisions of the Penal Code, 1860 are applicable to the Project in terms of penalties for effecting human lives and public property. It also addresses the control of noise, air emissions and effluent disposal.	Requires adherence to the law of the land, where it defines the need to comply with aspects affecting the environment and other humans.
9.	**Protection against Harassment of women at the workplace Act, 2010**	The Protection Against Harassment of Women at the Workplace Act (2010) refers to sexual harassment at the workplace.	This Act will be applicable to the Project if women are employed for the construction of the proposed Project.	Ensure that women are not harassed at workplaces.
10.	**Labor Laws as part of Constitution of Pakistan, 1973**	The Constitution of Pakistan contains a range of provisions with regards to labor rights, in particular: Article 11 of the Constitution prohibits all forms of slavery, forced labor and child labor. Article 17 provides a fundamental right to exercise the freedom of association and the right to form unions. Article 18 proscribes the right of its citizens to enter upon any lawful profession or occupation and to conduct any lawful trade or business. Article 25 lays down the right to equality before the law and prohibition of discrimination on the grounds of sex alone; and Article 37(e) makes provision for securing just and human conditions of work, ensuring that children and women are not employed in vocations unsuited to their age or sex, and for maternity benefits for women in employment. Labor law is controlled at both provincial and national levels with compulsory employment agreements containing the terms set out by the labor laws. The labor laws are a comprehensive set of laws in Pakistan dealing with the following aspects:	The labor laws are relevant as it would deal with employment of labor for the construction of proposed Project. Following are the major labor laws which are applicable to the Project: Sindh Workers Compensation Act 2015 Sindh Minimum Wage Act 2015 Sindh Terms of Employment (Standing Orders) Act 2015 Sindh Bonded Labor System (Abolition) Act 2015 Sindh Payment of Wages Act 2015 Sindh Occupational Safety & Health Act 2017 Sindh Factories Act 2021	Requires that the labor regulations defined therein are complied with during project implementation.

		Contract of Employment. Termination of Contract. Working Time and Rest Time. Working hours. Paid Leave. Maternity Leave and Maternity Protection. Other Leave Entitlements. Minimum Age and Protection of Young Workers. Equality Pay Issues. Workers' Representation in the Enterprise. Trade Union and Employers Association Regulation; and Other Laws.		
11.	**Land Acquisition Act, 1894**	The primary law for acquisition of land for public purposes in Pakistan is the "Land Acquisition Act (LAA), 1894" (hereinafter referred as the Act). The land acquired under the Act vests in the province, and it is only thereafter that the province may transfer it to someone else. The Sindh Amendment 2009 of LAA 1894 specifically related to Section 16, Section 23, Section 24, and Section 28-A.	Neither land acquisition nor physical displacement is envisaged under this project.	No land acquisition is required under the project as the land is owned by the Government.
12.	**National Disaster Management Act, 2010**	National Disaster Management Act, 2010 was passed by Parliament of Pakistan in 2010. The Act applies to whole Pakistan. The Act was passed in backdrop of 2010 Floods in Pakistan and strengthens Disaster Management system.	This Act is applicable as proper mitigation measure will be adopted by technical consultant during design stage to offset any chances of flooding during torrential rains.	Requires that the project design take into account the previous intake and data on any national disasters.
13.	**Building Code of Pakistan, 2007**	The provision of Building Code of Pakistan shall apply for engineering design of building like structure and related components. The construction in violation of the building code shall be deemed as violation of professional engineering work. Moreover, a certificate for the proposed action will be obtained from Provincial Building Control Authority.	These codes shall be used in structural design of building area components constructed under this proposed Project.	Requires that the codes defined therein are used in the construction of any buildings constructed for the project.

14.	**The Criminal Law (Third Amendment Act, 2011)**	The Criminal Law (Third Amendment) Act 2011 was passed by the Parliament in 2011 and assented by the President on 16th December 2011. The Act amended relevant sections in the Pakistan Penal Code and Code of Criminal Procedures. The Amendment criminalized a number of customary practices such as giving women or girls in marriage for settling a dispute), forced marriage, marriage with the Holy Quran and depriving women of inheriting property. All these offences are made non-compoundable and non-bailable under this Act.	This Act is applicable as the proposed project may involve the numbers of staff/worker having different religion, political affiliation, sect, colour, caste, creed, ethnic background.	Requires that workers of all different backgrounds, religions, cultures are treated the same without any discrimination.
15.	**Gender Equality as part of the Constitution of Pakistan, 1973**	The Constitution of Pakistan contains a range of provisions regarding gender equality, in particular, provides the principle of equal rights and equal treatment to all citizens/ persons, without any distinction including on the basis of sex: Article 3 calls upon the State to eliminate all forms of exploitation. Article 4 provides for the right of individual to enjoy the protection of law and to be treated in accordance with the law. This applies to the citizens as well as "to every other person for the time being within Pakistan" without distinction. This article also clearly states that certain rights cannot be suspended. Article 25 ensures equality before the law and equal protection of the law and states that there shall be no discrimination on the basis of sex alone. Articles 25(3) and 26(2) allow the state to make special provisions for the protection of women and children. Articles 26 & 27 provide for equal access to public places and equality of employment in the public and private sector. Articles 11 & 37 (g) prohibit trafficking in human beings as well as prostitution. Article 32 makes special provisions for the representation of women in local Government. Article 34 directs the state to take appropriate measures to enable women to participate in all spheres of life and social activities. Article 35 asks the state to protect the marriage, the family, the mother, and the child. Article 37 (e) directs the state to make provisions for	The articles of laws Constitution of Pakistan are relevant as it would deal with employment of male and female labor having different religion, political affiliation, sect, colour, caste, creed, ethnic background for the construction of proposed Project.	Requires that women are not discriminated against for jobs during project implementation.

		securing just and humane conditions of work ensuring that children and women are not employed in vocations unsuited to their age or sex, and for ensuring maternity benefits for women in employment. Articles 51 & 106 provide for the reservation of seats for women in the legislatures.		

Table 3.3 - Provincial Legislations & Legislations

Sr. No	Policy/Plan	Description	Relevance to K-IV Power Supply component of the project	Regulatory Requirement from Project
1.	**Sindh Strategy for Sustainable Development, 2007**	The Sindh Strategy for Sustainable Development (SSSD) proposes a ten- year sustainable development agenda for Sindh. Its purpose is to highlight the ecological, economic and social issues of the province and to provide recommendations and strategic actions to address them. The strategy promotes the sustainable use of natural resources to achieve the objectives of poverty alleviation and social development through the participation of the people of Sindh. It is a live document, which should evolve with the changing scenario. The strategy would be reviewed and revised every three years, incorporating lessons learned during implementation.	The K-IV project directly supports sustainable development by addressing critical water supply issues for Karachi, ensuring that infrastructure development aligns with broader sustainability goals. As the project involves significant infrastructure components (grid station, transmission lines), it fits within the framework encouraging robust infrastructure to support economic and social development.	Ensure that development carried out includes incorporation of sustainability to the extent possible
2.	**Sindh Drinking Water Policy, 2017**	This policy is to provide safely managed drinking water whose supply is adequate, well maintained and sustainable; and to enhance public awareness about health, nutrition and hygiene related to safe drinking water. The basic objective of this policy is to 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.	The K-IV project aims to improve the water supply for Karachi, directly supporting the policy's goal of ensuring access to safe drinking water for citizens. Improved water supply is likely to enhance public health outcomes by reducing the incidence of waterborne diseases, a key objective of the policy. There will be numerous workers working under the project, both during the construction and the operation stage,	Requires that people employed under the project are provided with clean drinking water for safe consumption

			along with living at the site, where it will need to be ensured that people	
3.	**Sindh Water Policy 2023**	The Sindh Water Policy outlines a comprehensive strategy aimed at addressing the pressing challenges surrounding water resources and their sustainable use. With increasing concerns over water scarcity, pollution, and climate change, this policy document seeks to establish a forward-looking framework that promotes efficient water management, conservation, and equitable distribution. The overarching goal of this policy is to ensure a secure water supply for present and future generations while preserving aquatic ecosystems and fostering socio-economic development.	Ensures the project's water usage is efficient and aligned with policy goals.	Ensures the project's water usage is efficient and aligned with policy goals.
4.	**1st Sindh Labour Policy, 2018**	1St Sindh Labour Policy was introduced in 2018. The Major focus of the 1st Sindh labour policy, 2018 is to ensure the health and safety of workers at work place with guaranteeing living wages for all. As labour laws are mostly male centric, but this policy will address women labour issues, which include equal opportunities and equal remuneration in line with the International Labour Organization (ILO) conventions.	The policy is applicable to the project since labor will be employed for the project at various stages.	Ensure that labor dealing and handling is in line with the requirements of the policy.
5.	**Sindh Environmental Protection Act, 2014**	Sindh Environmental Protection Agency as a part of Sindh Act No. VIII of 2014 prepared Sindh Environmental Protection Act (SEPA), 2014 which was passed by the provincial assembly of Sindh on 24th February 2014 and asserted by the Governor of Sindh on 19th March 2014 and notified on 20th March 2014. It is a fairly comprehensive legislation and provides legislative framework for protection, conservation, rehabilitation, and improvement of the environment. It contains concrete action plans and programs for the prevention of pollution and promotes sustainable development. Act has 11 parts with 37 Sections followed by sub-sections and clauses. Part VI is related to the environmental examinations and assessments while part X is related to the public participation.	The proposed Project is located in Sindh so it falls under the jurisdiction of the SEPA that will be the responsible authority for governing the environmental compliance of the project with local guidelines.	Prior to project construction, an Environmental Impact Assessment must be conducted against which an approval has to be obtained from the department.
6.	**Sindh Environmental Assessment Regulations, 2021**	These regulations set out: • Key policy and procedural requirements for filing an EIA. • The purpose of environmental assessment.	Defines the categories for different projects, where the type of study/ assessment required (Checklist, IEE, EIA) against each category of project is	As per the categories defined, the following project falls into the category of an EIA based on:

		• The goals of sustainable development. • The requirement that environmental assessment be integrated with feasibility studies. • The jurisdiction of the Provincial EPA and Planning & Development (P&D) Departments. • The responsibilities of proponents. • Duties of responsible authorities. • Provides schedules of proposals that the Project requires either EC, IEE, or an EIA. • The environmental screening process of the projects under schedule I, II and III; and The procedure for the environmental approval for filing the case with the Sindh EPA for the granting of the NOC.	defined to fulfil local environmental compliance.	**Schedule III – Projects Requiring an EIA** *Category (J) – Environmentally Sensitive Areas* All projects situated in environmentally sensitive areas being identified by the Agency
7.	**Sindh Environmental Quality Standards, 2016**	SEPA has formulated the Sindh Environmental Quality Standards (SEQS) as per Clause (g) of sub-section (1) of Section 6 of SEPA Act 2014. The SEQS were promulgated in 2016 which includes standards for liquid effluent, industrial gaseous emissions, ambient air, drinking water quality, noise levels and standards for motor vehicle exhaust, diesel vehicle, and petrol vehicles.	Defines acceptable standards for the construction and operation of different projects in Sindh with respect to ambient air quality, vehicular and exhaust emissions, drinking water quality, and effluent quality.	All projects to be implemented in Sindh must conform to SEQS during all the phases i.e., construction and operation.
8.	**Sindh Solid Waste Management Act, 2021**	The Sindh Solid Waste Management Act, 2021 enacted to establish a board for collection and disposal of all solid waste, to arrange effective delivery of sanitation services, to provide pollution free environment and to deal with other relevant matters. The Board established under the Act headed by the Chief Minister or his nominee and constitutes of thirteen other ex-officio members of other relevant departments.	This Act is applicable as the main Act of the implementing agency of the project. It will define the boundaries in which the project must take place, and continue operations in.	No requirements, only defines the ambit of SSWMB's operations.
9.	**Sindh Cultural Heritage (Preservation) Act, 1994**	This provincial Act empowers the Government of Sindh to preserve and protect any premises or objects of archaeological, architectural, historical, cultural, or national interest in Sindh by declaring them protected. Karachi alone has over 200 buildings declared as "Protected Heritage" by the Government of Sindh.	If a site is declared as a protected heritage, then no work may take place within 200 feet of that area.	None of the sites protected under this law has been identified within the RoW/ZoI of the proposed Project. STDC will get NOC from Department of Culture, Tourism and Antiquities if any protected site is identified along the project.
10.	**Sindh Wildlife Protection, Preservation, Conservation and**	The Sindh Wildlife Protection, Preservation, Conservation & Management Act was enacted in September, 2020. The Act was passed to make provisions for protection, conservation, preservation, and sustainable use of wildlife	Project is locate next to Keenjhar lake which is amongst protected areas and thus this act is applicable to the project.	Ensure work done is in line with the policies and provisions of the Act

	Management Act, 2020	for establishment, management and maintenance of protected areas in the Province of Sindh. The Act introduces the establishment of a Council for protection and the Conservation of Wildlife, and other measures which guarantee and protect the rights and ensure safety of wildlife in the Province of Sindh.		
11.	**The Sindh Prohibition of Employment of Child Act, 2017**	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 Prohibition of Child Employment Act (PCEA) 2017 disallow child labor in Sindh. The PCEA defines a child as a person who has not completed his/her fourteenth years of age, and an adolescent means a person who has completed fourteenth year of age but has not completed eighteenth years of his age. No child shall be employed or permitted to work in any establishment including construction, but an adolescent can be employed or permitted to work under strict guidelines provided in the PCEA and rules. An adolescent shall not be employed in any hazardous work included in the schedule to the PCEA.	The relevance of this Act to the Project will be to prohibit child employment for construction of the proposed Project.	Does not permit child labour during project construction or operation.
12.	**Sindh Factories Act, 2021**	The Act deals with regulations related to Project Area workers and workplace EHS requirements. The Factories Act also provides regulations with provision for general health and safety of the work force in their work area. Conditions are specified for clean workplace, toilets, waste handling, provision of drinking water quality, worker health and hygiene etc. Under the Act, no occupier of a factory shall be allowed to start manufacturing process unless he has obtained factory registration certificate from the Directorate of Labor. The Act does not allow a child below the age of 14 years to work in a factory in any case. The new Law restricts the employment of contractual labor in manufacturing process. The amendment 2021 is specifically related to the provision of safe transportation facility to women workers, working hours and working periods of seasonal and whole year factories.	This Act is applicable for the Project workers as well as belonging community including men, adults, women, adolescent working in and near the construction industry (during construction phase).	Requires that the occupational health and safety, along with labor regulations defined therein are complied with during project implementation.

13.	**Sindh EPA Hazardous Substances Rules, 2014**	The rule describes the procedure of handling, transportation and disposal of hazardous substances and hazardous waste. General safety precautions for handling hazardous substances as well as safety precautions for workers, and notification requirements in the event of an accident are also described in these rules.	This rule is applicable to the proposed Project due to involvement of hazardous waste handling, use and disposal during different construction activities at the construction stage.	A separate approval must be obtained from the Sindh EPA if there is any permanent use of any of the hazardous substances that are listed in the Rules.
14.	**Sindh Minimum Wages Act, 2015**	To provide the regulation of minimum rates of wages and various allowances for different categories of workers employed in certain industrial and commercial undertakings and establishments.	This Act will be applicable to the Project to ensure that the minimum wages and allowances should be given to the Project labor (skill and unskilled employed for the construction of the proposed Project.	Requires that the project ensure that workers are not paid below the defined minimum wage.
15.	**Sindh Occupational Health & Safety Act, 2017**	The Act makes provisions for occupational safety and health conditions at all workplaces in the province for the protection of workers during work. Under the Act, an Occupational Safety and Health Council will be established in Sindh with secretary of Sindh government's Labor and Human Resources Department as its chairperson. The proposed council lays down penalties in case of death and injury due to violation. In case of death sub-section 01 of section 38 will accord 2 years' imprisonment or a fine of PKR 100,000 or both. Similarly, in case of injury the imprisonment may extend to six months or a fine up to PKR 20,000 or both.	The Act applies in any Project situation where worker's rights and protections are enforced. This law is applicable to construction and Project workers and will be complied during construction and operation phases.	Requires that the occupational health & safety regulations defined therein are complied with during project implementation.
16.	**Sindh Bonded Labour System (Abolition) Act, 2015**	The Act is gender sensitive; an anti-discrimination clause is added to each new proposed Law in accordance with ILO requirement viz: "No discrimination shall be made on the basis of sex, religion, political affiliation, sect, colour, caste, creed, ethnic background in considering and disposing of issues relating to the enforcement of this Act". In all proposed Laws the cognizance has been changed from that of the Judicial Magistrate to the Presiding Officer Labor Courts who is a Session Judge.	This Act is applicable as the proposed project may involve the numbers of staff/worker having different religion, political affiliation, sect, colour, caste, creed, ethnic background.	Bonded labour will not be allowed or utilized for the project
17.	**Sindh Transparency and Right to Information Act, 2016**	The purpose of this Act to provide transparency and freedom of information to ensure that all citizens have better access to public information, to make the government more accountable to citizens, to enforce the fundamental right to information in all matters of public importance, to ensure transparency in all Government	This Act is applicable as the proposed Project is the public sector Project and shall be transparent for public.	Defines how the project must operate in a transparent manner to the public.

		matters. Transparency and access to information are essential principles of democracy which not only enable the citizens to hold the Government and their institutions accountable but also help in improving the system of governance.		
18.	**Sindh Differently Abled Persons (Employment, Rehabilitation and Welfare) (Amendment) Act, 2017**	The Act provides for the employment, rehabilitation, and welfare of differently able persons. The definition of "differently able" is any persons who on account of injury, disease, or congenital deformity, is challenged for undertaking any gainful profession or employment in order to earn his livelihood and includes a person who is blind, deaf, physically challenged or mentally challenged. In the Sindh Differently Able Persons (Employment, Rehabilitation and Welfare) Act, 2014 was amended and job quota was increased from two percent to five percent. The Act also waived admission fees at public educational institutions for people with disabilities as well as 75% of tuition fee, along with establishing reserved seats. Pakistan is a signatory of the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD).	This Act is applicable as the proposed project will involve serious occupation health and safety issues during construction phase and may cause serious injury to worker/staff causing permanent disability and differently able.	Requires differently abled persons are not discriminated against during project implementation for jobs.
19.	**Sindh Commission on the Status of Women Act, 2015**	The Act has enabled the government to constitute a Commission to be known as the Sindh Commission on the Status of Women, to exercise the powers to examine the policy, programs and other measures taken or to be taken by Government for gender equality, women's empowerment, political participation, representation, assess, implementation and make suitable recommendations to the concerned authorities. In addition, the Commission will be responsible to review all provincial laws, rules, and regulations prejudicial to the legitimate interest and rights of women and suggest accordingly.	This Act is applicable as the proposed project may involve the numbers of female staff/worker as well as local resident women along the project corridor which are directly or indirectly linked with project activities.	Requires that women are not discriminated against for jobs during project implementation.

20.	**Sindh Resettlement & Rehabilitation Policy, 2023 (R&R Policy)**	The Sindh R&R Policy aims to provide a structured framework for addressing involuntary resettlement resulting from development projects in Sindh. It's primary objective is to ensure fair and timely compensation, proper relocation, and the restoration of livelihoods for project-affected persons (PAPs). The main requirements under the policy are: 1. **Resettlement Planning:** ○ **Resettlement Action Plan (RAP):** Develop a comprehensive RAP detailing the extent of displacement, compensation strategies, relocation sites, and support for livelihood restoration. 2. **Eligibility Criteria:** ○ **Affected Persons:** Recognize all individuals experiencing loss of land, assets, or access due to project activities, regardless of legal land ownership status. 3. **Compensation Framework:** ○ **Replacement Cost:** Compensate lost assets at full replacement cost without depreciation. ○ **Timely Disbursement:** Ensure compensation is provided before displacement occurs. 4. **Relocation Assistance:** ○ **Housing and Infrastructure:** Provide suitable housing options and access to essential services at relocation sites. ○ **Transitional Support:** Offer interim assistance to cover the period between displacement and the restoration of livelihoods. 5. **Livelihood Restoration:** ○ **Skill Development:** Facilitate training programs to enhance employment opportunities for PAPs. ○ **Financial Assistance:** Provide support to re-establish businesses or agricultural activities. 6. **Consultation and Participation:** ○ **Stakeholder Engagement:** Conduct meaningful consultations with PAPs, ensuring their input influences resettlement decisions.	The project does not require any land acquisition, and neither were there any huts or settlements identified within the COI of the project or at any of the areas where the project has been proposed for development. There were some patches of land identified where rain fed agriculture practices may be taking place; however, no private land was identified by STDC.	A separate survey to be carried out by STDC prior to development of project works to identify whether there are persons who rely on the lands where work will take place and to quantify this impact in the form of livelihood loss that may be faced by these persons. If so, there will also be the need to develop a resettlement plan/ livelihood restoration plan that carries out the steps identified on the land to develop a plan, and then to implement it through providing compensations to any potential project affected persons.

		○ **Information Disclosure:** Provide clear and accessible information about resettlement plans and entitlements. 7. **Grievance Redress Mechanism (GRM):** ○ **Accessible Channels:** Establish multiple avenues for PAPs to voice concerns or complaints. ○ **Timely Resolution:** Ensure grievances are addressed promptly and transparently. 8. **Monitoring and Evaluation:** ○ **Internal Monitoring:** Regularly assess the implementation of resettlement activities to ensure compliance with the RAP. ○ **External Audits:** Engage independent parties to evaluate the effectiveness of resettlement measures. The policy underscores the importance of minimizing displacement and, when unavoidable, ensuring that affected individuals receive adequate support to rebuild their lives with dignity. It aligns with international best practices and legal frameworks to uphold the rights and well-being of displaced populations.		

3.3 World Bank's Environmental & Social Framework (ESF)

The section below discuss the application of the WB's ESF with its ten Envrionmental and Social Standards (ESS1 to ESS10) and associated directvies. Their requirements are tabulated beliw, where it additionally discuss the requirements relating to other guide notes from the World Bank:

Table 3.4 - Applicable World Bank ESF Objectives & Requirements

World Bank ESS Policy, Standards, Directive	Objectives	Requirements
ESS1 Assessment and Management of Environmental and Social Risks and Impacts	Identify, assess, evaluate, and manage environmental and social risks and impacts in a manner consistent with the ESF. Adopt differentiated measures so that adverse impacts do not fall disproportionately on the disadvantaged or vulnerable groups, and they are not disadvantaged in sharing development benefits and opportunities	Under ESS1, Environmental and Social instruments are to be prepared for the assignment, in accordance with national regulations and ESF as well as international best practices including WBG EHS Guidelines and EHS Guidelines for Power Facilities.

		Given that the project is not being directly funded by the Bank, this ESIA is stil being prepared in light of the requirements of the Bank and shall be disclosed as per the policies of the local regulator, i.e., the Sindh EPA. Furthermore, following approval, STDC will abide by the conditions stated in this ESIA report and the approval accorded by SEPA, against which monitoring and reporting & E&S performance will be carried out during implementation.
ESS2 Labor and Working Conditions	Promote safety and health at work. Promote the fair treatment, non-discrimination, and equal opportunity of project workers. Protect project workers, with particular emphasis on vulnerable workers. Prevent the use of all forms of forced labor and child labor. Support the principles of freedom of association and collective bargaining of project workers in a manner consistent with national law. Provide project workers with accessible means to raise workplace concerns.	The requirements of ESS2 have been covered under this ESIA, alongside the FIDIC codes of conduct that will be used for procuring of vendors and contract signing for the subject works under this project.
ESS-3 Resource Efficiency and Pollution Prevention and Management	Promote the sustainable use of resources, including energy, water, and raw materials. Avoid or minimize adverse impacts on human health and the environment caused by pollution from project activities. Avoid or minimize project-related emissions of short and long-lived climate pollutants. Avoid or minimize generation of hazardous and non-hazardous waste. Requires technically and financially feasible measures to improve efficient consumption of energy, water, and raw materials.	ESIA is being prepared under this project in which necessary pollution prevention and management measures along with waste management procedures is proposed. The procedure is prepared in accordance with national regulations, international standards and best practices including WBG EHS Guidelines for Power Facilities. Furthermore, project alternatives have also been analysed.
ESS4 Community Health and Safety	Anticipate or avoid adverse impacts on the health and safety of project-affected communities during project life cycle from routine and non-routine circumstances. Promote quality, safety, and climate change considerations in infrastructure design and construction. Avoid or minimize community exposure to project-related traffic and road safety risks, diseases, and hazardous materials. Have in place effective measures to address emergency events. Ensure that safeguarding of personnel and property is carried out in a manner that avoids or minimizes risks to the project-affected communities.	Under ESS4, the potential health and safety risks and impacts associated with the Project are to be assessed, including the necessary mitigation measures in the ESIA to be prepared for the project. Items such as traffic management plans, community health and safety measures, emergency response preparedness plans, to mitigate all health and safety risks and impacts of the project during construction and operations of the project. Furthermore, risks and impacts from exposure to waste and other pollutants, traffic accidents, risk of fire and explosion, flooding and other climate change risks will be considered.
ESS5 Land Acquisition Restrictions on Land Use and Involuntary Resettlement	Avoid or minimize involuntary resettlement by exploring project design alternatives. Avoid forced eviction. Mitigate unavoidable adverse impacts from land acquisition or restrictions on land use by providing compensation at replacement cost and assisting displaced persons in their efforts to improve or restore livelihoods and living standards to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher. Improve living conditions of poor or vulnerable persons who are physically displaced, through provision of	Neither land acquisition nor physical displacement is envisaged under this project.

	adequate housing, access to services and facilities, and security of tenure. Conceive and execute resettlement activities as sustainable development programs.	
ESS6 Biodiversity Conservation and Sustainable Management of Living Natural Resources	Protect and conserve biodiversity and habitats. Apply the mitigation hierarchy and the precautionary approach in the design and implementation of projects that could have an impact on biodiversity. To promote the sustainable management of living natural resources.	The project is planned for implementation near Keenjhar lake next to where the K-IV project is currently under construction. As such, the ecological sensitivities of the area have been considered in this ESIA and appropriate mitigation measures proposed accordingly.
ESS10 Stakeholder Engagement and Information Disclosure	Establish a systematic approach to stakeholder engagement that helps Borrowers identify stakeholders and maintain a constructive relationship with them. Assess stakeholder interest and support for the project and enable stakeholders' views to be taken into account in project design. Promote and provide means for effective and inclusive engagement with project-affected parties throughout the project life cycle. Ensure that appropriate project information is disclosed to stakeholders in a timely, understandable, accessible, and appropriate manner.	Stakeholder Consultation has been carried out for this project and plans for further stakeholders have also been prepared for the project.

3.4 World Bank Guidelines

The principal World Bank publications that contain environemntal and social guideliens are listed below:

- World Bank Group General Environment, Health, and Safety (EHS) Guidelines
- World Bank Group EHS Guidelines for Power Facilities
- Social Analysis Sourcebook

In addition to the EHS Guidelines, IFC/World Bank sector specfici EHS guidelines will also be used. These EHS guideliens are technical reference documents with general and industry specific examples of Good International Industry Practice (GIIP). When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards. These General EHS Guidelines will be used together with the relevant Industry Sector EHS Guidelines (Infrastructure Sector) which provide guidance to users on EHS issues.

A comparison of the local environmental regulations, along with the WB EHS Guidelines is also attached to this report as Annex.

4 Analysis of Alternatives

4.1 Introduction

The screening of alternatives is a part of the ESIA process to select the best among all possible project options. The alternatives of a project are defined as the options that can help to meet the objectives of a project by different means including an alternative project site, technology or material, design or inputs.

Alternatives to the proposed project components include:

- The “no project” alternative
- Technical alternatives
- Transmission line alternative

4.2 “No Project” Alternative

This project is crucial as the power generated from this project will support the KIV water project which aims to provide water for the Karachi city. Karachi, the largest city in Pakistan facing large population load. The city’s total water demand to meet the needs of this large population is 1,300 MGD, yet only 550 MGD[10] is currently being supplied, resulting in a significant water shortage affecting more than half of the population.

In November 2002, a committee formed by the Government of Sindh prepared a report outlining a long-term water supply plan for Karachi, extending to the year 2025. The committee's findings indicated that the city would need an additional 250 MGD of water, on top of the existing 250 MGD, to meet its total water requirement of 1,300 MGD (or 2,400 cusecs) by 2025[11]. The current project is essential for providing the necessary electricity to facilitate the water supply to Karachi. Choosing the "No Project" alternative would be an unsuitable option as it will keep the Karachiites from receiving the desired water demand.

4.3 Grid Station Technical Alternatives

This section will look into the different alternatives considered for the technical aspects of the project and its development:

4.3.1 Gas Insulated Switchgears (GIS) v Air Insulated Switchgear

Switchgears are a collection of switching and safety devices available in one common structure and used to control, protect, or cut-off circuits and equipment in an electrical system. In other words, it’s a series of circuit breakers, isolators, relays, fuses, and similar devices, assembled together. With switchgear, electrical systems provide a safe and reliable supply of electricity. Electrical switchgear can use a range of insulation methods such as air, gas, oil, or vacuum. Gas Insulated Switchgear (GIS) and Air Insulated Switchgear (AIS) are both used for high-voltage applications in electrical power systems, but they differ in terms of design, insulation medium, and suitability for different environmental conditions.

Advantages of GIS over AIS

[10] Situational Analysis of Water Resources of Karachi, World Wildlife Fund, Pakistan, 2019
[11] Executive Committee of the National Economic Council (ECNEC)

The project is located near Keenjhar Lake. Keenjhar Lake is an important freshwater resource, but the area is also prone to specific environmental challenges, particularly humidity, dust, and the risk of flooding. Considering the project location and above-mentioned characteristics of both insulators, it is evident that GIS is more suitable for this project for the following reasons:

GIS systems, sealed in gas-insulated enclosures, protect against moisture, reducing issues like short circuits, corrosion, and frequent maintenance, making them more reliable in humid environments.

- In desert areas like Thatta, Sindh, where dust and pollutants are common, GIS's enclosed design protects against insulation degradation, reducing maintenance needs compared to AIS systems exposed to the elements.
- GIS is fully sealed and resistant to water ingress, making it more reliable in flood-prone areas near lakes and rivers, unlike AIS systems which are vulnerable to flooding and equipment failure.
- In extreme climates, GIS requires less maintenance than AIS, reducing downtime and operational costs, which is especially beneficial for remote locations like near Keenjhar Lake.

Environmental Impact

Although both AIS (air-insulated switchgear) and GIS (gas-insulated switchgear) are generally safe, they can have specific environmental impacts, primarily due to the energy and gas used in substations, both of which need to be carefully managed. According to electrical engineering portal, GIS systems require lesser energy and area for their operation as well as also has lesser environmental impact in terms of acidification, nitrification and greenhouse potential.

Environmental Impact Comparison for AIS and GIS[12]		
	AIS	GIS
Primary Energy Consumption	100 %	73 %
Area Requirement	100 %	14 %
Acidification Potential	100 %	81 %
Greenhouse Potential	100 %	79 %
Nitrification Potential	100 %	71%

Noise Levels

When air-insulated circuit breakers and load break switches operate, they can generate significant transient noise. Other noise sources in substations include corona discharges, arcing during switch operations, and other electrical phenomena. In contrast, noise levels are lower in HV GIS installations since they are fully enclosed. The SF2 gas used in these enclosures acts as an effective sound absorber. Additionally, newer arc-interruption technologies in SF2 gas require less energy, leading to the development of smaller and quieter devices.

Gas Leakage

In this project, the opted switchgear contains SF2 which is a greenhouse gas and can have significant environmental impacts if leaked. But, the latest design of GIS technology is efficient and has only 1% leakage rate. **GIS systems are safer** in terms of gas leakage compared to AIS because GIS units are sealed, containing SF2 gas within robust, **metal-enclosed structures**, which significantly reduces the risk of leakage. The sealed environment of GIS also **protects against external factors** like weather and pollution, unlike AIS, which has exposed components

[12] *Electrical Engineering Portal*

vulnerable to environmental damage and contamination. Additionally, GIS systems feature regular gas pressure monitoring and strict maintenance protocols, ensuring **minimal leakage**, while **AIS systems** require more **frequent maintenance** and are more **prone to insulation degradation**. Overall, the sealed, controlled environment of GIS enhances safety and minimizes the risk of gas leaks.

Conclusion

For the selection for the switchgear, GIS systems are found to be more beneficial in terms of maintenance and environmental impact, particularly in terms of noise, gas leakage, and exposure to weather and pollution. GIS offers several advantages as it ensures reliable operation in an environment where AIS could fail or require extensive maintenance. It is also the best option for projects with limited space availability, especially in areas near lakes or water bodies where destroying a scenery is not feasible through acquiring larger spaces for AIS installation. Installing GIS would reduce the need for frequent inspections and maintenance, which is particularly beneficial in remote locations as the location in this project.

4.4 Transmission Line Alternatives

4.4.1 Overhead Transmission Line v Underground Transmission Line

Positives

Overhead Transmission Lines

The initial costing for the installation of overhead T/L is cheaper than the installation of Underground transmission lines. Overhead T/L is a cost-effective choice in terms of both labor work and material usage and transfer for remote areas. Moreover, in the event of faults or damage (such as storm damage or broken lines), overhead lines are easier to inspect and repair. This reduces the downtime and cost of maintenance. Overhead T/L are also beneficial for quicker turnaround as their installation is faster because only stringing of wires between poles is required for their installation. In addition, given that the area is uninhabited and sparsely vegetated, overhead transmission lines will have minimal environmental disruption compared to the extensive excavation required for underground cables. Overhead lines are ideal for areas with barren land, as they can easily traverse long distances without requiring complex groundwork. The area near Keenjhar Lake likely has few natural obstacles, making the installation of overhead lines simpler. In an uninhabited, remote area, the risk of damage from external sources (e.g., human activity or construction) is lower, making overhead lines a safer choice for the long term.

Underground Transmission Lines

Underground lines also serve several benefits in terms of aesthetics of the project site as these are **invisible** and do not interfere with the natural beauty of the landscape, their lesser vulnerability to weather conditions such as storms, high winds, or lightning, which makes them reliable and resilient in harsh environmental conditions and are protected from accidents like accidental cuts or fires. They also reduce the risk of tampering or vandalism, which can be a concern for overhead lines.

Negatives

Overhead Transmission Lines

While the project area is uninhabited, the visibility of overhead lines could still have an impact on the landscape, especially near scenic areas like Keenjhar Lake, where visual appeal might be a

consideration in the future. Also, overhead transmission lines can be vulnerable to weather events, such as strong winds, lightning, or ice storms. In the case of significant storms, there may be temporary outages. Overhead lines require significant right-of-way for installation and maintenance. However, since the land is barren and uninhabited with few areas being used for agriculture and cropping, this may not be a major issue in this specific case.

Underground Transmission Lines

Underground transmission lines, although provide aesthetic benefits but their installation and maintenance (fault detection and repair) are a complex process which is not only time consuming but also costly. The process involves extensive excavation, cable laying, and restoration of the land, making it a much more expensive option than overhead lines. Locating faults requires digging, which leads to longer downtime and higher maintenance costs. Specialized equipment and skilled labor are also needed. The installation of underground lines requires significant **time and effort**, particularly in remote and barren locations. This could delay the project timeline.

Conclusion

Given the specific conditions of the site near **Keenjhar Lake**, an **overhead transmission line (OHTL)** is the better choice as it will pose relatively lower environmental impact as there will be no need for extensive excavation, which could cause more ecological damage. Moreover, the project location is not expected to have severe weather conditions thus, the concern of damage from weather event is also lower. Other than the environmental benefits, overhead transmission lines are also cost-effective and easy to install and maintain.

4.4.2 Porcelain v Silicone Insulators

Environmental Suitability

Porcelain insulators are also known as ceramic insulators as evident from the name that these are made from ceramic material. These have been widely used for their electrical and mechanical strength thus, providing effective insulation by preventing current flow through components. However, they have low hydrophobic properties which results in pollution layers forming on its surface which in-turn affects its insulating performance. This can lead to electrical issues like flashovers or tripping in high voltage transmission lines. Additionally, they are brittle and susceptible to damage during transportation or installation. While porcelain insulators perform well in dry and less polluted environments, they face significant challenges near coastal or saline environments. The salty air around Keenjhar Lake can lead to contamination of the surface, requiring regular cleaning to avoid performance issues such as electrical tracking or flashover.
Polymer insulators are polymers of silicon, although it is a synthetic polymer but it is eco-friendly. It also has improved hydrophobic properties and these can also reduce the risk of pollution induced flashovers better than porcelain and glass insulators. They are increasingly used in high voltage transmission lines, especially in polluted areas. Polymer insulators are light weight and economical and also supports lighter tower designs for power transmission and ease of transportation, handling, and replacement of insulators. They also have high hydrophobic properties which makes it suitable for areas near a water body where humidity is relatively high. Polymer insulators are self-cleaning thus their performance remains unaffected by pollution and this property makes these suitable for polluted areas too. These properties of silicone polymer insulator extend its service life and maintenance requirements.

Cost

Porcelain Insulators are **initially cheaper** but requires **higher maintenance costs**, especially in humid or saline conditions. Their lifecycle cost is higher due to the need for regular cleaning, inspection, and replacement. Silicone Polymer Insulators are more **expensive initially**, but they

offer lower operational and maintenance costs over time, especially in environments with high humidity, salt, and pollution. The longer lifespan and reduced failure rates make them a more cost-effective choice in the long run.

Life Cycle

Porcelain Insulators typically last **20–30 years**, but their lifespan may be reduced due to exposure to moisture, salt, and pollution. They are also more prone to breakage under impact and also showcase higher failure rate in areas with heavy pollution or salt exposure due to surface contamination and electrical tracking. Silicone Polymer Insulators have a longer service life i.e., **30+ years**, especially in harsh environments like coastal areas. They are more resilient to environmental stressors, which reduces the likelihood of failure. Silicone polymer insulator manufacturing is also eco-friendly and thus these have lesser impact on the environment.

Table 4.1 - Major Grid Failures of Porcelain Insulators[13]

Major Grid Failures Across the World			
Details	Millions of People affected	Location	Date
2012 July North India Blackout	670	India	30-31 July 2012
2005 Java Bali Blackout	100	Indonesia	18th August 2005
1999 Southern Brazil Blackout	97	Brazil	11th March 1999
2009 Brazil and Paraguay Blackout	87	Brazil, Paraguay	10-11 November 2009
2003 Northeast Blackout	55	USA and Canada	14-15 August 2003
2003 Italy Blackout	55	Italy, Switzerland, Austria, Slovenia, Croatia	28th September 2003
1965 Northeast Blackout	30	USA and Canada	9th November 1965

Environmental Impact

While porcelain is a natural material, it requires significant energy to manufacture i.e., high-temperature firing, contributing to carbon emissions. The world's annual energy end-use for firing ceramics through natural gas is estimated at 182 TWh releasing abou 400 Mt CO_2/year (Del Rio et al., 2022). Moreover, manufactuing process of ceramics also consume large amount of energy i.e., 140 C for 4 hours is required for the drying process only. Additionally, porcelain insulators can break into sharp, brittle fragments when they fail, which can create waste and pose a safety hazard. The manufacturing process of silicone polymers also requires energy, but silicone is generally considered to have a lower environmental impact during production and a longer lifespan, which helps reduce overall waste. Furthermore, they are durable and require lesser maintenance using fewer resources for replacements and repairs, hence, lowering the environmental footprint over time.

Conclusion

Considering all the above discussed benefits of silicone polymers as compared to porcelain insulators, it is evident that silicone-polymer insulators are better a better option as these are not only cost-effective in longer terms but also environmentally friendly. The hydrophobic surface of silicone polymer reduces the need for frequent cleaning and maintenance, which is essential in a location with high humidity and salt in the air. These also have a longer lifespan (30+ years) and a lower failure rate, reducing long-term operational costs.

[13] *Del Rio, D. D. F., Sovacool, B. K., Foley, A. M., Griffiths, S., Bazilian, M., Kim, J., & Rooney, D. (2022). Decarbonizing the ceramics industry: A systematic and critical review of policy options, developments and sociotechnical systems. Renewable and Sustainable Energy Reviews, 157, 112081.*

5 Description of the Environment

5.1 General

This section provides baseline data (physical, biological, and socio-economic parameters) related to the project area. Information provided is both quantitative and qualitative, based on primary and secondary data sources, collected during site visits and desk studies.

The baseline information with relevant stakeholder consultation is required for scoping of potential environmental and social issues associated with the implementation of the project. On the basis of the baseline information, project interventions are assessed, and mitigation measures are proposed. The baseline information also helps to indicate specific issues to be monitored during project execution. A map of the project site is provided below:

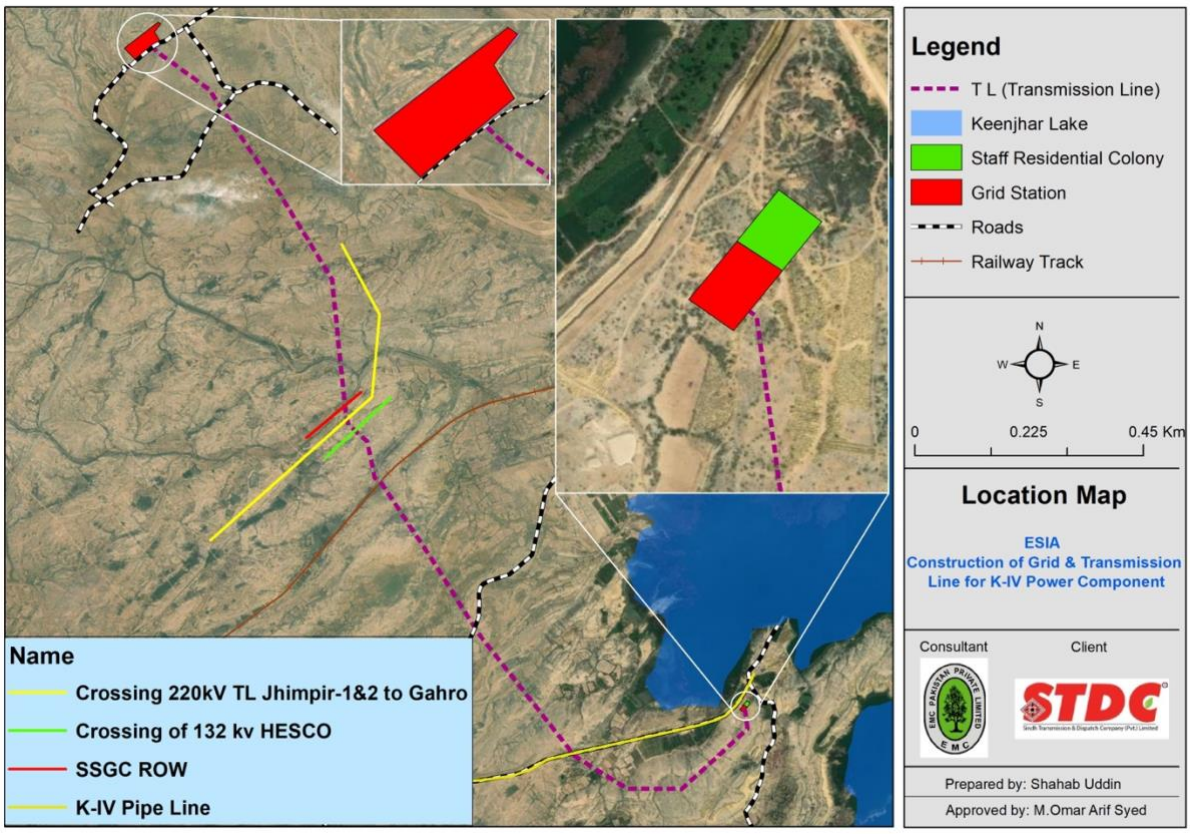


Figure 5.1 - Location of the Project

The existing environmental conditions of the proposed project interventions have been considered within the boundaries of the COI with respect to physical and ecological environment.

5.2 Reconnaissance & Field Visits

The E&S team conducted the reconnaissance visit of the project site and along the Right of Way. The major objective of the visits was to familiarize with the environment in general and to define the boundaries within which the perceieved impacts from each site would take place in – establish the COI. Furthermore, stakeholder consultations and acquisition of secondary data/ infromation was also carried out for identification of impacts at the scoping stage.

For the primary data acquisition, the E&S team conducted detailed field visit throughout 2024, where the main objective of these visits was to obtain detailed data on the existing physical, ecological, and social aspects, along with the idetification of significant envrionmental and social impacts of the proposed project. The secondary data was collected from published sources/ reports and relevant departments which was also verified through visual observations and primary data where possible. The land use map of the site is provided below along with a description of the area:

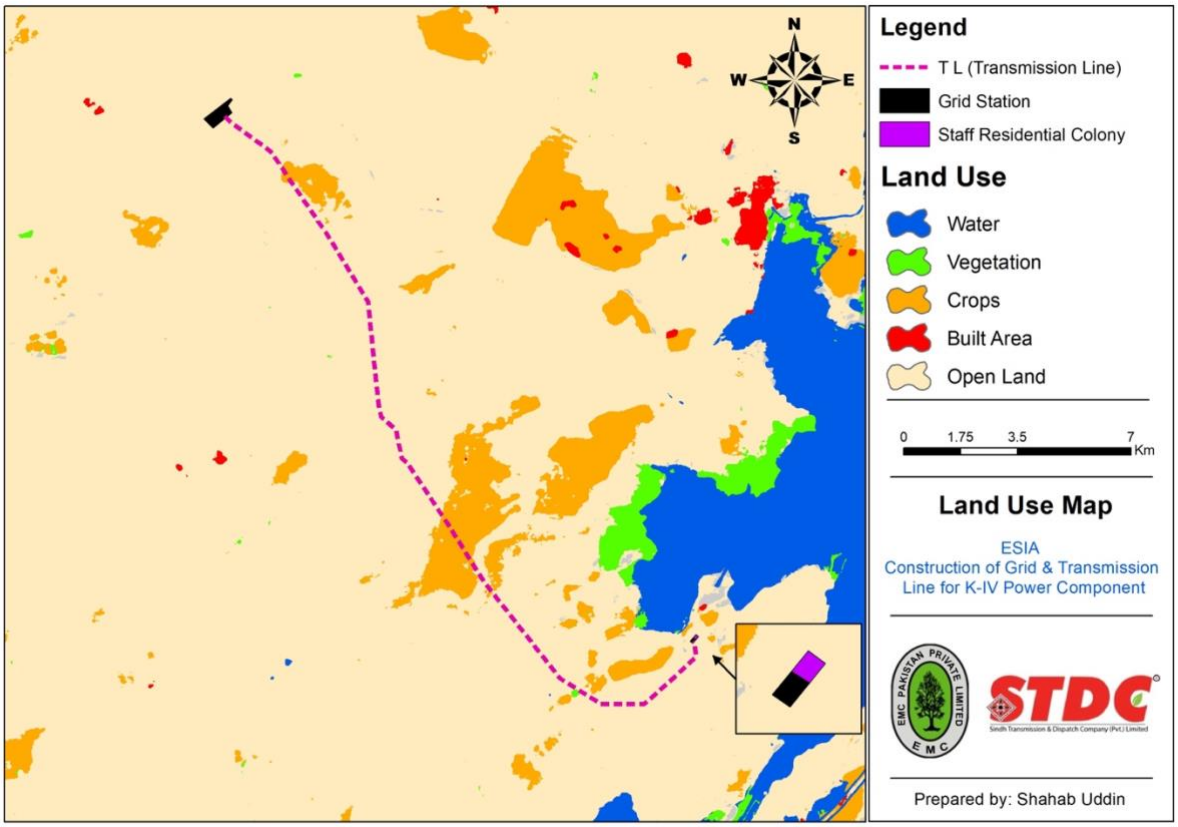


Figure 5.2 - Land Use Pattern of the Area

The Grid station of the project is situated near Keenjhar lake, where the transmission line and its surrounding land use around the project site consists primarily of open/ barren land, with some patches of agricultural land that were found along the way (which were observed to be mostly rain fed agriculture). Vegetation is found along the lake's edge, and there are also several built areas along the periphery of the lake.

The route of the transmission line, however, comprises mainly of barren land with a terrain that is not easily traversible and as such does not have any proper roads or infrastructure built to facilitate travel along it.

5.3 Physical Environment

5.3.1 Topography

A topographical map of the project area and surroundings is provided below:

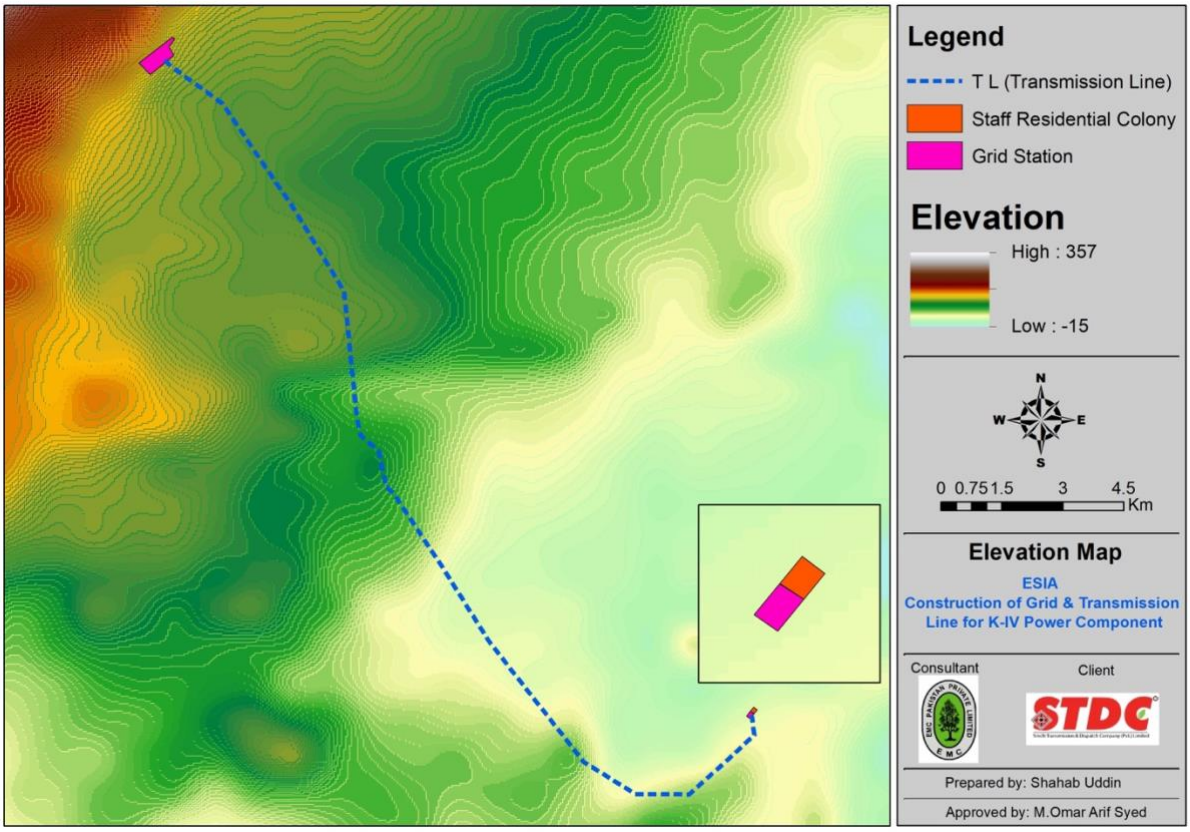


Figure 5.3 - Elevation Map of Project Site

Topographical conditions in and near the project site represent how Keenjhar lake acts as a drainage basin for the area around it, where the elevation near the Jhimpir-II grid station is the highest at an approximate 79 m. Moving from there towards the proposed K-IV grid station and staff colony, along the route of the transmission line, we see a gradual decrease in the elevation and the topography, with ultimately the area next to the lake being the lowest, at an approximate 29 m.

The topographical conditions of the site will play an important part in:

- Deciding the heights of the transmission towers and other associated infrastructure to ensure that any risks associated with flooding are dealt with accordingly
- Deciding the type of foundations that have to be developed in line with the elevations of the area

5.3.2 Geology, Geomorpohology, & Soil

Geologically, Thatta is composed of volcanic and sedimentary rocks from the Quaternary and Tertiary periods, sharing a similar composition with the Indus Plain and the eastern desert regions of Pakistan, including the Cholistan, Nara, and Thar deserts. The soils in the area are predominantly silt, clay, wet, and saline. The district's natural vegetation can be categorized into two main types: mangroves in the coastal or deltaic zone, and tropical thorn forests in the remainder of the region.

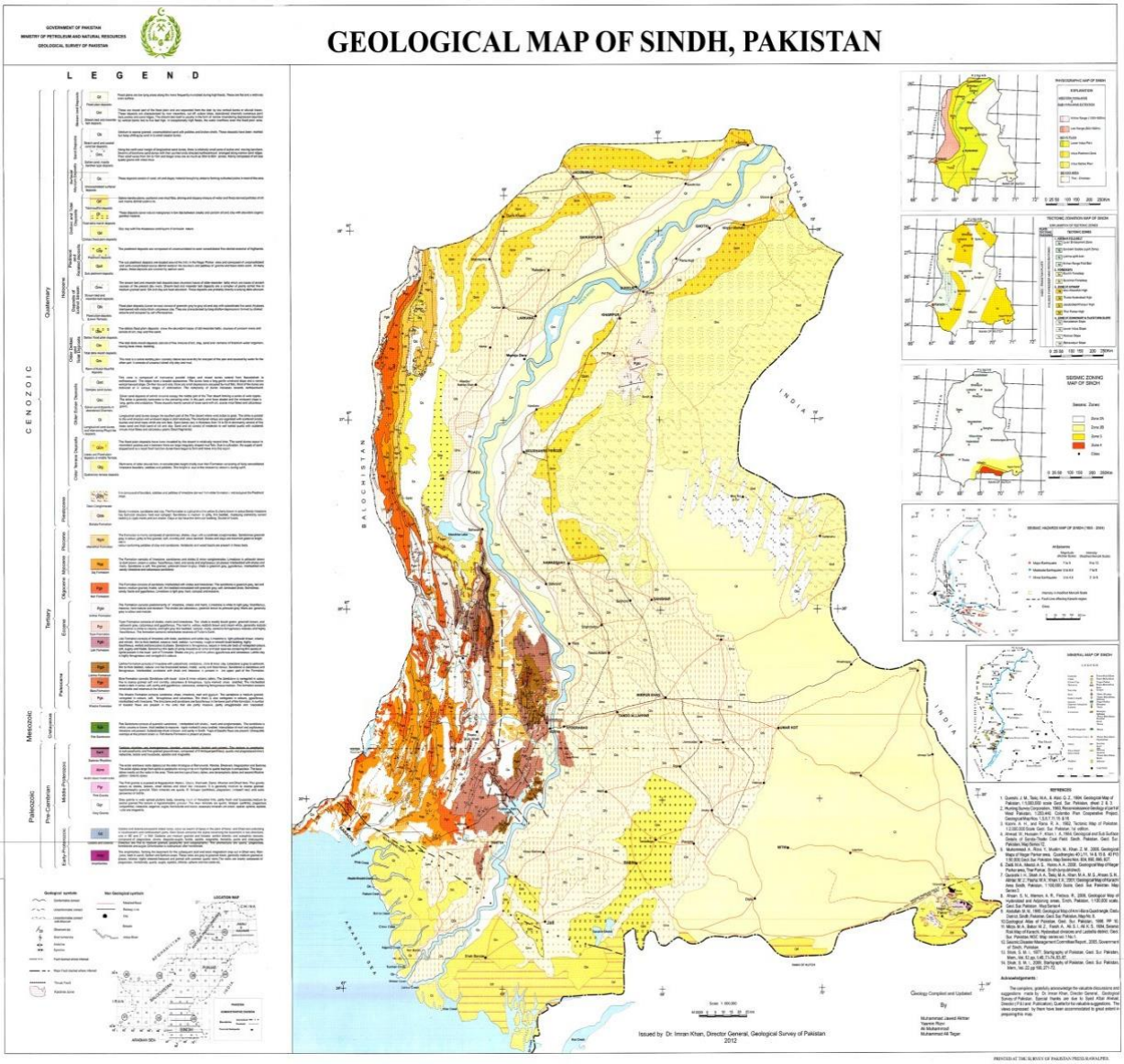


Figure 5.4 - Geological Map of Sindh

Thatta exhibits a diverse range of environmental features and resources, encompassing nearly all of the province's ecological characteristics. These include deserts, hills and gravelly rocks, rangelands, water bodies, delta areas, tidal flats, creeks, lakes, mangroves, riverine forests, and irrigated agricultural land.

The project is located in Thatta and has its own geological mapping. The primary sediments in the project area are Neogene sedimentary rocks and Quaternary rocks. The majority of the

transmission line route passes through Neogene sedimentary rocks, while both the grid station and the staff colony are situated in areas where Quaternary sediments are present.

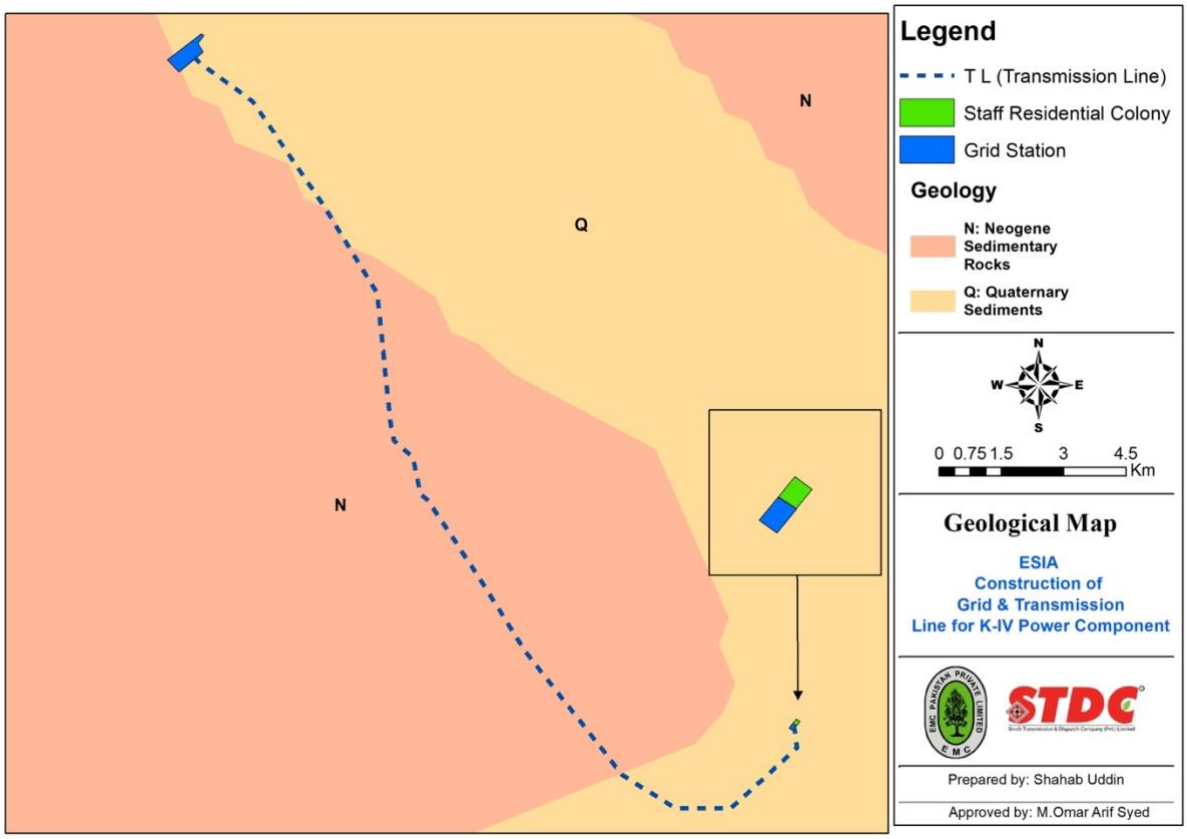


Figure 5.5 - Geological Map of the Project Area

Soil Composition: The project area is mainly composed of two soil types: Lithosols and Calcic Yermosols. Lithosol soils are characterized by a reddish-brown color and are shallow, with gravels close to the surface. They are light-textured, well-drained, and have a filtration rate slightly higher than alluvial soils. However, cultivation is limited in these soils due to the shallow root zone. The second major soil type, Calcic Yermosols, is found in regions with distinct dry seasons and in arid areas where carbonate-rich groundwater is close to the surface. These soils are marked by a (petro-)calcic horizon, which contains an accumulation of secondary calcium carbonates. Additionally, they lack diagnostic horizons other than an ochric or cambic horizon, a calcareous argic horizon, or a gypsic horizon beneath the petrocalcic horizon.

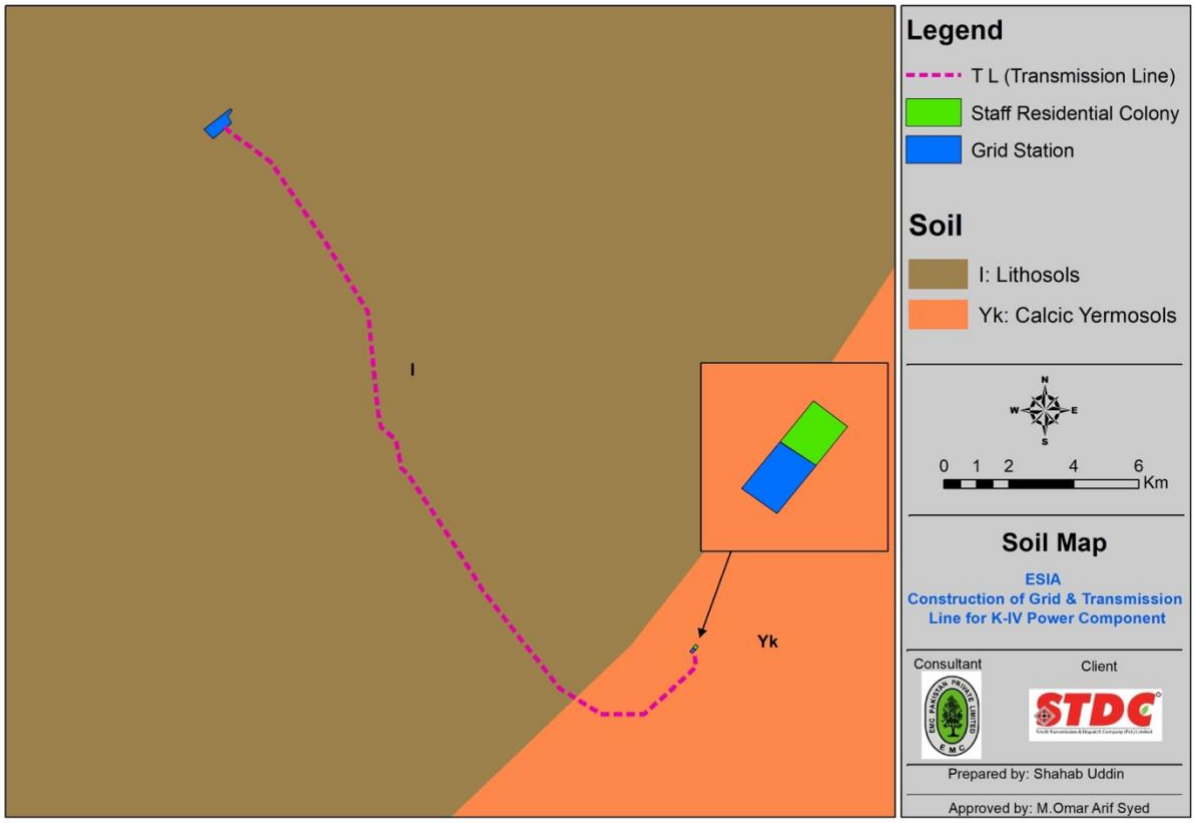


Figure 5.6 - Soil Map of the Project Area

The strata determined through GIS mapping determines the different types of controls that must be introduced at the design stage to curb E&S impacts:

To ensure structural stability and safety, items pertaining to the geology of the area will need to be taken into account at the design stage, e.g.:

- **Soil & Rock types** - as hard bedrock provides stable foundations but may require more specialized drilling techniques, whereas soft soils, clayey, or sandy terrains require deeper pile foundations or soil stabilization methods.
- **Bearing Capacity** – the ability of the ground to support tower loads is influenced by geological conditions, affecting the type and depth of foundation.
- **Groundwater Levels** – High water tables in certain geological formations can weaken foundations and complicate construction.
- **Seismicity** – Seismic activity in the area along with the ground's potential reaction in this scenario will define further measures that need to be considered.
- **Corrosion Potential** – Geological factors such as high salinity in soils can accelerate corrosion of tower materials and foundations.
- **Soil Movement** – Expansive soils (soils that swell and shrink) or shifting sediments can cause stress and damage to tower bases over time.

Given that the type of strata found in the area is mostly quarternary and neogene sedimentary, risks that can be posed include: stability issues, erosion susceptibility, variable strength, groundwater seepage and concerns, seismic risk, and low bearing capacities.

5.3.3 Seismicity

According to a map created by the Pakistan Meteorological Department, the country is divided into 4 zones ranging in term of major, moderate, minor and negligible zones with respect to ground acceleration values based on expected ground acceleration.

- The areas surrounding Quetta, those along the Makran coast and parts of the KPK, and also along the Afghan border fall in Zone 4.
- The rest of the KPK lies in Zone 3, with the exception of southern parts of this province, which lie in Zone 2. The remaining parts of the Pakistani coastline also lie in Zone 3.
- The remaining parts of the country lie in Zone 2. According to this classification, the Project site would be placed in Zone 2A.

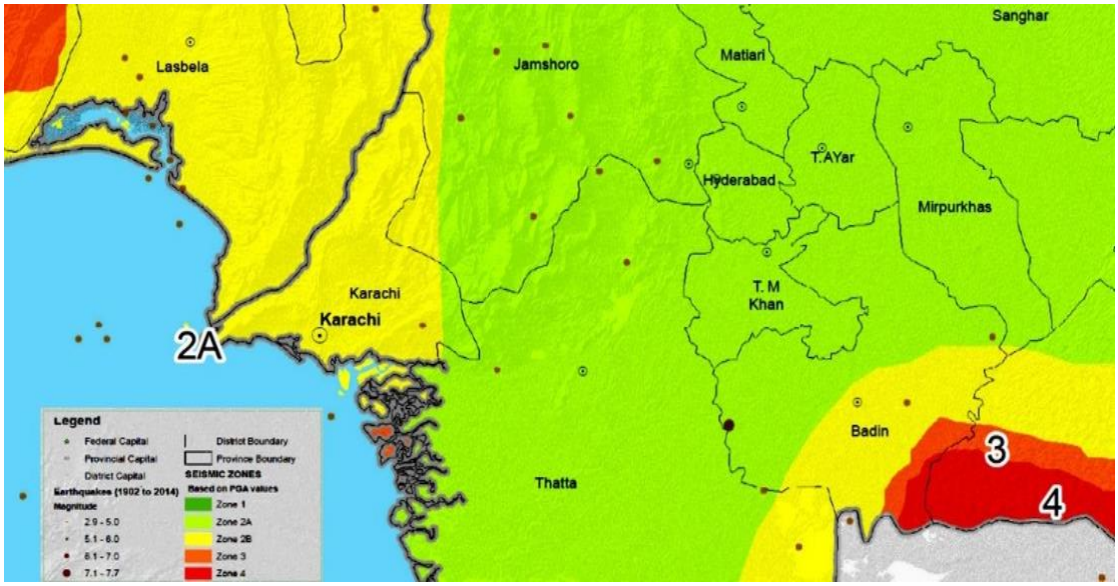


Figure 5.7 - Seismic Zones Data

Map data source(s): PMD, GSP, Pakistan Engineering Council – Prepared by Al Hasan Systems Private Limited

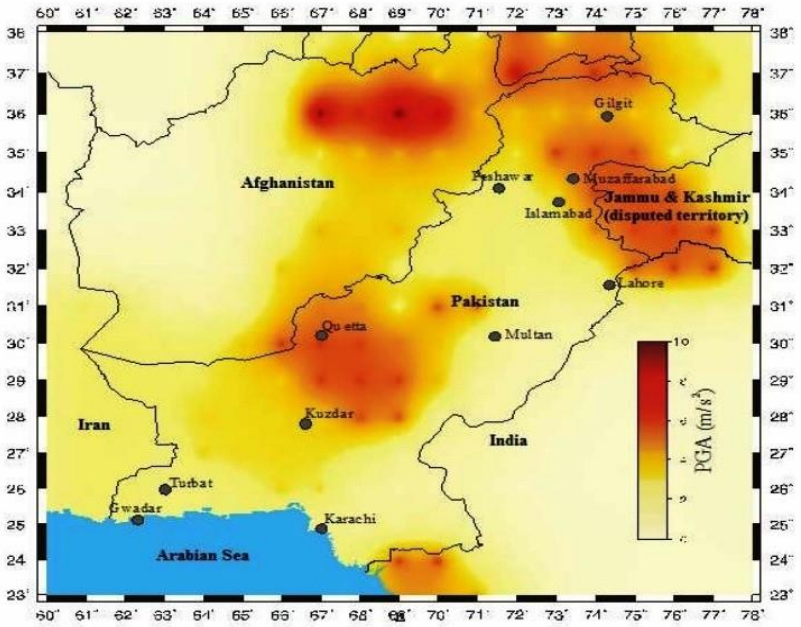


Figure 5.8 - Seismic Hazard for Pakistan in terms of Peak Ground Acceleration. (PGA) *PMD*

Seismic Monitoring and Early Tsunami Warning Centre - http://seismic.pmd.gov.pk/seismicnew/map2.html

5.3.4 Hydrology & Flood Risk

Despite existing next to Keenjhar lake, there are no waterways along the RoW of the transmission line. District Thatta however is rich in surface water resources with River Indus the largest surface water body in the district, followed by Keenjhar, Hadero and Haleji lakes. Keenjhar Lake is the source of water for Karachi city. However, the overhead transmission lines do cross water channels emerging from Keenjhar lake. The hydrological flow patterns at the site and along the right of way highlight the nature of flows in the area.

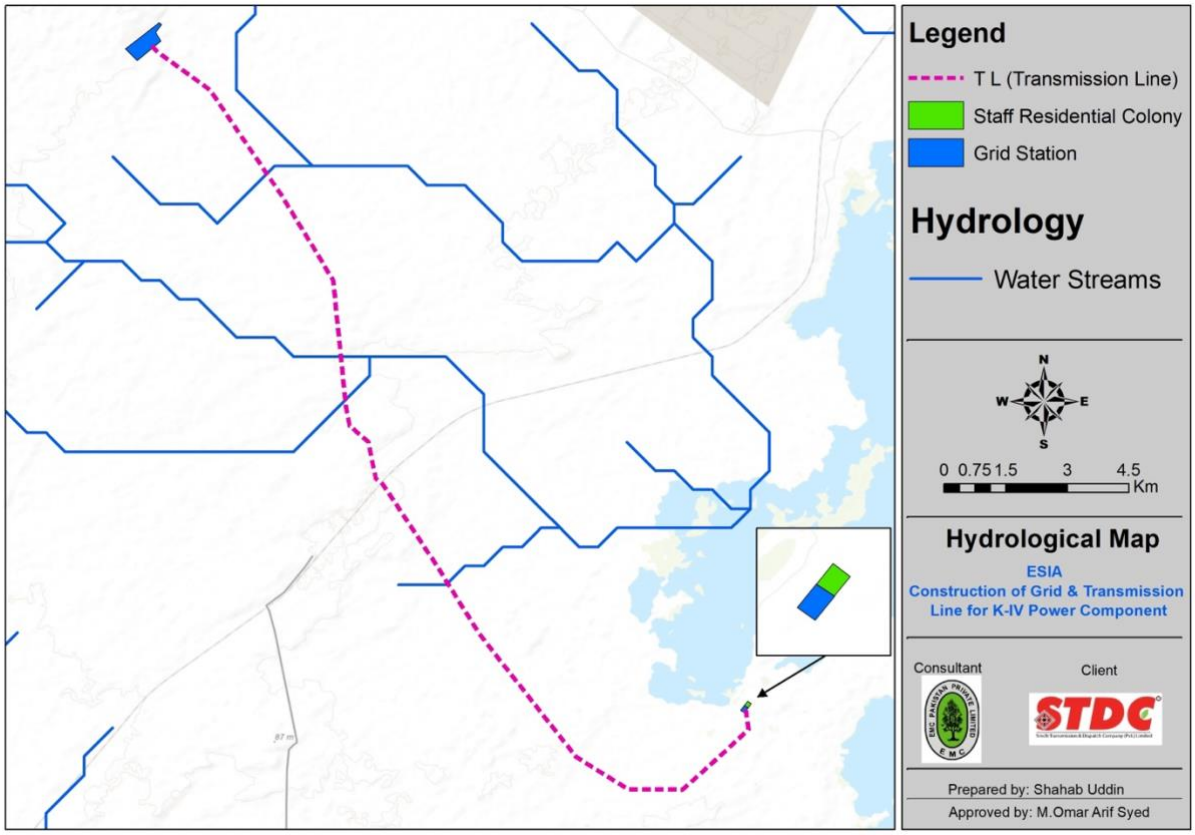


Figure 5.9 - Hydrology of the project area

Coupling the hydrological flow patterns of the area with the topographical conditions and the rainfall intentsity of the area, the potential flood risk to the site and the transmission line can be calculated also, where a depiction of this is provided below:

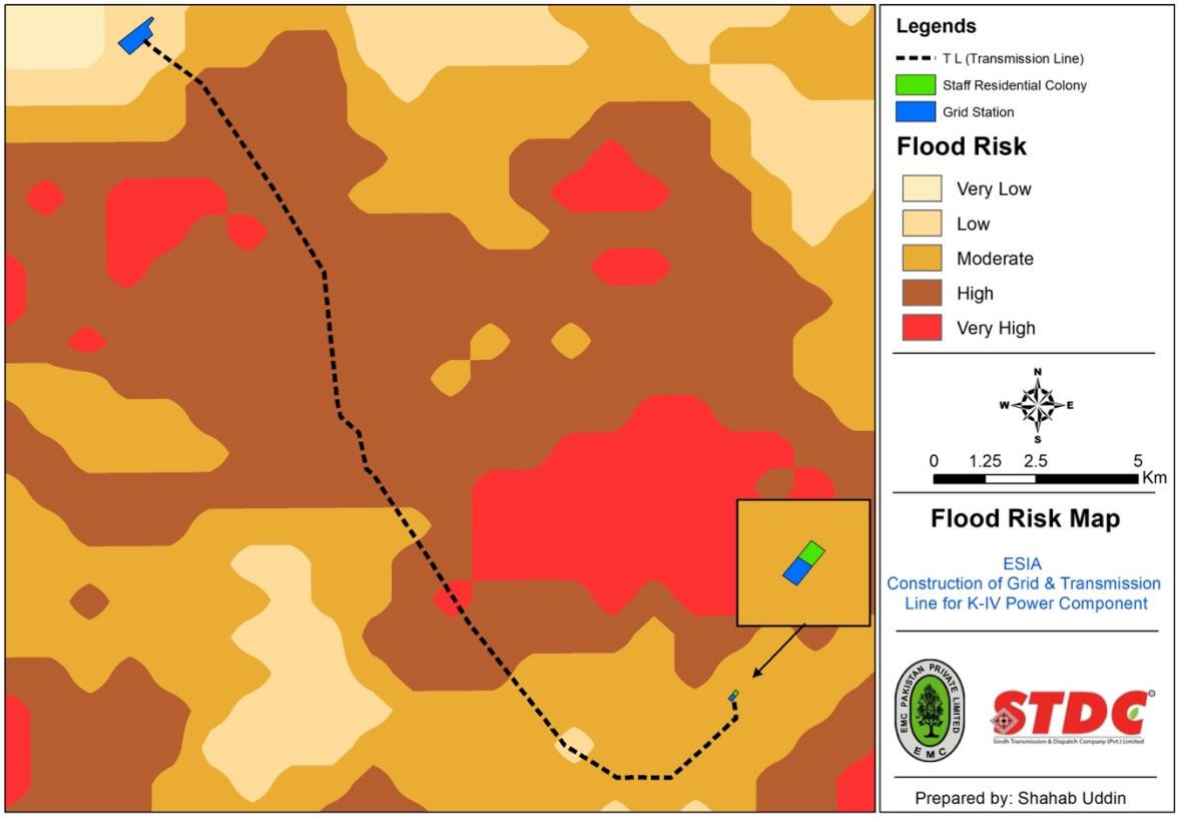


Figure 5.10 - Flood Risk of the Project Area

The project overall falls in an area of Moderate to High flood risk, with parts of it also falling in areas of very high flood risk. The different aspects that have to be considered during design of the project include:

For the Transmission Line

- Structural Integrity, where flooding can weaken the soil around tower foundations, leading to erosion, settlement, or instability.
- Prolonged water exposure increases the risk of corrosion for metal structures, reduing their lifespan and strength
- Roads, bridges, and other infrastructure required to support construction and maintenance can be washed away and damaged during floods
- Towers must be designed to withstand potential floods, including significant height considerations
- Electrical hazards such as short circuits, fires, electrocution, endangering those around these sites

For the Grid Station

- Flooding can submerge critical components such as transformers, circuit breakers, and control systems causing malfunction or permanent damage
- Water ingress into the buildings can disrupt operations and pose safety risks
- Potential interruptions and outages caused by disabling key components of the grid
- Electrical hazards such as short circuits, fires, electrocution, endangering those around these sites

5.4 Climate

The climatic conditions of the area determine various factors in the development and operation of the transmission line and grid station that would contribute towards E&S impacts, such as:

- Temperature and rainfall would serve to define the risks posed to the construction and operation of the transmission line, where extreme temperatures and excessive rainfall would shorten the lifespan of the grid station and the transmission line
- High winds and humidity would serve to have a similar impact on the infrastructure items and could also lead to potential corrosion and damage to the equipment

5.4.1 Temperature

The representative meteorological and climatic data for the district of Thatta is primarily based on observations from Thatta city. The climate in Thatta is broadly classified as arid, with moderate humidity and hot conditions. Summers are sweltering, muggy, arid, and windy, extending from May to September, while winters are short, comfortable, and dry, typically occurring from November to February. The weather tends to be very humid during June, July, and September, and pleasant during March and April. Throughout the year, temperatures typically range from 53°F to 102°F, rarely dropping below 46°F or exceeding 108°F.

In Thatta, the atmospheric temperature remains generally moderate throughout the year due to its proximity to the sea. The average annual temperature reaches a maximum of 35ºC and a minimum of around 8ºC. The accompanying data shows that the mean monthly maximum temperatures in Thatta fluctuate between 25ºC and 39ºC, while the mean monthly minimum temperatures range from 8ºC to 27.6ºC. Temperatures begin to decrease from October to January, while dry and hot conditions prevail from April to September.

Table 5.1 - Meteorological Parameters for Thatta, Sindh

Month	Temperature º C		Rainfall (mm)	Relative Humidity %
	Maximum	Minimum		
January	25.78	8.73	0.96	50.38
February	28.59	11.60	3.60	48.81
March	34.02	16.80	2.30	48.36
April	38.40	21.80	2.49	48.67
May	39.85	25.47	0.69	53.10
June	38.02	27.46	10.76	60.70
July	35.11	27.04	70.49	69.61
August	33.61	26.06	89.88	72.55
September	34.36	24.87	34.43	68.78
October	35.80	21.70	3.72	58.15
November	31.87	15.86	1.67	53.88
December	26.68	10.10	1.11	52.46

Annual Average	33.48	19.76	221.64	57.56
Source: Pakistan Meteorological Department (PMD)				

5.4.2 Precipitation

The southwest monsoon introduces humid air from the sea, but overall precipitation is quite low, with nearly 80% of the annual rainfall of 70 to 83 mm occurring between July and August. When rainfall does happen, it can be torrential, leading to drainage issues and erosion in the lightly vegetated areas of Jhimpir.

Winters are short and mild, lasting from late November to early February, with prevailing winds coming from the northeast and minimal rainfall. A notable feature of the local meteorological conditions is the high dust levels resulting from the surrounding area's dryness; dust storms are particularly common before the monsoon season. During the southwest monsoon, stronger winds carry airborne dust inland, while in winter, winds are lighter to moderate and typically move particulate matter seaward.

In general, the monsoon in the arid region of Kohistan is marked by low and highly variable rainfall both temporally and spatially. Rainfall trends tend to be below medium levels, with significant rain occurring roughly every three years, while droughts may happen every 8 to 10 years. Annual rainfall increases from under 100 mm in the north to 350 mm in the southeast. In some years, strong winds prevent the monsoon from reaching the region, resulting in no rainfall. The rainy season spans from June to September, peaking in September, with an average evapotranspiration rate of 218.2 mm.

5.4.3 Humidity

Humidity is influenced by temperature and pressure. The same volume of water vapor yields higher humidity in cooler air compared to warmer air. A related measure is the dew point, which indicates the temperature at which air becomes saturated with moisture; this temperature increases as the amount of water vapor increases. When the temperature of a parcel of air decreases, it eventually reaches saturation without any addition or loss of water. In the Jhimpir region, the most humid months are July, August, and September, while May and June are the least humid. Average monthly relative humidity (RH) values for the entire Thatta District are detailed in the figure below

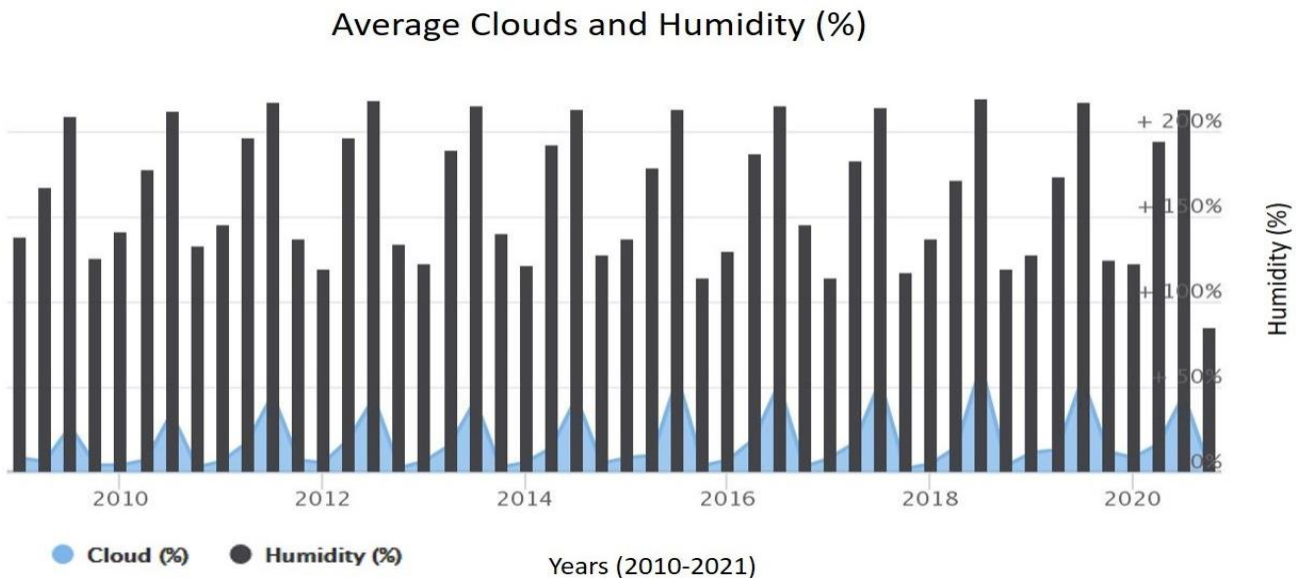


Figure 5.11 - Average Humidity Data for Thatta, District Sindh (since 2009 to 2020)

5.4.4 Wind Speed & Direction

In the Thatta region of Pakistan, the wind patterns follow distinct seasonal trends, influenced by the changing monsoon cycles. During the summer monsoon season, the prevailing winds typically originate from the west-northwest. This direction is characteristic of the summer months when the southwest monsoon winds dominate the region. In contrast, during the brief winter monsoon, the winds shift to a predominantly east-northeast direction, bringing cooler, drier air from the northeast. At ground level, wind speeds in the Thatta region fluctuate throughout the year. During the calmer months, wind speeds tend to be relatively low, ranging from 0 to 2 meters per second (m/s). However, as the region transitions into the pre-monsoon season, wind speeds begin to pick up, reaching a range of 4 to 8 m/s.

To better understand the wind power potential in this region, the Pakistan Meteorological Department (PMD) has undertaken an extensive survey across the coastal areas of the country, including the Thatta district. This survey was designed to assess wind conditions and their suitability for harnessing wind energy. As part of this effort, the PMD has mapped out a series of wind monitoring stations located throughout Sindh, which includes a total of 18 stations spread across various points of the coastal region. The following figure provides a detailed overview of the stations in Sindh and their respective locations.

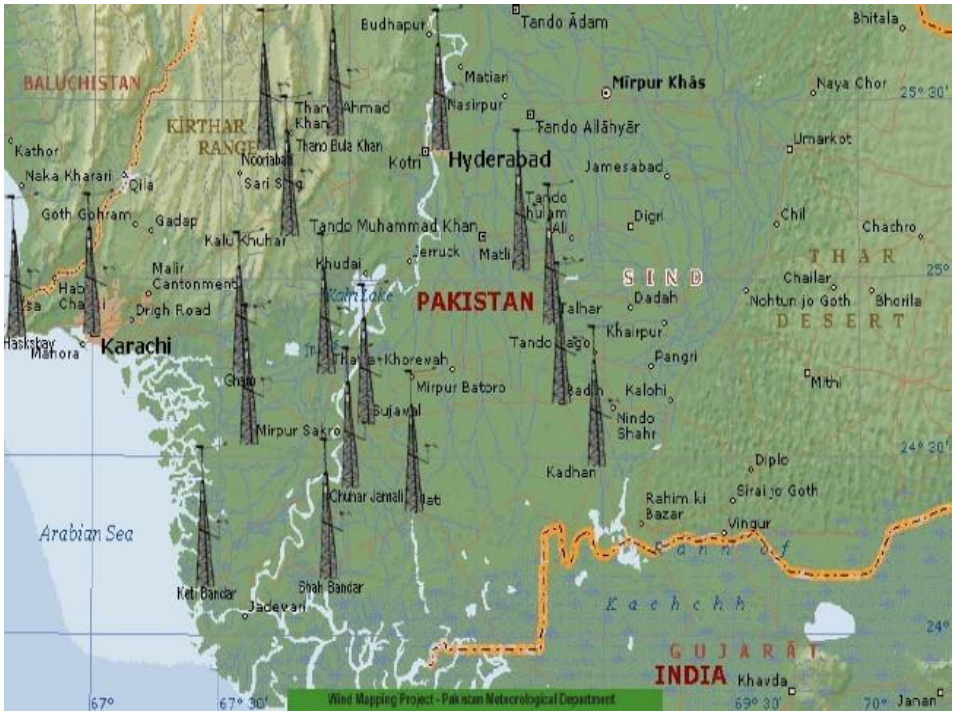
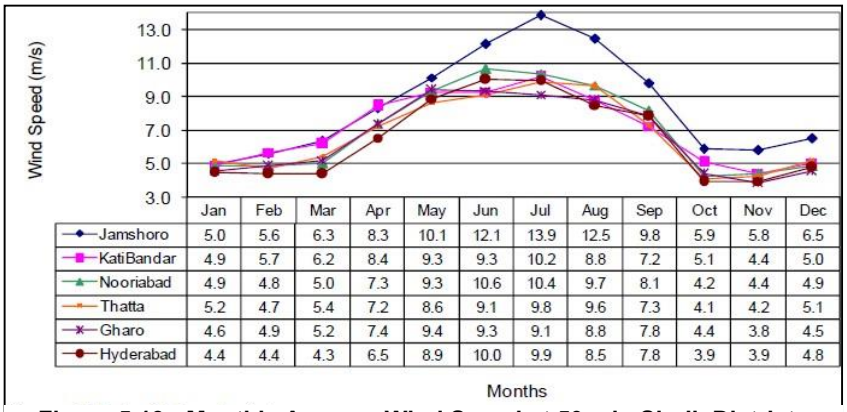


Figure 5.12 - Wind Mapping Stations installed by Pakistan Meteorological Department

The monthly average wind speeds are different in the region compare to the other region of Thatta District and adjoining areas are shown below:



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Jamshoro	5.0	5.6	6.3	8.3	10.1	12.1	13.9	12.5	9.8	5.9	5.8	6.5
KatiBandar	4.9	5.7	6.2	8.4	9.3	9.3	10.2	8.8	7.2	5.1	4.4	5.0
Nooriabad	4.9	4.8	5.0	7.3	9.3	10.6	10.4	9.7	8.1	4.2	4.4	4.9
Thatta	5.2	4.7	5.4	7.2	8.6	9.1	9.8	9.6	7.3	4.1	4.2	5.1
Gharo	4.6	4.9	5.2	7.4	9.4	9.3	9.1	8.8	7.8	4.4	3.8	4.5
Hyderabad	4.4	4.4	4.3	6.5	8.9	10.0	9.9	8.5	7.8	3.9	3.9	4.8

Figure 5.13 - Monthly Average Wind Speed at 50m in Sindh Districts

5.4.5 Cloud Cover

In Thatta, the average cloud cover shows significant seasonal variation throughout the year. The clearer period typically starts around September 8 and lasts for approximately 9.1 months, concluding around June 12. October is the clearest month, with the sky being clear, mostly clear, or partly cloudy about 92% of the time. Conversely, the cloudier season begins around June 12

and lasts for roughly 2.9 months, ending around September 8. July is the cloudiest month, with the sky being overcast or mostly cloudy around 52% of the time on average.

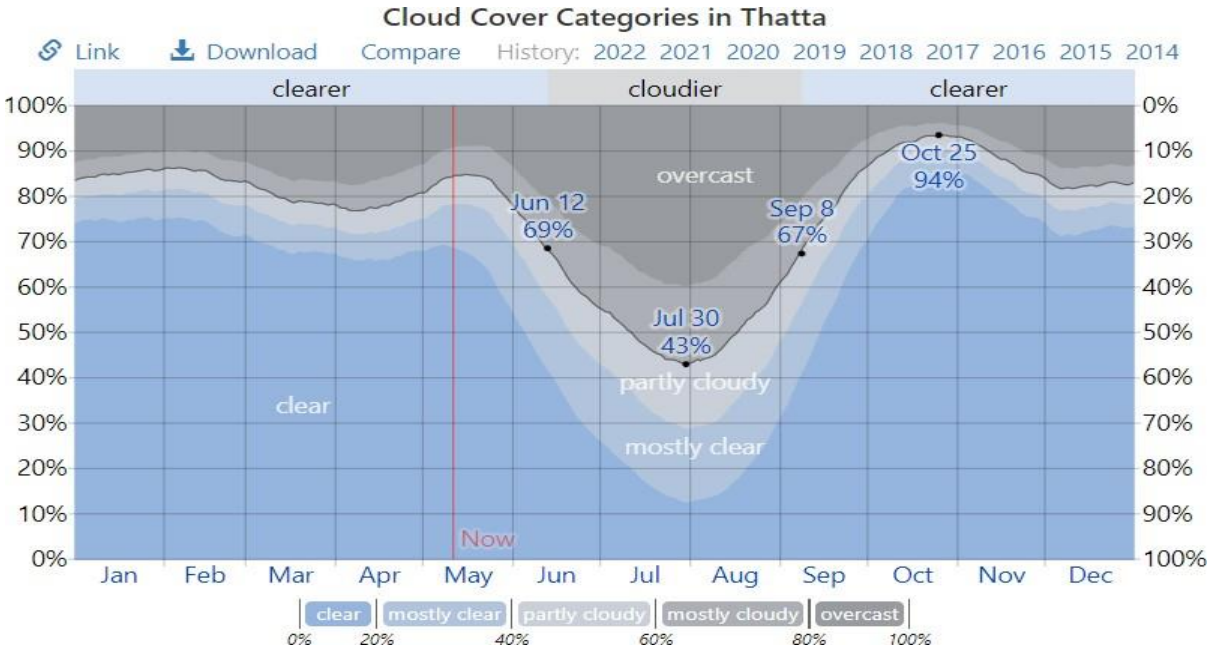


Figure 5.14 - % of time spent in each cloud cover band, categorized by the % of sky covered by clouds

5.5 Environmental Monitoring

Environmental monitoring of ambient air, noise, drinking water, groundwater, waste water and surface water was conducted by a Sindh EPA approved environmental lab for ascertaining the environmental baseline conditions within the COI of the project. Monitoring locations are marked in Figure 5.14 and its results are discussed in the succeeding sections. The detailed monitoring reports are also attached as Annex 3, where a map depicting the different areas where monitoring was carried out is provided below:

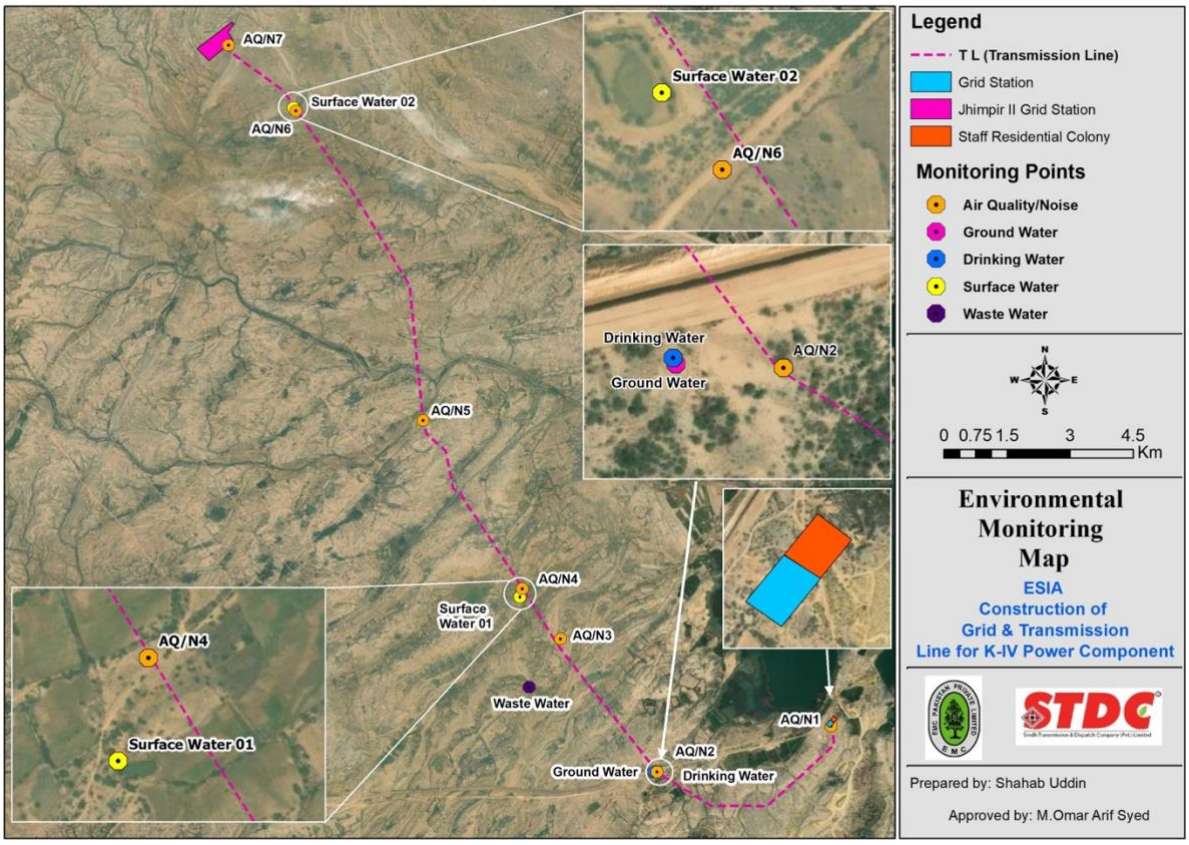


Figure 5.15 - Environmental Monitoring Points for Subject Project

5.5.1 Ambient Air Quality

For assessing the ambient air quality within the COI, ambient air monitoring was conducted at 07 different locations based on receptors around the proejct area, so as to have a baseline against which further impacts can be assessed during the construction and operational phases. The monitoring locations and co-ordinates are provided below:

Table 5.2 - Ambient Air Quality & Noise Level Locations

S. No.	Area	Point No.	Co-ordinates	Rationale for Selection
1	Proposed site for K-IV Grid Station	AQ/N1	24°53'37.6"N 67°57'32.4"E	To understand how the placement of the grid station will affect the airshed
2	Intersection of K-IV alignment and proposed transmission line	AQ/N2	24°53'37.4"N 67°57'34.6"E	To understand how the development of the projects will affect the airshed
3	Along the Transmission Line RoW	AQ/N3	24°55'19.8"N 67°56'20.0"E	To understand conditions along the RoW
4	Along the Transmission Line RoW	AQ/N4	24°55'58.6"N 67°55'50.8"E	To understand conditions along the RoW
5	Along the Transmission Line RoW	AQ/N5	24°58'08.2"N 67°54'34.1"E	To understand conditions along the RoW
6	Along the Transmission Line RoW	AQ/N6	25°02'06.8"N 67°52'56.3"E	To understand conditions along the RoW
7	At the Jhimpir-II Grid Station	AQ/N7	25°02'57.5"N 67°52'04.3"E	To understand conditions at the Grid Station

The points chosen above correspond to different points along the route of the transmission line and the location of the grid station. The results obtained from the monitoring are provided below:

Table 0.1 - Results from Ambient Air Monitoring

Parameter	Applicable Stringent Standards*	Average Values for (AQ/ N1)	Average Values for (AQ/ N2)	Average Values for (AQ/ N3)	Average Values for (AQ/ N4)	Average Values for (AQ/ N5)	Average Values for (AQ/ N6)	Average Values for (AQ/ N7)
CO	5 µg/m^3	0.22	0.30	0.21	0.34	0.25	0.20	0.33
NO	40µg/m^3	17.1	21.6	17.8	17.1	20.2	16.0	27.2
NO_2	80 ug/m^3	36.1	37.2	34.3	23.7	28.2	34.2	37.2
O_3	100µg/m^3	22.9	25.7	21.8	21.5	23.4	22.5	24.4
SO_2	20µg/m^3	27.6	25.6	12.9	10.3	11.2	14.0	22.4
Lead	1.5µg/m^3	-	-	-	-	-	-	-
PM 2.5	75µg/m3	106.2	71.8	61.8	63.5	44.6	41.9	51.0
PM 10	150µg/m^3	183.6	148.4	123.5	113.9	106.8	106.4	130.5
SPM	500µg/m^3	333.4	252.0	223.9	228.7	223.4	199.5	255.1

*Note: Discussed in Chapter 03 of this ESIA Report

The results show that most of the monitored parameters are within the prescribed limits of the stringent standards. The red highlighted values, however, are exceeding the regulatory limits. The level of SO2 monitored at three different locations and PM2.5 and PM10 at one location each were found to exceed the permissible limits. Coincidentally, all points exceeding the limits correspond to areas in or near areas where anthropogenic interventions are apparent, i.e. where work on the K-IV project is taking place or at the Jhimpir-II grid station.

Identifying that elevated levels of contaminants are found near where construction is taking place or anthropogenic interventions are apparent, specialized mitigation measures should be adopted in these areas to ensure that any impacts that may be compounded are addressed and minimized accordingly.

5.5.2 Noise Levels

The area in and arund the project site is devoid of any sort of persons or activity for the most part other than at the ends where the two grid stations are proposed. Aside from these two areas, there is negligible activity along the Corridor where the transmission line is to pass. Given that noise limits are prescribed across the world in line with the sort of area where the noise is being generated, barren land does not fall into any such category. However, given that commercial activities are taking place in 2 parts of the alignment, the commercial category of noise limits will be applied to the entirety of the alignnment.

In line with this, noise monitoring was carried out at the same locations where ambient air monitoring was carried out, in order to obtain an idea of the noise levels along the entire length of the alignment. The results from the monitoring are provided below:

Table 0.2 - Results from Noise Levels Monitoring

Monitoring Point	Zone	Applicable Stringent Standards		Average Monitored Values	
		Day Time	Night Time	Day Time	Night Time
		07:00 – 22:00	22:00 – 07:00	dB(A) Leq	dB(A) Leq
AQ/N1	Commercial	65	55	53.2	53.0
AQ/N2				53.0	52.5
AQ/N3				53.1	52.9
AQ/N4				53.6	53.0
AQ/N5				53.9	53.2

AQ/N6				51.7	53.0
AQ/N7				53.6	53.5

From the results provided above, it can be seen that all results obtained complied with the stringent standards for noise levels in the area, however, this can be mainly attribtued to there being no work or activity happening along the RoW.

5.6 Biotic Environment

Due to arid climate, the land use of the microenvironment is mostly barren with patches of small-scale agricultural activity. The vegetation mostly comprises of various species of grass, bushes, shrubs and few specie of cactus and other thorny plant.

5.6.1 Flora

Dominant specie in the project area is Prosopis juliflora. Very few species of trees are present in and around the project area, that include Conocarpus erectus etc. these trees are in very small number and widely spaced. The native flora of the typical habitat as in project area is given in below list, however, only a few species such as Capparis aphylla, Euphorbia caducifolia, Calotropis procera, Prosopis juliflora and Salvadora oleoides can be found in the project area. Farmlands had cultivations of Pappaya, Oats/cereals and vegetables.

Table 0.3 - List of Floral Species

S. No	Botanical Name	Local Name
Trees and Shrubs		
1.	*Capparis aphyla*	Kirir
2.	*Salvadora oleoides*	Khabar
3.	*Acacia Senegal*	Kunbhat
4.	*Prosopis cineraria*	Kandi
5.	*Prosopis juliflora*	Mesquit, devi
6.	*Tecoma undulata*	Lohiro
7.	*Euphorbia caudicifolia*	Thuar
8.	*Tamarix aphylla*	Lai
9.	*Ziziphus nummularia*	Ber
10.	*Acacia nilotica*	Babur
Grass		
1.	*Aristida adscenciones*	Lumb
2.	*Aristida funiculate*	Lumb
3.	*Cenchrus biflorus*	Bhurt
4.	*Cenchrus ciliarus*	Dhaman
5.	*Chrysopogon aucheri*	Putar
6.	*Cymbopogon jawarncusa*	Poi
7.	*Desmostachya bipinnata*	Dubh
8.	*Dicanthium annulatum*	
9.	*Lasiurus sindicus*	Sain
10.	*Lasiurus hirsutus*	
11.	*Leersa spp.*	

5.6.2 Fauna

The right of way of the project area is mostly vacant, barren and sparsely inhabited with little vegetation comprising mostly bushes. Due to human disturbance and shrinking habitat, only nominal fauna could be recorded on the site. However, the habitat of common wild animals, who could be found if there had been no disturbance in this area, comprises: Jackal, Porcupine, Fox and Wild Hare. Birds of the eco-zone likely include Grey Partridge, Common Quail, Spotted Owlet, Indian Nightjar, Woodpecker, Passerines, etc. Reptiles of the area could include Monitor Lizard, Spiny-tailed Lizard, Krait, Vipers and Rat Snake.

At present, there are no serious threats to the animal species, most of which have already moved to the distant surrounding lands due to disturbance. Only the species adapted to the presence of humans occur in the area. These include Rodents, Squirrels, and Birds usually associated with human habitations in the vicinity of water points or garbage areas where food is available. Lizards may be surviving well in the rocky or wasteland area even with sparse vegetation.

5.6.3 Protected Areas

The only identified protected area in the project's vicinity is Keenjhar Lake. Keenjhar Lake is a protected site due to its ecological and environmental significance. As a vital wetland, it supports a diverse range of wildlife, including migratory birds along the Indus Flyway, making it a key stopover for species like the Siberian crane. The lake also serves as an important freshwater reservoir for local communities, supporting agriculture and drinking water needs. Recognized as a Ramsar Wetland of International Importance, it is legally protected to preserve its biodiversity and water quality. Efforts are underway to safeguard the lake from threats like pollution, illegal fishing, and encroachment, ensuring its ecological balance and continued role in the region's environmental and economic stability. Further details on Keenjhar lake and the type of environment it supports are provided below:

Keenjhar Lake

Keenjhar Lake, also known as Kalri Lake, is a significant freshwater lake located in the Thatta District of Sindh, Pakistan, approximately 113 kilometers east of Karachi. The lake lies at coordinates 27º 47' N latitude and 68º 02' E longitude, about 20 kilometers to the north and northeast of Thatta city. Spanning an area of approximately 145 km² (35,380 acres), Keenjhar is the largest freshwater lake in Pakistan. The lake is formed by the merging of two smaller lakes, Sonheri and Keenjhar, through the construction of an embankment in the 1950s. Historically, these lakes were created when the Indus River changed its course, leaving them isolated. Originally, these lakes were fed by seasonal torrents from the surrounding hills, but today, the primary source of water is the Indus River, which flows into the lake through the Kalri Baghar Canal, originating from the Kotri Barrage. Additional water flows in from smaller seasonal streams on the western and northern shores, while the only outlet is through the Keenjhar Gujjo Canal at the southeastern corner.

Keenjhar Lake has a maximum depth of 5–6.5 meters, a significant reduction from its original depth of around 18.5 meters before siltation from the Indus River (Anon, 1999)[14]. The lake serves as a crucial water resource for the local population and for Karachi, as well as parts of the Thatta District. The surrounding area is home to about 62 villages, which are part of four Union Councils: Sonda, Oongar, Jhimpir, and Chatto Chan. The main occupations of the local communities are fishing and agriculture. Tribes such as the Palari, Shora, Turk, Hilaya, and Sarki are engaged in farming, often

[14] *Anon. (1999). Report on study into causes and effects of eutrophication in major Lakes in Sindh. Environmental Protection Agency, Government of Sindh.*

using pesticides, and in livestock grazing in the buffer zone surrounding the lake. The lake's rich biodiversity, particularly its fish populations, has been a critical source of livelihood, though overfishing and reduced catches have led some villagers to seek alternative income sources, such as mining stones from the nearby rocky hills.

Keenjhar Lake is also a popular recreational destination for people from Karachi, Hyderabad, and Thatta. The Sindh Tourism Development Corporation has established a Tourist Center with air-conditioned accommodations along the eastern shore, offering visitors boat rides on speedboats, though safety concerns persist due to the lack of proper safety equipment, leading to occasional accidents. Other infrastructure in the area includes a rest house by the Irrigation Department and a facility operated by the Fisheries Department at Chillya, about 10 kilometers from the lake, which includes a fish hatchery, training center, and hostel.

In recognition of its ecological significance, Keenjhar Lake was designated a Ramsar Site in 1976, marking it as a wetland of international importance. It was also declared a Wildlife Sanctuary in 1977 under the Sindh Wildlife Protection Ordinance, 1972, with a 5 km buffer zone to protect its environment. The lake's extensive reedbeds, submerged and floating vegetation, and riverine forests support a wide variety of bird species, making it an important habitat for waterfowl. Up to 140,000 waterbirds, including species such as the European Wigeon, Black Coot, and Common Pochard, use the lake for breeding, staging, and wintering. The lake's surrounding riverine forests not only support biodiversity but also provide clean water, air, and opportunities for physical activity and community engagement.

The lake's role in supporting local fisheries is significant, with traditional fishing methods such as the "Gol Jaar" (circular nets) still in use. Despite challenges posed by siltation, reduced fish catches, and environmental pressures, Keenjhar Lake remains an invaluable resource for both the local communities and the wider region, offering ecological, economic, and recreational benefits. The ongoing conservation efforts aim to maintain the lake's delicate ecological balance and preserve it for future generations.

Table 5.3: Hydrological Data of Keenjhar Lake

Parameter	Value
Lake Area	38 square miles (24,320 Acres)
Storage Capacity	0.508 MAF
Usable Capacity	0.38 MAF
Average Depth of Water	20 Feet
Length of Embankments	12 Miles
Maximum Height of Embankments	30 Feet
Deposition of Silt per Year	4,335 Acre Feet
Original Design Life	132 years
Reduced Life after Silting	87 years
Life after Construction of Link Canal by passing Keenjhar Lake	192 years
Main water Supply Source	Kalri Baghar Feeder Upper
Outlet	KG Canal, & K-IV outlet (proposed)

Fishing landing centers	Chilya, Khambo, Hilya, Sonhari, Khudi, Jhimpir, Mouldi Doulatpur
Population	45,000 Souls Living around the Lake
Main Commercial Fish Species: Labeo rohita (Rohu, Dumbhro, Kurriro), Catla catla (Thailhi), Cirrihina mrigala (Morakhi), Cyprinus carpio (Gulfam), Notopterus chitala (Gandan), Cirrina reha (Suhni), Puntius chola (Popri), Mystus seenghala (Seenghari), Channa striatus (Shakur), Channa puntatus (Mukkur), Mastacembelus armatus (Gouge), Heteroneustus fossilis (Luhar), Ompok bimaculatus (Fabino) Wallago attu (Mullee), Tilapia mossambicus (Dayo, Tilpo)	
Source: Directorate of Fisheries Sindh Inland Hyderabad, Livestock & Fisheries Department, GOS	

5.7 Socio-Economic Environment

The socio-economic provides a comprehensive review of the social and economic conditions of District Thatta with the objective of setting the context for the proposed development of a dedicated 132 kV double circuit overhead transmission line and grid station, which will provide uninterrupted power to the pumping complex of the K-IV Water Supply Project. This Section builds primarily on secondary resources from published literature, consultations with communities in formal and informal settlements, consultations with key institutional stakeholders and on-site observations of the potential project localities. This aims to provide an overview of the socio-economic conditions of the people who reside and work in the said area. It also includes an assessment of public utilities and social services (education and health facilities) in the area concerning the subject project.

International best practice for ESIA studies demands an alignment of the proposed project components with the applicable Sustainable Development Goals (SDGs) adopted by all UN Member States in 2015. The SDGs provide broad universal targets for reducing poverty, environmental degradation, injustice and important pillars of social upheaval that must be achieved by 2030. In March 2017, the global indicator framework was developed and agreed upon by the Inter-Agency and Expert Group on SDG Indicators (IAEG-SDGs) to monitor progress towards the achievement of these indicators. Moreover, all member states, including Pakistan have developed national indicators linked to the global targets that provide the basis for a national effort of monitoring progress towards fulfillment of the indicators. The proposed project should be aligned with Goal 11 of the SDGs that requires all essential steps be taken to ensure development that is socially acceptable and environmentally sound.

The socio-economic baseline data in this chapter identifies the existing socio-economic trends in the area, where this baseline is divided into macro and micro environment of the project area. The macro-environment of the project encompasses District Thatta, which covers the administrative setup, demography, education, health and Utilities profile of the area. Furthermore, despite no persons or settlements found within the COI of the project area, the micro-environment data covers the data of persons found nearby the project site.

5.7.1 Macro-Environment of District Thatta

District Thatta is situated at a distance of 98 Kilometers in the east of Karachi Division on the National Highway. The district is surrounded on the north and northwest by Jamshoro district, on the east by Hyderabad, Tando Muhammad Khan, Sujawal districts and the Indus River while the Arabian Sea is situated on the south of the district.

5.7.1.1 Demography

According to the national census conducted in 2023, there are a total of 1,083,191 peoples in district Thatta with an average annual growth of 1.65% between the last two censuses (2017-

2023). The gender ratio in District Thatta is 105.18, with the proportion of males (51%) slightly higher than the proportion of females (49%). District Thatta is rural by its characteristics like majority of the other districts in Sindh. Nearly 82% of the population resides in the rural area while 18% resides in the urban areas. The following table shows the demographic details of Thatta based on the findings of the 2023 census.

Table 0.4 - Population Census Survey Summary for District Thatta

Administrative Units		Average Household Size	Population 2023				Population 2017	Sex Ratio 2017	Annual Growth Rate 2017-2023
			Male	Female	Trans-gender	Total			
Thatta	Total	5.2	555,252	527,895	44	1,083,191	982,138	105.18	1.65
	Rural	5.1	457,107	432,373	32	889,512	805,662	105.72	1.67
	Urban	5.7	98,145	95,522	12	193,679	176,476	102.75	1.57
Source: Pakistan Bureau of statistics, population census-2023									

5.7.1.2 Administrative Context

The project falls under the jurisdiction of district Thatta. District Thatta has four sub-divisions, locally called (Taluka): Ghorabari, Keti Bunder, Mirpur Sakro and Thatta. It is spread over an area of 8,570 sq.km and according to the 2023 national census, the total population of District Thatta was above 1 million. Previously, Sujawal was part of district Thatta before being granted the status of a district on 12th October 2013 through official notification by the Government of Sindh. The new district comprises of five talukas; Sujawal, Kharochan, Mirpur Bathoro, Jati and Shah Bander. It is located at about 20 km west of Thatta.

Table 0.5 - Population of District Thatta and Sub-Divisions (1998,2017)

District/Talukas	Status	Population (Census-2017)	Population (Census-2023)
Thatta	District	982,138	1,083,191
Ghorabari	Taluka	174,046	198,920
Keti Bunder	Taluka	59,699	63,217
Mirpursakro	Taluka	341,689	376,078
Thatta	Taluka	406,704	444,976

5.7.1.3 Ethnicity and Religion

Sindhi is the major language of the district, although Urdu is also spoken and understood. Besides, Seraiki and Balochi are also spoken in the city area. Islam is the major religion of this district representing 96.2% of the population followed by Hinduism (2.89%) and Christianity (0.18%). Caste system is very strong in this region. Majority of the population of Thatta district belongs to indigenous Sindhi clans. Jokhio, Palijo, Sheerazi, Soomro, Sammo, Syed, Memon, Khoja and Mirbahar are the main tribes of Thatta district.

This district has a rich heritage of ancient Sindhi and Arabian culture. Both can be seen in the architect and culture of this district. Thatta's Jamia Masjid known as Shah Jehan Masjid is a masterpiece. It was built on the orders of the Mughal Emperor, Shah Jehan, who gifted it to the

people of Thatta. Its construction started in 1644 and was completed in 1647. Makli hills, also known as Makli graveyard, are one of the largest necropolises in the world, with a diameter of approximately 8 kilometers. These hills are supposed to be the burial place of some 125,000 sufi saints. The graveyard is located on the outskirts of Thatta city.

5.7.1.4 Livelihood

Agriculture and fisheries are the two major sources of employment for the people of district Thatta. In addition to that, there is a substantial number of landless people who own and manage livestock or are engaged in the non-farm sectors. According to a study conducted by Asian Development Bank, 79% of the population of district Thatta is poor. The incidence of poverty is negatively correlated with land ownership. Landowners are usually non-poor.

There are about 30 industrial units established in the district. Apart from the sugar mills, all the larger industrial units are located in Dhabeji and Gharo mouzas adjacent to Karachi. Most of the labour force working in these units is non-local and generally belongs to Karachi. The industrial units of the district include sugar mills (5), textile mills (9), paper mills (2), flour mill (3) salt works, ice factory (2), etc. In addition, crushed stones from the Makli Hills and Kohistan are supplied to the Pakistan Steel Mill and the Thatta Cement Factory. There are also large coal deposits in Thatta Taluka. Recent addition to the industrial units is the car manufacturing plant near Budho Talpur, belonging to the Deevan Group, adjacent to the Deewan Sugar Mills.

5.7.1.5 Economic Profile and Source of Income

Agriculture and fisheries are the two major sources of employment for the people of district Thatta. In addition to that, there is a substantial number of landless people who own and manage livestock or are engaged in the non-farm sectors. There are two main crop seasons; "Kharif" and "Rabi" in Thatta District. The Kharif season starts from April-May and ends in October-November while the Rabi starts from November-December and ends in April-May. However, due to regional variation in temperature, several factors i.e. varieties, availability of water, soil texture etc. determine the crop pattern, sowing and harvesting time.

The Crops are further categorized into major and minor crops. Wheat, Cotton, Rice, Sugarcane is the major crops of the district, while Barley, Bajra, Jowar, Maize, Gram, Rapeseed, Mustard, Sesame, Oil seeds fall in the category of minor crops. The total cultivated area in the district is 49%. The Wheat, Cotton, Rice, Sugarcane are the major crops of the district while Barley, Bajra, Jowar, Maize, Gram, Rapeseed, Mustard, Sesame, Oil Seeds fall in the category of minor crops. Wheat is a staple food crop of the people of Thatta district and it occupies the majority of cultivated land. The Onion, Bajra, Masoor, Maize, Sesame, Gram, Jawar, Rape & Mustard and Mattar are the minor crops which significantly contribute the share to the total cropped area of the district Thatta.

The agriculture sector in the district is challenged with many issues. Half of the district's lands are not available for cultivation and this proportion is increasing steadily over the years. The declining availability of water in Indus has serious repercussions for the Indus Delta and agriculture in the district. A large section of the population that was previously engaged in agriculture has turned to fishing nowadays. Due to sea intrusion, the growers are sprouting betel leaf crops to make ends meet as needs less water and yields more profit. The degradation of Indus Delta and grazing lands has also resulted in the decline of livestock population.

5.7.1.6 Education Profile

According to Sindh Education Management Information System (SEMIS) 2023-2024 the enrolment and teaching staff across various educational levels in Sindh. At the primary level, there are 896

institutions with a total enrolment of 60,734 students, of whom 35,922 are male and 24,812 are female. The teaching staff at this level consists of 1,816 male and 1,290 female teachers, totaling 2,106 staff members. At the elementary level, with 3 institutions, there are 853 students enrolled (494 male and 359 female), supported by 39 male and 28 female teachers. The middle school level has 30 institutions and an enrolment of 2,712 students (1,796 male and 916 female), with 304 male and 220 female teachers. Secondary education in Sindh is provided by 38 institutions, enrolling 15,352 students (9,189 male and 6,163 female) with a teaching staff of 873 male and 508 female teachers. Higher secondary institutions total 9, with an enrolment of 9,498 students (7,818 male and 1,680 female), supported by 312 male and 240 female teachers. In total, there are 976 institutions across all levels, with a combined enrolment of 89,149 students, of which 55,219 are male and 33,930 are female. The total number of teaching staff across all levels amounts to 3,344, including 2,286 male and 1,058 female teachers.

Table 0.6 - Schools Data by Gender

S#	LEVEL	INSTITUTIONS				ENROLMENT			TEACHING STAFF		
		T	M	F	Mixed	T	M	F	T	M	F
1	Primary	896	368	124	404	60,734	35,922	24,812	1,816	1,290	526
2	Elementary	3	-	1	2	853	494	359	39	28	11
3	Middle	30	10	11	9	2,712	1,796	916	304	220	84
4	Secondary	38	19	13	6	15,352	9,189	6,163	873	508	365
5	Higher secondary	9	3	1	5	9,498	7,818	1,680	312	240	72
GRAND TOTAL		**976**	**400**	**150**	**426**	**89149**	**55219**	**33930**	**3344**	**2286**	**1058**
Source: RSU-Sindh Education Management Information System (SEMIS) 2023-2024											

According to Sindh Education Management Information System (SEMIS) 2023-2024. In Ghorabari, 93.5% of schools have buildings, but only 35.3% have boundary walls, 40.2% have functioning toilets, 24.5% have electricity, and 34.2% have access to drinking water. In Keti Bundar, 93.2% of schools have buildings, but the availability of facilities is lower: 33.9% have boundary walls, 66.1% have toilets, 3.4% have electricity, and 39.0% have drinking water. Mirpur Sakro shows a better situation in some areas, with 91.3% of schools having buildings, 41.4% with boundary walls, 60.1% with toilets, 7.9% with electricity, and 70.3% having access to drinking water. In Thatta, 95.5% of schools have buildings, 50.9% have boundary walls, 56.2% have toilets, 10.8% have electricity, and 50.7% have drinking water. This data highlights significant disparities in the availability of basic facilities across the talukas, with most schools having building structures, but many lacking essential amenities such as electricity and drinking water, which are critical for providing a conducive learning environment.

Table 0.7 - Basic Facilities by Taluka

Taluka	Building	Boundary Wall	Toilet	Electricity	Drinking Water
Ghorabari	93.5%	35.3%	40.2%	24.5%	34.2%
Keti Bundar	93.2%	33.9%	66.1%	3.4%	39.0%

Mirpur Sakro	91.3%	41.4%	60.1%	7.9%	70.3%
Thatta	95.5%	50.9%	56.2%	10.8%	50.7%
Source: RSU-Sindh Education Management Information System (SEMIS) 2023-2024					

5.7.1.7 Health Profile

According to Health Profile of Sindh 2016, there are 648 hospitals in the province with a total capacity of 30,126 beds. Additionally, there are 800 BHUs and 133 RHCs in the province with a total capacity of 3318 beds. The doctor to population ratio in the province is 1 doctor for 3159 people. There are only 8 hospitals in the entire district of Thatta with a total capacity of 300 beds. Additionally, there are 22 BHUs and 6 RHCs in the district with a total capacity of 124 beds. (Health Profile of Sindh 2016) The doctor to population ratio in the district is 1 doctor for 5859 people, showing that the health personnel in the district are inadequate to serve the population of entire district. According to PESA report for district Thatta 2014, 44% (Male 44%: Female 43%) of the children aged 12-23 months have received full immunization.

Table 0.8 - No. of Health Facilities in District Thatta (2017)

District	Hospitals	Dispensaries	Basic Health Units	R.H. Centers	T.B Clinics	M.C.H.C.	Total
Thatta	8	91	22	6	8	6	141

Source: Health Profile of Sindh-2017 (BOS Sindh)

5.7.2 Micro-Environment

5.7.2.1 Main Source of Livelihood/Income

The people in the nearby villages of the project's area are mostly laborers working in agriculture fields, construction works, poultry farms, livestock farms and transportation. Only few of them are educated enough to work in factories or own a small business.

5.7.2.2 Education Facilities

There are no major educational facilities near the project site, and for the few that are present, exist in poor conditions. These schools are without proper infrastructure and staff and are currently non-functional due to the lack of population in and around the project area. There is a school near the proposed receiving grid station at Lake Keenjhar, which is non-operational as well.

5.7.2.3 Health Facilities

There are no health facilities in the nearby villages of the project's area. People of these areas suffer greatly when someone gets sick, or require medical attention. These persons either go to BHU Chato Chand, or Makli, Thatta Civil hospital for treatment. If there is a major health problem, people go to Karachi. Major health complain of the area are fever, cough and flu. People use private transport to reach the health facility where they hardly manage to afford private vehicle expenses.

5.7.2.4 Utilities

The main source of drinking water in most of the nearby villages is either Keenjhar Lake itself in Thatta or through water lines and boreholes. Some settlements closer to the project's ROW utilizes stored rainwater. The villages do not have proper sewerage system for the disposal of domestic toilet waste. The toilet system in these villages consist in open area and use of pit-hole latrine .

There are no proper mechanism of solid waste disposal and people throw waste in the open lands. Electricity is not available in the nearby villages except the few villages that are closer to Thatta City. There is no gas connection in the villages so people use fire-wood for cooking purpose. In some areas, people use rain water, which is collected in catchments for their basic utilities, including for drinking purposes.

5.7.2.5 Transportation

There is no public transportation available in the nearby villages and people usually prefer to walk from one place to another. Some people who can afford motor bikes use motor-cycles for travelling. The villages do not have proper road infrastructure, only dirt tracks because people can't afford cars. Use of donkey carts were also noticed by the survey team during the visit. The main road is Hyderabad-Thatta National highway which is 20 km away from the project side.

6 Anticipated Impacts & Mitigation Measures

6.1 Introduction

This chapter outlines the findings from the assessment of potential environmental and socio-economic impacts of the project and proposes appropriate mitigation measures. It includes the identification, analysis, prediction, significance, and characteristics of the impacts, as well as the proposed measures to prevent unacceptable adverse effects by incorporating necessary project modifications.

The chapter is a crucial component of the Environmental Impact Assessment (EIA), highlighting all significant impacts that may arise during the design, construction, and operation phases of the project. It also evaluates the environmental and social aspects identified through stakeholder consultations and the screening process, assessing their severity and recommending mitigation strategies based on these assessments. Additionally, residual impacts that may persist even after the implementation of mitigation measures are identified through professional judgment. The project proponent will adopt these measures to reduce, minimize, and compensate for negative impacts to the greatest extent possible.

6.2 Screening Methodology

This section identifies potential project impacts associated with the design, construction, and operational phases of the transmission line. Impact predictions are based on the consultants' previous experiences with similar projects, professional judgment, field data, discussions with local communities, relevant government authorities, and technical experts. The predicted impacts encompass all aspects of the proposed transmission line project. Mitigation measures primarily address community and occupational health and safety concerns, as well as the adoption of good construction practices.

The environmental impact assessment (EIA) uses the following definitions to assess the significance of potential impacts:

- **No Impact:** An impact is considered negligible or non-existent if the project activity is either geographically or temporally distant from the environmental component, or if the impact is so minor that it cannot be measured. No mitigation is needed for such impacts.
- **Minor Impact (Positive or Negative):** If an impact occurs but does not meet the criteria for a significant impact, it is classified as minor. For minor adverse impacts, appropriate mitigation measures will be implemented.
- **Major Impact (Positive or Negative):** A major impact is considered significant if the project has the potential to affect the environmental component. The criteria for determining whether an impact is significant include: (i) spatial scale of the impact (local, regional, national/international); (ii) time scale of the impact (short, medium, or long term); (iii) the extent of the change in the environmental component (small, moderate, or severe); (iv) significance for local communities; (v) compliance with relevant conservation laws, regulations, and standards (local, national, international). If serious adverse impacts are identified, mitigation measures will be developed to reduce them to acceptable levels.
- **Unknown Impact:** If the severity of an impact cannot be determined due to uncertainties about the nature or location of the project, the environmental components in the study area,

the time frame, or the spatial scale of the impact, the potential impact is classified as "unknown." Where possible, mitigation measures will be defined for unknown impacts.

- Impacts can be categorized as follows:
- **Direct Impacts:** These result from project activities that occur at the same time and in the same location, both during construction and operation. Direct impacts are expected to be limited in this project, as the reconstruction and construction of water supply and sewerage systems are primarily environmental protection measures.
- **Indirect Impacts:** These include secondary effects, such as project-induced growth or longer-term or more distant environmental consequences. Although indirect impacts may occur later or at a greater distance, they remain relatively predictable.
- **Short-term Impacts:** These typically involve temporary effects, such as noise and emissions from heavy machinery during construction, and generally do not result in long-term environmental damage.

Environmental screening identifies a range of potential environmental impacts associated with project activities. If these impacts are considered significant or severe, mitigation measures will be developed and incorporated into the project documentation.

The impacts of construction activities will depend on various factors, including the temporary use of land and its restoration after construction. Adopting best practices during construction, coordinating with local authorities for impact management, and ensuring compliance with environmental regulations outlined in project proposals and specifications, as well as the Environmental and Social Management Plan (ESMP), will be key to mitigating these impacts.
The following section details the environmental impacts expected from the project, along with the mitigation measures designed to minimize these impacts to technically feasible levels. The description is divided by project phase: design, construction, and operation. All construction-related mitigation measures will be included in the tender or contract documents, making them mandatory for construction and supervision contracts.

6.3 Design Phase: Impacts and Mitigation Measures

Impacts during the design phase mainly relate to:

- Land acquisition, resettlement, and necessary approvals;
- Sensitive receptors (e.g., settlements, schools, protected areas) and existing infrastructure (e.g., roads, railways);
- Physical cultural resources

The mitigation measures focus on the careful selection of the transmission line's right-of-way (ROW) to minimize or avoid impacts.

6.3.1 Land Acquisition

No resettlement is anticipated due to the project. The RoW for the transmission line's tower base placement and trenching will be secured from the relevant authorities during the design phase. Necessary No Objection Certificates (NOCs) will be obtained from relevant institutions before construction begins.

Mitigation Measures:

- No mitigation measures are required as there is no land acquisition and resettlement.

6.3.2 Cultural Resources

There are no protected cultural or heritage sites located near the proposed transmission line route.

6.3.3 Sensitive Receptors and Existing Infrastructure

There are no sensitive receptors identified along the Right of Way (RoW) of the project, furthermore, given the project passes through sparesely populated areas, there is minimal already existing infrastructure.

For areas where the proposed transmission line's construction will intersect existing infrastructure, the appropriate approvals have been obtained from departments and the required construction methodologies incorporated for minimizing impact on this infrastructure.

6.3.4 Temporary Construction Camps

There may be a requirement to establish small construction camps. If not undertaken carefully, activities involved in establishing and running campsite can result in deterioration of air & water quality, and social impacts including disease transmission.

Mitigation Measures

- Sanitation facilities in the camps should be provided and its wastewater should adequately be disposed offsite through septic tank and soak pit or connected to the local sewerage system;
- Contractor shall be made responsible through contract documents for proper disposal of the waste generated and not to dump these spoils/ earth near open plots, open spaces, open storm water drains, in front of settlements, on cultivated lands or left unattended along the construction site. It should be disposed in designated landfill site.
- Contractors shall also be made responsible through contract documents to follow Sindh Environmental Quality Standards (SEQS) and applicable standards during all the construction activities and ensure compliance of the same through periodic environmental monitoring reports.

6.3.5 Health and Safety of Workers and Public

Contractors shall be made responsible through contract documents to follow Standard Practices and Standard Operating Procedures (SOPs) to ensure health & safety of workers at the site and public during construction and operations.

6.3.6 Living and Livelihood of the Neighboring Community

The proposed transmission line route avoids the community areas and settlements. The proposed transmission line is unlikely to cause any loss of livelihoods to the area populace.

6.4 Construction Phase: Impacts and Mitigation Measures

Construction phase impacts include erosion of soil; impacts on surface and groundwater; solid waste management; air quality issues - primarily related to dust generation; noise; vegetation removal; aesthetic impacts; and occupational and community health risks. Mitigation measures

include good construction and housekeeping practices, and compensatory plantation for any loss of trees in the ROW.

6.4.1 Solid Waste Management

Typical solid waste generated during construction include waste concrete, steel scrap, wooden scaffolding, empty cement bags, excavated soil, wood remains etc. Solid waste generated during land clearance and Earth-fill material could be in significant quantities. This waste has the potential to cause negative impact on the surroundings if not properly managed and disposed of. It may block nearby natural drainage channels that can ultimately cause localized flooding during monsoon season. Random storage of this waste may be injurious to the workers at the site as well. Windblown debris is a nuisance to the nearby settlements. Poor waste management practices would result in short term and long-term negative impacts on the aesthetics of the surrounding.

Mitigation Measures

- A Comprehensive Waste Management Plan for Construction phase should be developed;
- Construction sites should be equipped with temporary refuse bins, and construction wastes should be collected on a daily basis and contained in a temporary designated waste storage area on each site;
- Any hazardous waste should be separated and stored in areas clearly designated and labeled, and disposal in environmentally friendly manner;
- All type of wastes should be routinely collected from the designated area and disposed at designated waste disposal site(s); and
- Upon completion of activities at a construction site all solid wastes should be completely removed and the site should be re-contoured or prepared for natural re-vegetation.

Waste Segregation

- All hazardous waste if found shall be segregated from nonhazardous wastes at the point of generation of waste. During construction phase, suitable containers with following color coding shall be kept to collect and segregate common wastes at all facilities:

Waste material	Color code
Concrete/ Campsite Debris	Blue
Metal	Green
Plastic	White
Oily Rags	Black
Used Oil	Red
Rubbish/Trash	Yellow

Recycling

Recycling and reuse minimize the quantity of waste requiring disposal. Some of the wastes can be reused within the construction site while others can only be recycled. There is a great recycling potential for few of these wastes in the recycling market. Waste shall be sold to the third-party contractors/ companies, who have proper recycling facilities.

CC will suggest/recommend recycling of the paper, glass, plastic wastes in their respective processing units. Iron/steel waste would be sent to re-rolling mills.

Table 6.1 - Waste Management Options (Different Categories)

S#	Waste Type	Category	Disposal Options
1.	Septic Tank Sludge	Non-hazardous	Disposed in Landfill site.
2.	Excavation Material	Non-hazardous	Reuse for backfill
3.	Construction debris including Scrap	Non-hazardous	Recycle, reuse or sell to third party contractor.
4.	Metals	Non-hazardous	Store cuttings in designated area for reuse. Remove surplus materials and use them at other sites, where feasible.
5.	Concrete	Non-hazardous	Store unused concrete blocks for later reuse. Recycle, reuse or sell to third party contractor.
6.	Bricks	Non-hazardous	Reuse for footings and broken bricks.
7.	Plastic and vinyl	Non-hazardous	Recycle, reuse or sell to third party contractor.
8.	Corrugated Cardboard	Non-hazardous	Recycle, reuse or sell to third party contractor.
9.	Woods	Non-hazardous	Recycle
10.	Empty Drums and Containers	Non-hazardous	Disposed them off through recycler.
11.	Oil waste (fuel oil, transformer oil, switchgear oil)	Hazardous	Handled and disposed through incineration via EPA certified waste contractor hired by CC.
12.	PV modules	Hazardous	Send back to the supplier/equipment manufacturer for recycling/disposal.
13.	Sanitary Wastewater	Non-hazardous	Treat wastewater in septic tanks before disposal.
14.	Trash	Non-hazardous	1. Segregate glass, metal, plastic from trash. 2. Recycle all recyclable items. 3. Designed landfill.

6.4.2 Impact on Air Quality

6.4.2.1 Dust Emissions

Construction activities that may lead to dust generation include excavation; transportation and tipping of cut materials; handling and storage of aggregates in concrete plants; concrete batching; site leveling and clearing of vegetation; and associated activities. The quantity of dust that may generate on a particular day of construction phase will depend on the magnitude and nature of activity and the atmospheric conditions prevailing on that day.

Mitigation Measures

Different options are available to control dust and exhaust pollution. They are listed below:

- The exposure of construction workers to dust should be minimized by provision of dust masks and mandating the workers to wear them.

Dust Reduction Measures

- Water should be sprinkled daily to wet all the expose surfaces.

- Use of water suppression for control of loose materials on paved or unpaved internal road surfaces. Oil and oil by-products are not recommended method to control dust[15].
- Truck loads should be covered with tarpaulin.
- Construction site, including soil and material piles at the site, should be adequately barricaded to avoid material escape, generation of dust.
- Ready-mix can be used in the stages of the project wherever and whenever required and deemed appropriate.
- Careful handling and working under moist conditions and monsoon season will be avoided as much as possible.

6.4.2.2 Exhaust Emissions

Major sources of exhaust emissions are standby diesel generators, material transport vehicles and emissions from construction machinery/earth moving equipment. Major exhaust emissions of concern are CO, SOx, NOx and Particulates. These emissions are injurious to human health in high concentration and can also cause vegetation damage by clogging the photosynthesis process in plants.

Mitigation Measures

- Construction machinery, vehicles should be properly tuned and kept in good working condition, minimizing exhaust and vehicular emissions.
- Emissions from the machinery and vehicles will be monitored on regular basis to ensure compliance of SEQS;
- Excessive engine idling will be discouraged and machinery causing excessive pollution (i.e., visible smoke/soot) will be banned from sites;
- Standby generators for power supply will be kept away from pathways and will be placed at locations where probabilities of human intervention are limited.

6.4.3 Noise Pollution

During the construction phase noise will be generated from the operation of heavy machinery and haulage of construction materials to and around construction sites and construction activities including concrete mixing, excavation, backup power generators for supply of electricity; use of pressure horn etc. These construction activities are expected to produce noise levels in the range of 80 – 95 dB and may cause discomfort to local residents and fauna.

Table 6.2 - Typical Noise Levels of Construction Equipment

Clearing		**Structure Construction**	
Bulldozer	80	Crane	75-77
Front end loader	72-84	Welding generator	71-82
Jack hammer	81-98	Concrete mixer	74-88
Crane with ball	75-87	Concrete pump	81-84
		Concrete vibrator	76
Excavation and Earth Moving		Air compressor	74-87
Bulldozer	80	Pneumatic tools	81-98
Backhoe	72-93	Bulldozer	80
Front end loader	72-84	Cement and dump trucks	83-94
Dump truck	83-94	Front end loader	72-84
Jack hammer	81-98	Dump truck	83-94
Scraper	80-93	Paver	86-88

[15] WBG EHS Guidelines

Clearing		Structure Construction	
Grading and Compaction		**Landscaping and clean-up**	
Grader	80-93	Bulldozer	80
Roller	73-75	Backhoe	72-93
		Truck	83-94
Paving		Front and end loader	72-84
Paver	86-88	Dump truck	83-94
Truck	83-94	Paver	86-88
Tamper	74-77	Dump truck	83-94
Source: U.S. Environmental Protection Agency, Noise from Construction Equipment and Operations. Building Equipment and Home Appliance. NJID. December 31, 1971			

Mitigation Measures

- Machinery operation and high noise activities should be carefully planned and scheduled;
- To the extent practical, batching plants and construction areas should not be located within 500 meters of a settlement;
- Where that is not possible, high noise activities should cease between 22:00 and 06:00 hrs (Night time hours given in SEQS for Noise) at any construction site within 500 meters of a settlement, or if noise complaints are received from settlement residents.
- Vehicles and machinery will be equipped with silencers. Contractors will be required to fit noise shields on high noise construction machinery;
- Site labor working in high noise area such as where noise level exceeds 80 dB (A), will wear earplugs;
- Occupational health, safety and environmental procedures and Environmental management plan for proposed project would be followed.

6.4.4 Vibration Impacts

Construction activity can result in varying degrees of ground vibration, depending on the equipment and methods used. The operation of construction equipment causes vibrations that spread through the ground and diminish in strength with travelled distance. During earthworks and excavations heavy machinery such as bulldozers, excavators, and loaders used for earthmoving can generate significant vibrations and it can have impact on nearby building structure. The predicted ground vibrations at various distances are shown in Table 6.2 for typical equipment that may be used during proposed construction.

Table 6.3 - Typical Vibration Levels at Distance (Peak mm/s)

Plant Item	Peak Vibration (mm/s), Distance from Source			
	10 m	20 m	50 m	100 m
Roller	7.0 to 8.0	3.8	1.5	0.8
Compactor	5.0 to 7.0	3.0	1.2	0.6
Dozer	2.5 to 4.0	1.6	0.7	0.3
Backhoe	1.0	0.5	0.2	0.1
Source: Environmental Noise Management Manual-Roads & Traffic Authority, NSW, Australia, 2001				

Based on the predicted peak vibration levels described in above table, it is expected that vibration would be barely perceptible at sensitive receiver locations within over 50m for most construction activities. According to British Standards of Noise and Vibration, humans are particularly sensitive to vibration with the threshold of perception typically being in the range of 0.14 to 0.3 mm/sec Peak Particle Velocity (PPV) and levels above this may cause annoyance. However, significantly higher levels than this can be tolerated for single short-term events and do not cause annoyance or disturbance to humans.

Mitigation Measures

- Vibration measurement will be carried out during construction phase by the contractor near the settlements in the AOI.
- Timing of the construction works to be conducted during the recommended operational hours, to reduce vibration levels in the AOI.
- The vibration from major construction activities such as excavation, compacting, drilling, etc. are considered intermittent and short-term, and likely to be tolerated if prior warning is given to potentially affected residents as and where they may be encountered along the route.
- The equipment operators to be made aware by the contractor of potential vibration issues problems and of techniques to minimize vibration effects during construction works.

6.4.5 Impacts on Ecology

6.4.5.1 Impacts on Flora

The overhead TL will require the least footprint on flora as only site clearance is required at tower bases. However, a total of 134 trees has been identified along the RoW which will be removed during the construction phase for making access roads. The detailed placement of trees along the T/L route has been shown in zoomed maps attached in Annex-1 in the land use maps.

Mitigation Measures

- Review and adjust the route of the transmission line to avoid areas with dense vegetation or areas with significant tree cover. This can reduce the number of trees that need to be removed.
- For every tree removed, establish a replanting program to replace the trees lost. Native species should be used for replanting to maintain biodiversity.
- If direct replanting is not feasible, create an afforestation program in nearby areas to compensate for the loss of trees.
- Compensatory plantation shall be provided at a ratio of 1:10 for the removed trees (Sindh Forest Department)

6.4.5.2 Impacts on Avi-fauna

During the construction phase, the use of heavy machinery will generate high levels of noise, which can adversely affect the hearing abilities of birds. The project site is located near Keenjhar Lake, a significant bird habitat and migration route, making it a critical area for both resident and migratory bird populations. Thus, the noise from construction activities will directly have negative impacts on the bird populations.

The impacts of noise pollution on birds are multifaceted. High noise levels can cause physical damage to their hearing organs, leading to permanent or temporary hearing loss. The constant disturbance may also trigger stress and induce a fright-flight response, causing birds to abandon the area. This disruption can lead to habitat avoidance, which in turn can negatively affect foraging and nesting opportunities. Additionally, noise pollution may interfere with communication among birds, disrupting mating calls and social interactions. This can lead to changes in reproductive success, which, in some cases, may result in population declines. Noise can also mask other critical sounds, such as predator calls or the calls of conspecifics, potentially reducing birds' ability

to detect threats or communicate effectively, further compromising their survival and well-being (Ortega, 2012)[16].

Noise Source Type	Hearing Damage	TTS (Temporary Threshold Shift)	Masking	Potential Behavioral/ Physiological Effects
Single impulse e.g., (blast)	140 dB[1]	NA[3]	NA[6]	Audible components of noise have the potential of causing behavioral and/or physiological effects independent of any direct effects on the auditory system of PTS, TTS, or masking
Multiple impulse (e.g., jack hammer, pile driver)	125 dB[1]	NA[3]	Ambient dB[5]	
(e.g., construction noise)	None[2]	93 dB[4]	Ambient dB[5]	

1. Estimates based on bird data from Hashino et al.1988 and other impulse noise exposure studies in small mammals.
2. Noise levels from these sources do not reach levels capable of causing auditory damage and/or permanent threshold shift based on empirical data on hearing loss in birds from the laboratory.
3. No data available on TTS in birds caused by impulse noises.
4. Estimates based on study of TTS by continuous noise in the budgerigar and similar studies in small mammals.
5. Conservative estimates based on addition of two uncorrelated noises. Above ambient noise levels, critical ratio data from 14 bird species, well documented short term behavioral adaptation strategies, and a background of ambient noise typical of a quiet suburban area would suggest noise guidelines in the range of 50—60 dB(A).
6. Cannot have masking to a single impulse.

Source: Dooling, R. J., & Popper, A. N. (2016, July). Some lessons from the effects of highway noise on birds. In Proceedings of Meetings on Acoustics (Vol. 27, No. 1). AIP Publishing.

Mitigation Measures

To mitigate these impacts, several measures should be considered:

- Selection of plants for landscaping should consider the habitat suitability, trees of national interest, flowering trees and shrubs; and
- By using the best practice for vegetation clearing and disposal practices; will minimize the environmental risk associated with clearing and disturbance of vegetation communities.
- Employing quieter, low-noise construction machinery and equipment, as well as maintaining machinery to ensure it operates efficiently, can reduce noise levels.
- Scheduling construction activities during periods of lower bird activity, such as outside of peak migration seasons or during the night when many bird species are less active, can help minimize disturbances.
- Establishing buffer zones around critical bird habitats and migratory routes can reduce direct exposure to construction noise and provide birds with areas of refuge.
- Regular monitoring of bird populations and behaviors can help identify areas of concern. If significant disruptions are observed, adaptive management strategies such as temporary cessation of activities or relocation of operations may be implemented.

[16] *Ortega, C. P. (2012). Chapter 2: Effects of noise pollution on birds: A brief review of our knowledge. Ornithological monographs, 74(1), 6-22.*

- Post-construction efforts to restore or enhance nearby habitats can help compensate for any displacement or loss of habitat due to construction activities, providing long-term benefits for local bird populations.

6.4.6 Impact on Land Resources

6.4.6.1 Top-soil Removal

During site preparation, the removal of topsoil is necessary for leveling and grading the land. This is typically done to facilitate the construction of infrastructure such as buildings, roads, and utilities. The removal of topsoil removes the nutrient-rich layer essential for supporting vegetation, which could impact local biodiversity and lead to long-term degradation of soil quality if not managed properly. Once the topsoil is removed, the land is more vulnerable to erosion, especially if vegetation is not re-established in a timely manner.

6.4.6.2 Soil Compaction

The movement of construction machinery, transport vehicles, and heavy equipment across the project site leads to soil compaction. Areas that will be developed, such as internal access roads, temporary laydown areas, and building foundations, are especially vulnerable to compaction. Compaction decreases the pore space between soil particles, reducing air and water flow within the soil. This can impair plant growth and affect water retention. Compacted soils have reduced capacity to absorb water, leading to increased surface runoff, erosion, and potential flooding risks in the long term.

6.4.6.3 Waste Generation and Soil Contamination

Construction activities generate a variety of waste materials, both general and hazardous. Improper handling of waste materials, particularly hazardous ones, could have significant consequences for the land. This includes materials such as concrete, wood, metals, and packaging waste. If not disposed of or recycled properly, these can contribute to land pollution and waste accumulation on-site. Waste such as used oils, hydraulic fluids, fuel, and chemicals can pose serious risks to land quality if they leak or are disposed of irresponsibly. These materials can contaminate soil and groundwater, leading to long-term environmental degradation.

Mitigation Measures

- One way to reduce the impact is to stockpile the removed topsoil for later reuse in landscaping or reclamation efforts. Additionally, erosion control measures, such as mulching or silt fences, can be employed.
- Use of less invasive machinery, proper scheduling of construction activities, and restoration techniques (e.g., subsoiling or deep tillage) can help alleviate compaction impacts. Additionally, controlling vehicle movement to designated paths can minimize the extent of compaction.
- Proper waste segregation, recycling programs, and designated storage areas for hazardous materials are essential to prevent contamination.
- All hazardous wastes should be disposed of according to local regulations, ideally by certified waste management contractors.
- Spill prevention measures (e.g., secondary containment for fuel storage) should be implemented.
- Develop and implement a soil management plan that includes strategies for stockpiling and reusing topsoil, reducing compaction, and restoring soil health post-construction

- Once construction activities are completed, the site should be revegetated with native plants to help restore soil structure, prevent erosion, and enhance biodiversity.
- Establish a comprehensive waste management system that includes recycling, proper hazardous waste disposal, and contamination prevention measures to protect land resources

6.4.6.4 Soil Erosion

Project activities may cause erosion of soil. Such activities may be identified as trenching, transportation of materials and equipment, preparation of tower base for overhead TL, landscaping and removal of bushes etc. Usually, the exposed soil after excavation is vulnerable to erosions and runoff by moderate to heavy rains. But, the impact of all these activities would be less significant and temporary lasting only for construction period. Inappropriate handling, storage and disposal of fuels, oils and chemicals at construction sites may also lead to contamination of soil.

Mitigation Measures

- Construction activities should be so scheduled to avoid runoff due to rain;
- The removed soil must be contained in an enclosure to reduce the chances of runoff during the seasons of precipitation;
- Stock piles of fine material should be wetted or covered with tarpaulin especially during windy weather conditions;
- Site workers should wear dust masks especially during the dry and windy weather conditions;
- Debris should be collected during construction and disposed of in low lying areas near the site;
- Cut material should be used to level the site area where required or be disposed at designated spoil disposal sites;
- Chemicals and oils should be stored in secure designated areas with temporary impermeable bunds at distance of at least 100 m from any water course;
- Refueling, oil changing and maintenance of machinery, equipment and vehicles should only be carried out at designated areas within the construction site;
- Oil contaminated materials should be disposed at designated waste disposal facilities.

6.4.6.5 Impacts on Surface and ground water sources

While the direct impacts of soil disturbance, compaction, and waste generation may be confined to the project site, there is always potential for broader, off-site effects. Erosion or runoff from compacted or disturbed soils could carry sediments and contaminants into nearby water bodies, affecting water quality. If the project site is part of a larger ecosystem, the loss of topsoil and compaction could reduce the ability of the land to support local plant and animal life, potentially leading to habitat loss.

Mitigation Measures

- Remove all excavated soil completely
- Regularly clear all the debris and vegetation clogging ditches, sewers, drains and pipe systems
- Prevent soil runoff from the site leading to off-site contamination (particularly during rainy season)
- Avoid the spillage of oil and grease from the vehicles

6.4.6.6 Temporary Access Roads

The proposed Project currently does not have any direct roads due to lying outside of the city of Karachi, and as such will require access roads to be built for work. Similar access roads will be required along the length of the project also for contractors working on the T/L, grid station and staff colony.

The development of these roads will allow for the transport of workers, construction materials, and machinery for purposes related to the project. The construction of these roads however, may cause damage to crops, soil erosion, soil contamination, air and noise problems.

Mitigation Measures

- According to usual practices during the construction of large-scale infrastructure projects like these, the access road will be developed within the RoW of the proposed project. This will limit and reduce the additional impact of the establishment of the access roads for the proposed Project.
- For the development of access roads/tracks, contractor will be bound to consider mitigations to further reduce the severity of this impact including the selection of access roads/tracks based on certain criteria to ensure high stability, no or minimum tree cutting and crop damage, minimum disturbance to nearby settlements and other social amenities.
- The approach roads should be selected to avoid any soil degradation and erosion impacts.
- Special care should be taken for known sensitive areas to ensure that all interested parties are aware of the type and location of work being done. Measures should be taken where necessary to protect such areas physically.
- Mitigations for the loss of tress and crops, soil erosion, soil contamination, air and noise pollution, waste generation, and loss of agricultural land provided in below sections will be adopted.

6.4.7 Fuel, Oil & Chemical handling, storage and disposal

Inappropriate handling, storage and disposal of fuels, oils and chemicals at construction sites may lead to contamination of soil.

Mitigation Measures

- Chemicals and oils should be stored in secure designated areas with temporary impermeable bunds at distance of at least 100 m from any water course;
- Refueling, oil changing and maintenance of machinery, equipment and vehicles should only be carried out at designated areas within the construction site;
- Oil contaminated materials should be disposed at designated waste disposal facilities.

6.4.8 Water Consumption and Conservation

Water is used in numerous construction activities such as concreting, curing, plastering, domestic etc. Water required for such activities is likely to be met from external sources such as water tankers supplying water to the construction site.

Mitigation Measure

- Regular monitoring of water consumption, conservation and quality;
- Use of leak proof water storage tanks;

6.4.9 Seismicity

Potential Impact

Sindh province, where Thatta is located, is generally considered to be in a **moderate-risk seismic zone** (Zone 2). The Project Area is in Seismic Zone 2A, where 2A (upper limit of moderate damage) represents peak horizontal ground acceleration is less than 0.05 g. The last 50 years data shows that the magnitude of earthquake in this region is ranged from 4.5-4.7 near K-IV grid station and 4.3-4.4 near Jhimpir grid station. In this Zone, designing of various types of structures should be done based on Peak Ground Acceleration (PGA). A low to moderate intensity earthquake impacting the Project site can adversely impact the development if adequate measures are not incorporated in design.

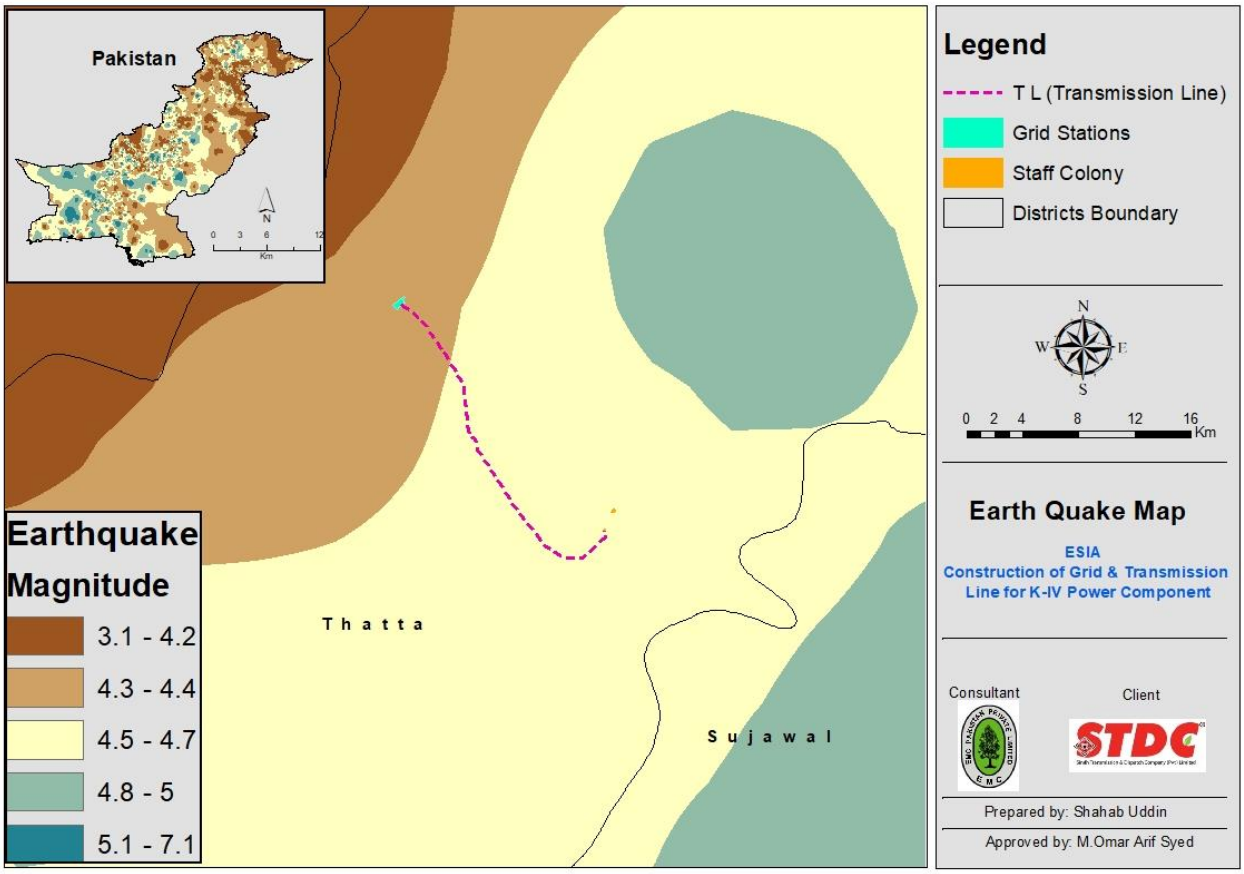


Figure 6.1 - Seismic Map of Project Area

Mitigation Measures

The proposed project and the associated structures should be designed and constructed as per Seismic Building Code of Pakistan 2007 (SBC-07) to comply with minimum requirements for seismic safety of structures.

6.4.10 Impacts on Traffic

Traffic flow in the locality of project slightly increases during construction activities. The transportation of trucks for raw materials and mobilization and demobilization of the earth works equipment are required during construction phase of proposed project. This activity has potential to directly impact the traffic flow along the right of way of proposed transmission line. However, as

the project area is not frequented by heavy and light traffic, adverse impact of general traffic conditions in area would be minimal.

Mitigation Measures

- Traffic management plan will be developed and implemented during the construction phase;
- Construction activities will be scheduled to reduce the chances of traffic congestion;
- Adequate and appropriate road signs will be erected to warn road users along the ROW of transmission line;
- Raw materials for construction work will be adequately covered within the trucks to prevent any escaping into the air and along the roadway;
- Vehicles will be maintained regularly to reduce the exhaust emissions; and
- Any complain launched by community member will be responded and appropriate action will be taken to avoid it in future.

6.4.11 Community Health & Safety

The construction of transmission line may pose a modest risk to local communities from emergency events such as entry of local people in dangerous working environment i.e., close to transmission line infrastructure.

Mitigation Measures

- Emergency response plan should be prepared and implemented during entire phase of construction;
- In order to minimize traffic congestion (if applicable), deliveries of materials and equipment should avoid peak traffic hours;
- Erection of towers and poles for the overhead TLs should be barricaded and crane movement should be assessed prior to the operation near the community areas;
- Diversions, hazard points and works at construction sites will have appropriate warning signs; this is particularly important at night to avoid accidents.

6.4.12 Heat Stress to Construction Workers

The project is located in Thatta, which is a desert and faces temperatures as high as 40 degree C during summers. There will be a likely impact of sunlight causing heat stress to construction workers during summer season as the temperatures may well cross 40°C. Moreover, the project corridor has no significant tree cover.

Mitigation Measures

- Move to a cool place e.g., cool shady area;
- Provide plenty of drinking water;
- Break the working in shifts

6.4.13 Occupational Health and Safety

The construction works involving earthworks, excavation, erecting structures, etc. poses an inherent risk of injury to labor from accidents. Poor housekeeping practices may lead to stagnant water as breeding grounds for insect vectors (causing malaria, dengue fever etc.). Hazards from handling equipment, ergonometric stress, lifting heavy materials etc. may cause injury to the labor. Electrical equipment and substation pose electrocution hazard.

Mitigation Measures

Site-specific labor health and safety hazards are also critical to identify based on job safety analysis or comprehensive hazard or risk assessment. Health and safety management planning should include the adoption of a systematic and structured approach for prevention and control of physical, electrical, chemical, and biological health and safety hazards. Use of PPE should be made mandatory. Only trained and experience crane, forklift, etc. operators should be hired. CC shall ensure that Job Hazard Analysis (JHA) is performed prior to commencing jobs. It shall also be ensured that the JHA is reviewed after the following:

- Whenever work is stopped
- Every time work conditions or the job scope changes
- Persons working the job shall review and acknowledge the JHA by their signature

6.4.13.1 Crane and Lifting Operations

For all Crane & Lifting Operations CC shall ensure full compliance with standard operating procedures. CC shall develop a site-specific pre-lift checklist which includes the following at minimum:

- Crane rigging capacity adequately for load
- Condition of slings
- Rigging condition adequate for load
- Area of swing or travel unobstructed
- Multiple crane use
- Power line approach distance maintained
- Stability and footing
- Taglines and spotters
- Illumination and weather
- Signal operator
- Job hazard analysis and other permits

All lifting and rigging activities shall be supervised and conducted by a competent person or team, CC shall maintain a lifting gear registry for all lifting gear on-site inclusive of a listing of all lifting gear, copies of equipment certificates (manufacturer, safe working load, serial number) and the inspection/recertification frequency.

6.4.13.2 Forklifts and Non-Road Vehicles

CC should ensure forklift and non-road vehicles are fit for purpose and operated according to manufacturer's requirements. Only competent operators are permitted to operate forklifts and non-road vehicles.

At minimum, all forklifts and non-road vehicles shall be equipped with following equipment:

- Seat belts
- Horn
- Emergency Brake
- Wheel chock
- Labeled Controls
- Fire Extinguishers
- First Aid Kit
- Back-up Alarm

6.4.13.3 Scaffolding

CC is responsible to establish periodic inspection, certification and recertification program for scaffold works. Only qualified worker is authorized to erect, inspect and certify scaffold. All scaffolds should have a guardrail system on each open side, up to the access point. It should be equipped with toe boards having suitable access ladder.

6.4.13.4 Over-exertion

Over-exertion, and ergonomic injuries and illnesses, such as repetitive motion, over-exertion, and manual handling, are among the most common causes of injuries at construction site.

Mitigation Measures

Recommendations for their prevention and control include:

- Workers will be trained with lifting and materials handling techniques before the construction of the project, including the placement of weight limits above which mechanical assists or two-person lifts are necessary.
- Work site layout will be planned to minimize the need for manual transfer of heavy loads.
- Tools will be selected and work stations would be designed to reduce force requirements and holding times, which promote improved postures, including, where applicable, user adjustable work stations.
- Administrative controls, such as job rotations and rest or stretch breaks will be implemented into the work processes.

6.4.13.5 Slips and Falls

Slips and falls on the same elevation associated with poor housekeeping, such as excessive waste debris, loose construction materials, liquid spills, and uncontrolled use of electrical cords and ropes on the ground, are also among the most frequent cause of lost time accidents at construction site.

Mitigation Measures

Recommended methods for the prevention of slips and falls from, or on, the same elevation include:

- Good house-keeping practices, such as the sorting and placing loose construction materials in established areas, would be implemented.
- Excessive waste debris and liquid spills will be cleaned up regularly.
- Electrical cords and ropes will be located in common areas and marked corridors.
- Slip retardant footwear will be used.

6.4.13.6 Struck By Objects

Construction activities of the project may pose significant hazards related to the potential fall of materials or tools, as well as ejection of solid particles from abrasive or other types of power tools which can result in injury to the head, eyes, and extremities.

Mitigation Measures

Techniques for the prevention and control of these hazards include:

- Maintaining clear traffic ways to avoid driving of heavy equipment over loose scrap.
- Temporary fall protection measures in scaffolds and out edges of elevated work surfaces would be used, such as hand rails and toe boards to prevent materials from being dislodged.
- Appropriate PPE such as safety glasses with side shields, face shields, hard hats, and safety shoes, would be worn.

6.4.13.7 Moving Machinery

Vehicle traffic and use of lifting equipment in the movement of machinery and materials on a construction site may pose temporary hazards, such as physical contact, spills, dust, emissions, and noise.

Heavy equipment operators have limited fields of view close to their equipment and may not see pedestrians close to the vehicle. Center-articulated vehicles create a significant impact or crush hazard zone on the outboard side of a turn while moving.

Mitigation Measures

Techniques for the prevention and control of these impacts include:

- The location of vehicle traffic, machine operation, walking areas, and controlling vehicle traffic will be planned and segregated through the use of one-way traffic routes, establishment of speed limits, and on-site trained flag-people wearing high-visibility vests or outer clothing covering to direct traffic.
- The visibility of personnel will be ensured through the use of high visibility vests when working in or walking through heavy equipment operating areas as well as training of workers to verify eye contact with equipment operators before approaching the operating vehicle.
- Inspected and well-maintained lifting devices will be used that are appropriate for the load, such as cranes, and securing loads when lifting them to higher job-site elevations.

6.4.13.8 Electrocution Hazard

High voltage transmission lines may pose electrocution hazard for unauthorized person(s) attempting to climb the tower(s). An electrical hazard can be defined as a serious workplace hazard that exposes workers to any of the following:

- Burns
- Electrocution
- Shock
- Arc flash or arc blast
- Fire
- Explosions

List of potential electrical hazard at site is as follows;

- Improper grounding
- Exposed electrical parts
- Inadequate wiring
- Damaged insulation
- Overload circuits
- Damaged tools and equipment

Mitigation Measures

Detailed electrocution prevention measures are attached in Annex-E

- Use of ground-fault circuit interrupters
- Periodic inspection of extension cords and portable tools
- Use power tools and equipment as designed
- Proper lockout/tagout procedures will be followed
- Safety signs for electrical hazard will be placed
- Ensuring proper guarding of electrical equipment and facilities such as substation and switchgear

6.4.13.9 Other Site Hazards

- Construction of site may pose a risk of exposure to dust, hazardous or flammable materials, and wastes in a combination of liquid, solid, or gaseous forms.

Mitigation Measures

- Only authorized personal should be allowed at the construction site
- Identify and minimize, so far as reasonably practicable, the causes of potential hazards to workers, including communicable diseases such as HIV/AIDs and vector borne diseases;
- Avoid stagnation of water and initiate drainage/cleanup of stagnant water;
- Provide for the provision of appropriately stocked first-aid equipment at work sites;
- Provide for appropriate personal protective equipment (PPE) to minimize risks, such as but not limited to appropriate outerwear, boots and gloves; safety helmets;
- Provide training for workers for the use of PPE;
- WB Group's Environment, Health and Safety (EHS) Guidelines (attached at the end of this document) will be implemented;
- No bonded and child labor will be permitted at site;
- Major labor laws will be followed e.g., Minimum Wage, Harassment of women in the work place Hours of work, Overtime Payment.
- Also, laborers will be trained on appropriate interaction with local people especially women;
- Include procedures for documenting and reporting accidents, diseases, and incidents; and
- All safety precautions will be taken to address safety hazards for the nearby community. These precautions may include safety/warning signage, safety barrier around the construction site.
- Lighting provided for labor during night time work should be adequate.
- CC will include appropriate clauses to protect environment and public health. The sub-project ESMPs will be included in the bidding document;

Summary of Recommended Personal Protective Equipment According to Hazard		
Objective	**Workplace Hazards**	**Suggested PPE**
Eye and face protection	Flying particles, molten metal, liquid chemicals, gases or vapors, light radiation.	Safety Glasses with side-shields, protective shades, etc.
Head protection	Falling objects, inadequate height clearance, and overhead power cords.	Plastic Helmets with top and side impact protection.

Hearing protection	Noise, ultra-sound.	Hearing protectors (ear plugs or ear muffs).
Foot protection	Falling or rolling objects, pointed objects. Corrosive or hot liquids.	Safety shoes and boots for protection against moving & falling objects, liquids and chemicals.
Hand protection	Hazardous materials, cuts or lacerations, vibrations, extreme temperatures.	Gloves made of rubber or synthetic materials (Neoprene), leather, steel, insulating materials, etc.
Respiratory protection	Dust, fogs, fumes, mists, gases, smokes, vapors.	Facemasks with appropriate filters for dust removal and air purification (chemicals, mists, vapors and gases). Single or multi-gas personal monitors, if available.
	Oxygen deficiency	Portable or supplied air (fixed lines). On-site rescue equipment.
Body/leg protection	Extreme temperatures, hazardous materials, biological agents, cutting and laceration.	Insulating clothing, body suits, aprons etc. of appropriate materials.
Source: IFC Environmental, Health, and Safety General Guidelines		

6.4.14 GHG Emissions

Greenhouse gas emissions contribute to global warming and other climate changes on both regional and global scales. During the construction phase of the transmission line, grid station, and staff colony near Keenjhar Lake, greenhouse gas (GHG) emissions (such as CO2, CH4, NOx, etc.) will result primarily from fuel combustion in construction vehicles, machinery, and temporary power generation units. The process of excavation, land clearing, and materials transport will also contribute to CO2 emissions. The use of diesel-powered equipment and the disturbance of soil and vegetation can lead to increased carbon emissions, both directly through fossil fuel use and indirectly through the reduction of carbon sequestration capacity of the disturbed land. Additionally, the establishment of the grid station and staff colony will require energy-intensive processes, which could further increase emissions if the power supply is derived from fossil fuels.

Mitigation measures

- Employing energy-efficient and low-emission machinery, as well as transitioning to electric or hybrid vehicles for transport, can significantly reduce direct CO2 emissions.
- Minimizing land disturbance and adopting soil conservation practices can help preserve the carbon sequestration capacity of the area. Reforestation and replanting efforts post-construction can also help offset emissions.
- Streamlining the construction schedule and reducing idle time for machinery can minimize unnecessary fuel consumption and associated emissions.

- Implementing carbon offset initiatives, such as funding renewable energy projects or supporting local reforestation efforts, can help balance out the GHG emissions generated during construction.
- Regular maintenance of vehicles, plants, and machinery according to the manufacturer's specifications.
- Monthly visual inspections of vehicle and plant exhausts to detect excessive smoke emissions and take corrective action when needed.
- Installation of approved pollution control devices on equipment and machinery.
- Avoid over loading the transport vehicles to reduce emissions.
- Site vehicles and machinery will be switched off or throttled down when not in use.

6.5 Operational and Maintenance Phase: Impacts and Mitigation Measures

The most focusable area in the impact assessment process of proposed project is operational and maintenance activities of Transmission line, grid station as impacts generated during this phase may have long term and continuous. Potential operational issues include impact on migratory birds (the project route is at considerable distance from Indus Flyway), occupational and community health and safety risks, risks from fires, earthquakes. Mitigation measures have been provided to minimize the impacts to acceptable levels.

6.5.1 Impact on Wild Life Sanctuaries

A total of six wildlife sanctuaries have been identified at a certain distance from the proposed T/L route including Hub Dam Wildlife Sanctuary at 61.48 km from proposed T/L route, Marho Kotri Wildlife Sanctuary at 55.45 km, Haleji Lake at 17.4 km, Hadero Lake at 11 km. However, Keenjhar Lake is close to the project's proximity at less than 1 km from the project location and can be subjected to negative impacts caused by the project activities.

Keenjhar Lake, located in Sindh, Pakistan, is a significant wetland and a vital stopover for migratory birds, especially during the winter months. The lake is part of the Indus Flyway, one of the major migratory routes for waterfowl, and provides essential habitats for a wide variety of species. Thus, there is a potential of impacts to the migratory birds visiting Keenjhar Lake. Moreover, it is also subjected to multiple impacts that can be caused due to project activities including water pollution, thermal pollution etc. these negative impacts can disrupt the ecology of the lake along with the land in the project's vicinity.

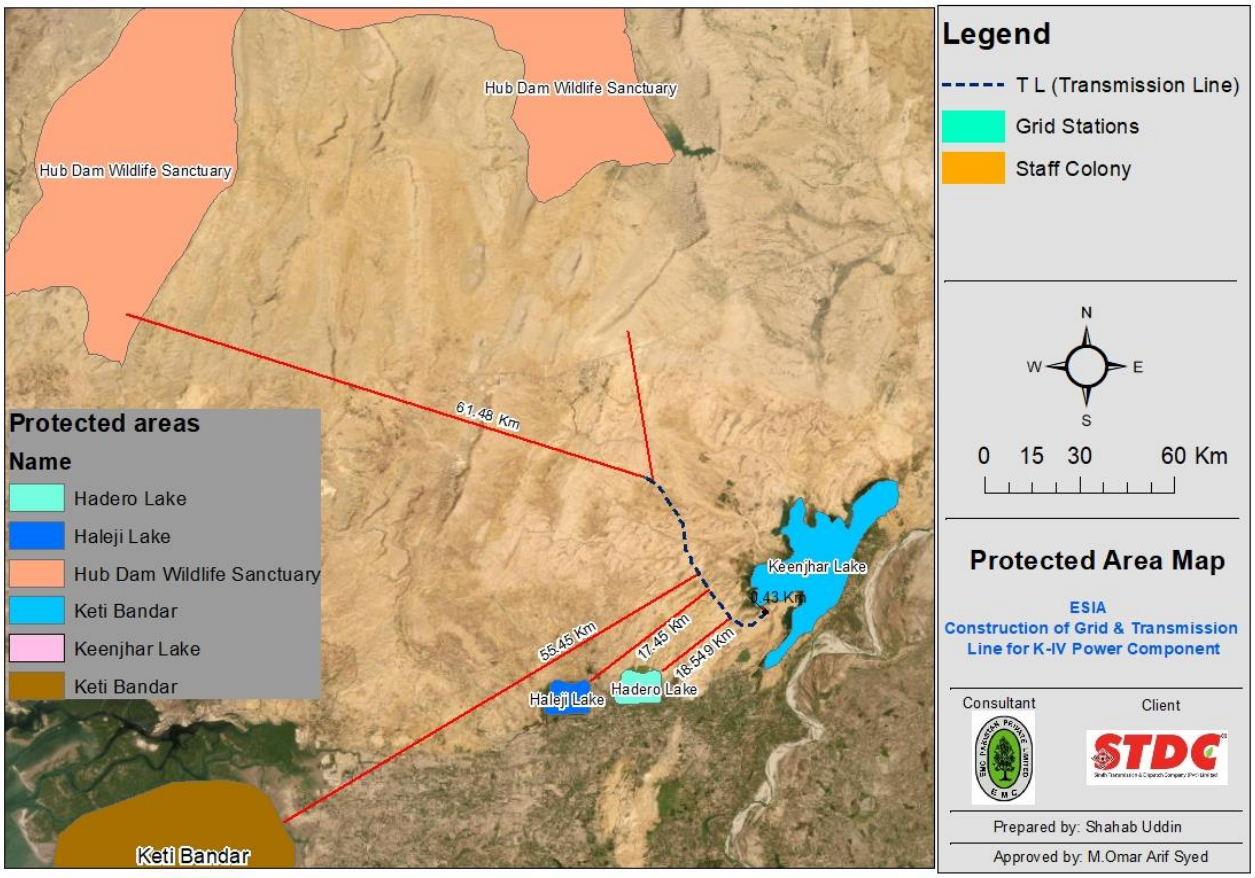


Figure 6.2 - Distance of Project from Wildlife Sanctuaries

Mitigation Measures

- Creating buffer zones around critical wetland areas (Keenjhar Lake) to reduce the disturbance from human activities and infrastructure.

6.5.2 Impacts on Birds

Apart from the negative impacts during construction phase, there are also significant potential impacts on birds during the operational phase. Migratory birds, especially large waterfowl like cranes, geese, and ducks, are at risk of colliding with power lines, which can result in injury or death. This is especially problematic during migration when birds are flying at night or in low visibility conditions. Tall structures such as transmission towers can also pose collision risks. Birds can fly into them, or they might avoid these areas altogether, altering their migratory routes or behavior.

If the power project involves lighting, such as for transmission towers or substations, it could lead to light pollution. Migratory birds are often disoriented by artificial lights, particularly during night migrations. This can cause them to fly off course or become fatigued, increasing their risk of accidents or predation. The construction of large infrastructure can fragment habitats, making it harder for birds to move between feeding, resting, and breeding areas. For species that rely on Keenjhar Lake as a critical Power supply projects may lead to more human activity in the area, whether through construction workers or maintenance crews. This can increase disturbances to migratory birds, particularly if the area is not well-managed. With increased human presence, there could be a higher risk of illegal hunting or egg collection, especially in regions where migratory birds are abundant. This could have a negative impact on bird populations.

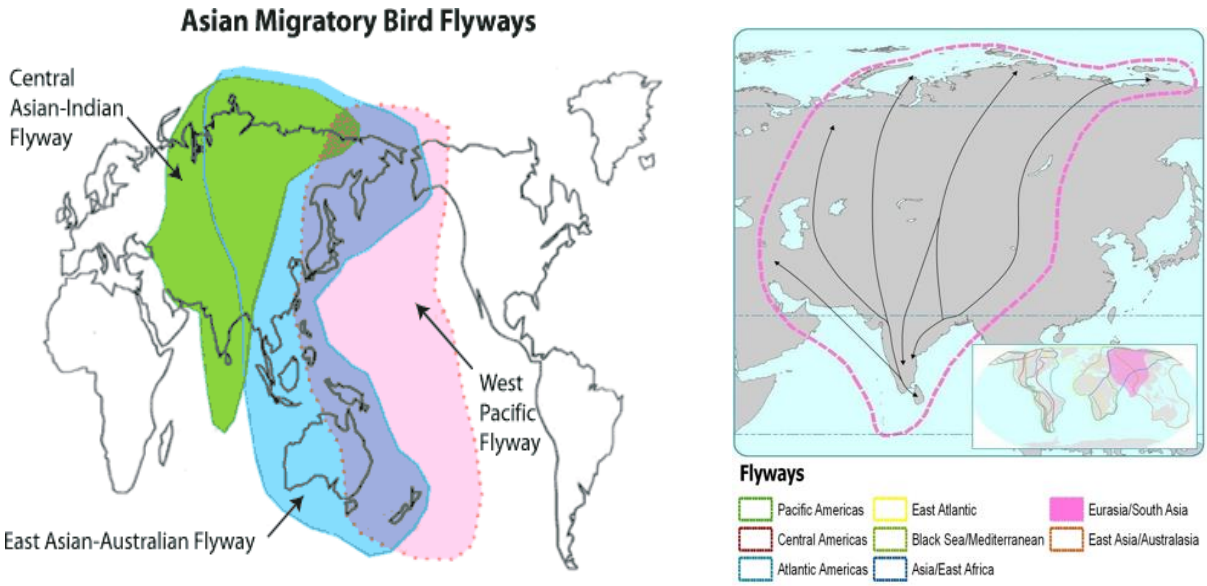


Figure 6.3 - Various flyways of birds from Siberia to South (Source: Birdlife International)

Figure 6.3 shows the Indus Flyway or Central Asian-Indian Flyway (green). This famous route from Siberia to various destinations in Pakistan over Karakorum, Hindu Kush, and Suleiman Ranges along Indus River down to the delta is known as International Migratory Bird Route Number. It is also called as the Green Route or more commonly Indus Flyway, one of the important migratory routes in the Central Asian - Indian Flyway. The birds start on this route in November. February is the peak time and by March they start flying back home. These periods may vary depending upon weather conditions in Siberia and/or Pakistan.

As per an estimate based on regular counts at different Pakistani wetlands, between 700,000 and 1,200,000 birds arrive in Pakistan through Indus Flyway every year. Figure 6.2 shows the Migratory route, breeding range and wintering range of Ferruginous Duck (Aythya nyroca) in Pakistan. This study suggests that the project site lies on the corridor of migratory birds. Therefore, several adverse impacts on of overhead powerlines on the wetland habitat/ecology (migratory birds) are expected including increase death and injury of birds due to electrocutions and collisions with wires. In addition, increase scavenger activity and population size of scavengers along and near the power line corridor[17].

[17] Richardson, M. L., Wilson, B. A., Aiuto, D. A., Crosby, J. E., Alonso, A., Dallmeier, F., & Golinski, G. K. (2017). A review of the impact of pipelines and power lines on biodiversity and strategies for mitigation. *Biodiversity and Conservation*, *26*, 1801-1815.

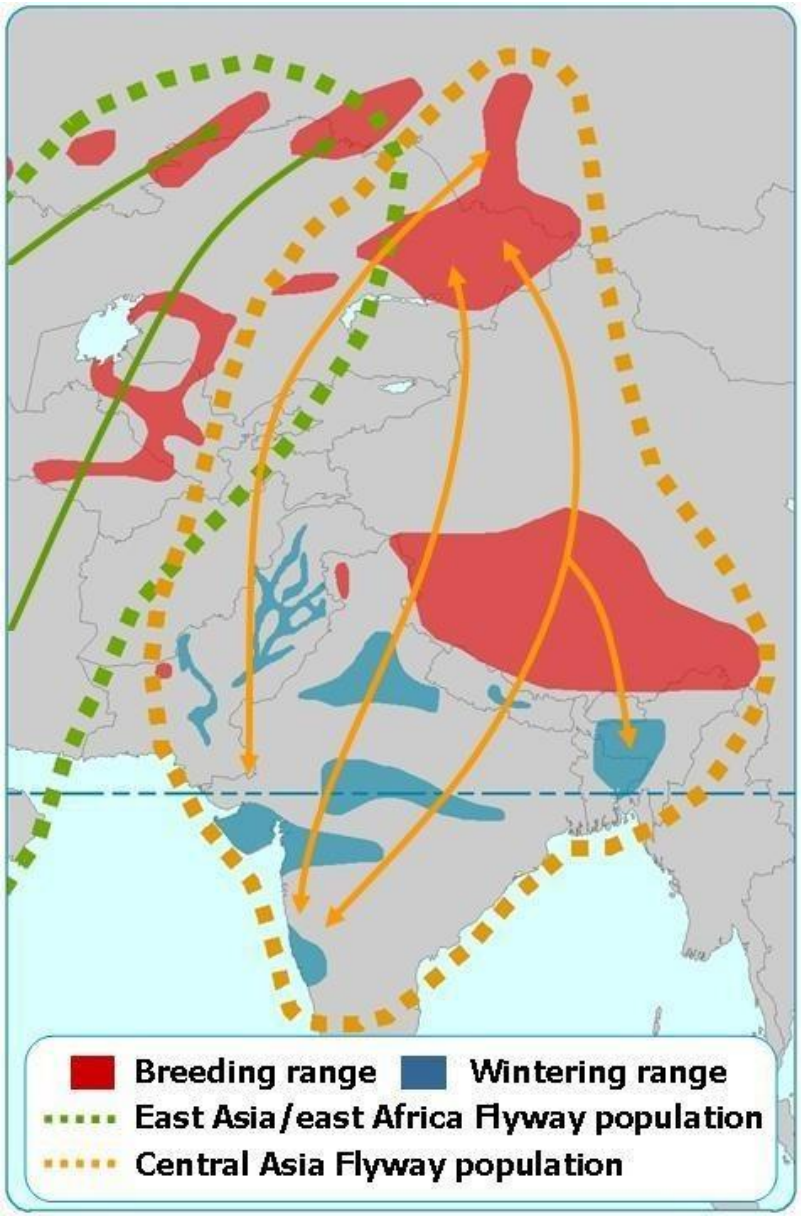


Figure 6.4 - Migratory Route, Breeding Range, and Wintering Range of Ferruginous Duck in Pakistan

Mitigation Measures:

To minimize the negative impacts on migratory birds, several mitigation strategies can be implemented:

- Designing power lines and transmission towers to be more visible and less hazardous to birds. This could involve adding markers to lines.
- Regular monitoring of bird populations and the surrounding environment to assess the effects of the power project and adjust management strategies accordingly.
- Implementing measures to reduce light pollution in the area, such as using low-impact lighting and shielding light sources.
- All suspension towers and tension towers having jumper insulator strings shall be provided with bird-repellent devices on each cross arm over insulator strings. The bird-repellent devices shall be spiking type galvanized and fitted with bolts and nuts.

6.5.3 Flood Risk

The majority of the transmission line runs through an area that is classified as having a high flood risk. This means that a significant portion of the infrastructure is exposed to the potential hazards associated with flooding, which could lead to operational disruptions. In contrast, the K-IV grid station is located in a region that falls under the moderate flood risk zone. This station, along with the nearby staff colony, faces a somewhat lower, though still notable, risk of flooding compared to the areas in the high-risk zone. On the other hand, the Jhimpir II grid station is situated in a low-risk flood zone, indicating that it is less likely to be affected by flood-related issues.

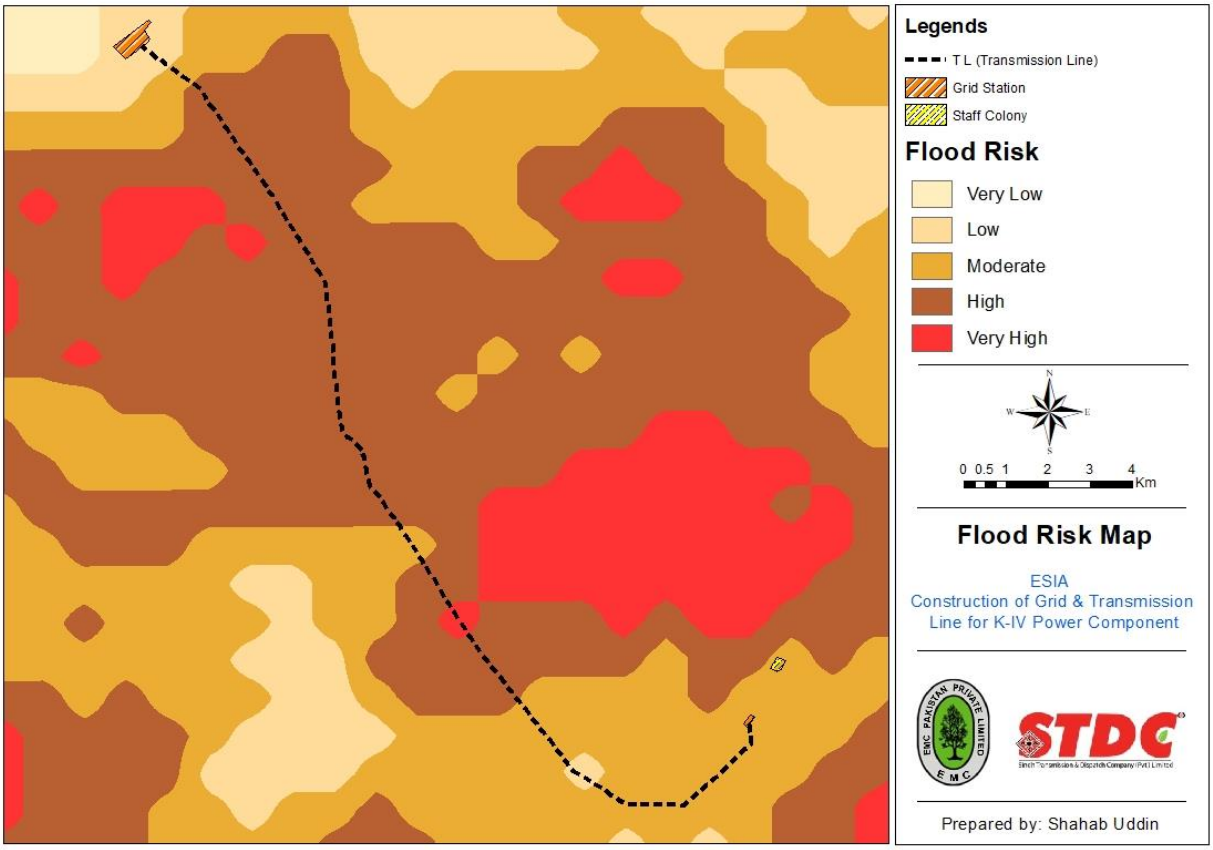


Figure 6.5 - Flood Risk map of project area

However, the data from 2010-2022 shows that the project site has not been under the influence of flood risk since 2010 and thus is unlikely to be affected by flooding in the coming years too may be due to higher elevation in this area.

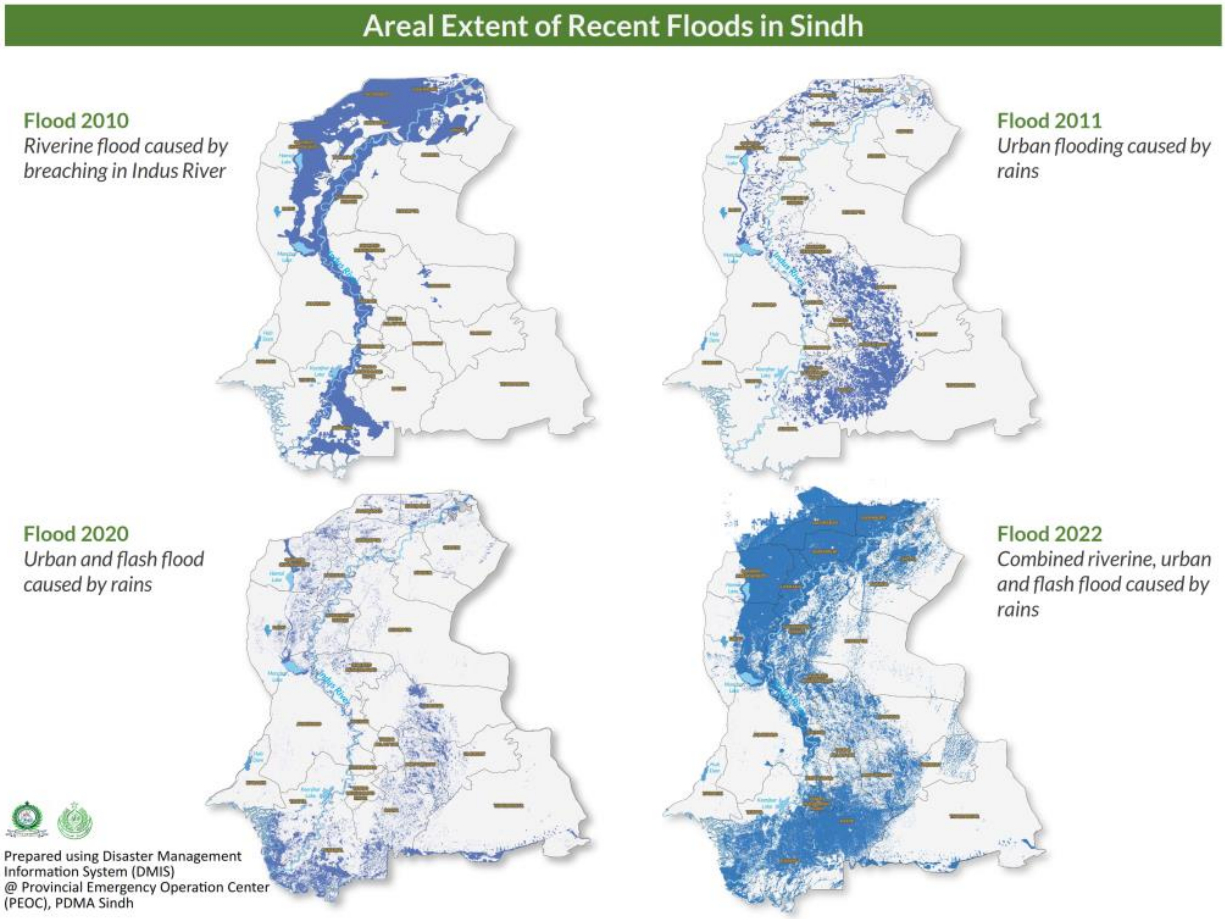


Figure 6.6 - Recent Flood Profile of Sindh

Mitigation measures

- Construct levees, embankments, or floodwalls around critical infrastructure to prevent floodwater ingress.
- Design power substations, transformers, and other critical equipment to be elevated above the potential flood levels.
- Use flood-resistant materials and construction techniques for buildings and electrical infrastructure to withstand flood events.
- Develop water retention or detention ponds to manage excess rainwater and reduce the flow of water into the project area.
- Enhance the local drainage system to efficiently manage and redirect excess water away from the power supply infrastructure.
- Install flood forecasting and monitoring systems to provide early warnings, enabling timely action to safeguard infrastructure.
- Develop and implement flood emergency response plans for rapid evacuation of personnel and securing equipment if needed.
- Establish buffer zones around critical infrastructure to reduce vulnerability to floodwaters and allow space for floodwater management.
- Avoid building critical infrastructure in high-risk flood zones, and ensure that new construction follows flood-resistant zoning regulations.
- Conduct studies to assess the long-term impacts of climate change on flood patterns near Keenjhar Lake and adjust design and operational strategies accordingly.
- Plan for future flood risks by incorporating flexible, adaptable infrastructure that can handle increased frequency or intensity of flooding events due to climate change.

6.5.4 Health Impacts due to Human Exposure to Electromagnetic Fields (EMF)

During the operation phase the Transmission Line will be energized and which may generate electromagnetic fields (EMFs). Experimental studies have not found that magnetic fields are the cause of any disease. Many reputable health authorities such as the World Health Organization (WHO) and Health Canada have conducted thorough reviews of all the different types of studies and research on EMF and health. These health authorities have examined the scientific weight-of-evidence and have determined that when all of the epidemiological and experimental studies are considered together, the consensus is that there is no cause-effect relationship between exposure to magnetic fields and human health. The WHO concludes: *From the current scientific literature there is no convincing evidence that exposure to radiation field shortens the life span of humans or induces or promotes cancer* (WHO, 2006).

Mitigation Measures

Following mitigation measures have additionally been adopted:

- Operation phase EMF monitoring will be undertaken. Average and peak exposure levels should remain below the ICNIRP recommendation for general public exposure; and
- Both Ac and Dc technologies produce magnetic fields and both decrease with distance as you move away from the line or cable. See graphs below:

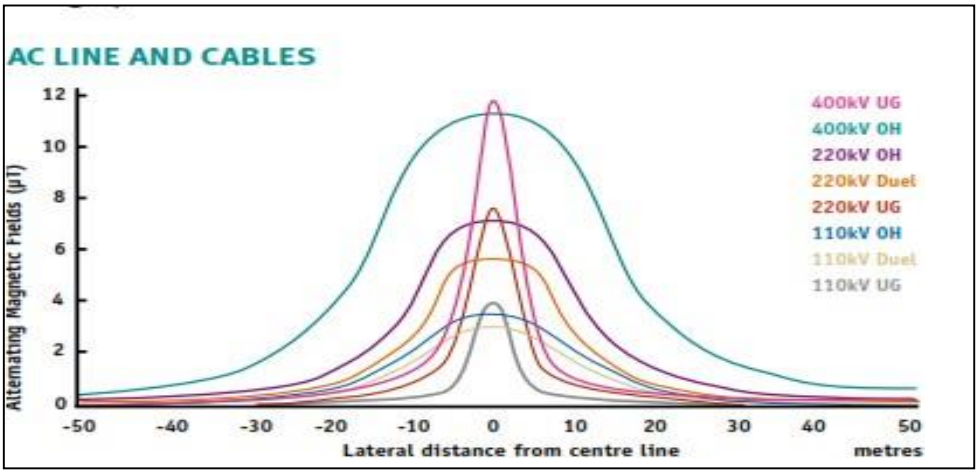


Figure 6.7 - Overhead Transmission Line: Maximum Magnetic Field

The maximum EMF given in the graph is approximately 12 micro-Telsa (μT), which is well below the ICNIRP guideline of 100 μT. Overall, no significant adverse EMF impacts are predicted during Project operation.

6.5.5 Wind, Fire and Earthquake Hazards

Wind, fire and earthquakes pose risks to the project operation and the likelihood of occurrence consider medium with significance of impact is major.

Mitigation Measures

- Transmission towers have been designed as per relevant national building codes which include earthquake resistance and loading requirements related to wind conditions.
- Transmission support structures such as tower foundations have also been designed to withstand different combinations of loading conditions including extreme winds that generally exceed earthquake loads.

- The fire hazards risk will be minimized through the use of tall towers and wide ROW.
- System protection features designed to safeguard the public and line protection systems will consist of Transmission Line relays and circuit breakers that are designed to rapidly detect faults and cut-off power to avoid shocks and fire hazards.
- Regular maintenance of the protection system including conductors and circuit breakers should be undertaken.

6.5.6 Electromagnetic Interference

The corona of overhead Transmission Line conductors and high frequency currents of overhead Transmission Line can create radio noise which may interfere with broadcast signals or electronic equipment.

Mitigation Measures

- Standard design guidelines have been adopted to limit the conductor surface gradients so as to minimize electronic interference.

6.5.7 Electrocution Hazard

High voltage transmission lines and grid station may pose electrocution hazard for unauthorized person(s) attempting to climb the tower(s).

Mitigation Measures

- Reduction in the Resistance to Ground of the grounding system
- Proper placement of ground conductors
- The addition of resistive surface layer
- Use of insulating protective equipment inside safety boots or standard class safety shoes to provide protection against electrocution, during wet season.
- Keep extra safety margin from live part during wet season.
- A grounding (earthing) system must be designed. The total ground potential rise, and the gradients in potential during a fault (called touch and step potentials) must be calculated to protect passers-by during short-circuit.
- Each tower shall be fitted with an anti-climbing device to prevent unauthorized persons from climbing the tower. The anti-climbing device shall be the ACD spiked type barbed wire or other approved type, and shall be fixed at a height not less than 3 meters above ground.

6.5.8 Seismic hazard

The risk of earthquakes is not limited to the construction phase; seismic activity could also occur during the operational phase of the project. During this phase, the operational staff will be residing in the staff colony, and personnel at the grid station will be at risk from earthquake activity.

Mitigation measures

- Install real-time earthquake monitoring systems to detect seismic activity early, allowing staff to respond quickly.
- Ensure that buildings, including the staff colony and grid station, are designed and constructed to meet or exceed seismic building codes. This may include reinforced structures, flexible building materials, and foundations that can absorb seismic shock.
- Implement a comprehensive emergency response plan specific to earthquake scenarios, including evacuation routes and safe zones.

- Provide regular earthquake safety training for all operational staff, including drills on how to protect themselves during an earthquake and evacuate safely.
- Ensure that the staff colony and grid station are equipped with emergency supplies, such as first aid kits, food, water, and communication devices.
- Consider providing emergency shelters in the vicinity in case evacuation is necessary.
- Establish reliable communication channels for emergency alerts, both for internal use (staff coordination) and external use (alerting authorities and emergency services).
- Regularly inspect and maintain structural integrity, including checking for any earthquake-related damage and performing repairs as needed.

6.5.9 Occupational Health and Safety

There will be minimal requirement of onsite staff to ensure the smooth plant operations after commissioning. Electrocution will be the main hazard for the onsite workers during operations.
In view of the existence of the occupational health and safety risks in the plant operations, the EHS department needs to develop an Occupational Health and Safety Risk Management Plan for exposure control in situations when workers may be exposed to electrocution hazards. This plan should provide a detailed approach for protecting workers against electrocution hazards, including health hazard information, engineering controls, safe work procedures, worker training, and record keeping.

Mitigation Measures

- Electrical equipment will adequately be grounded for workers safety.
- Electrocution hazard signs will be displayed, particularly for the PV panel area and substation.
- Staff will be required to wear necessary PPE once they are out of their campsite for routine inspection, surveillance and/or monitoring.
- Maintenance at the site will be duly be authorized and be carried out with necessary safety precautions such use of PPE, adequate grounding, etc.

It is also recommended that the Occupational Health and Safety Risk Management Plan should necessarily include the following elements:

- Statement of purpose
- Responsibilities of employers, supervisors, and workers
- Risk identification and assessment
- Risk controls
- Worker education and training
- Written safe work procedures
- Hygiene facilities and adequate grounding procedures
- Documentation & record keeping

6.5.10 Visual Impacts

Transmission Line

- The presence of tall transmission towers and cables can be visually intrusive, especially in an otherwise pristine or rural environment like the area around Keenjhar Lake. These structures could alter the natural skyline and the area's overall visual appeal. Moreover, as there is little to no vegetation around the project site, the transmission line might be visible from long distances, particularly from the lake or adjacent viewpoints. This could reduce the area's natural beauty, especially for tourists or people living nearby.

Grid Station

- The grid station, depending on its size, could introduce large industrial structures into an otherwise natural environment. These could include transformers, switchgear, control rooms, and other technical equipment, which may stand out in the landscape. In addition, operational lighting at the grid station, especially if it runs 24/7, could create light pollution, especially if the area is otherwise dark at night.

Staff Colony

- The construction of a staff colony would introduce residential buildings, roads, and other urban infrastructure into an otherwise undeveloped area. This would change the character of the land, and depending on the design, could lead to a suburbanization of the area. The accumulation of waste, vehicles, and other infrastructure associated with the colony could create additional visual clutter and detract from the natural beauty of the site.

Mitigation Measures

- After construction, disturbed areas along the transmission line route should be re-vegetated with native plant species to restore some of the natural visual aesthetics. This would help reduce the visual footprint of the transmission line in the long term.
- The grid station could be designed to minimize its visual impact, including using natural landscaping to screen the site. Fencing and plantings around the perimeter could help obscure the station from nearby views.
- Use low-intensity lighting for the grid station, and install motion sensors to minimize unnecessary lighting. The lighting could also be shielded to avoid light pollution.

6.5.11 Sulfur Hexafluoride Gas (SF6) Leak

Sulfur Hexafluoride (SF_6) will be used as a gas insulator for electrical switching equipment. Commercially available SF_6 is not dangerous, and is not specifically subjected to the local environmental regulations. The use of SF_6, a heavy gas in a confined area presents the risk of asphyxia, since it reduces oxygen content. SF_6 is a stable gas, heavier than air, not harmful to humans, non-toxic and non–corrosive. It is also non-explosive and non-inflammable and a greenhouse gas.

SF_6 is used in fully encased systems which are extremely safe and unlikely to leak under normal circumstances. SF_6 is collected and recycled if a piece of equipment or a grid station needs to be opened. Despite the fact that SF_6 gas is very stable, it will partly decompose in association with electric discharges and arcs, producing gaseous and solid decomposition products. Normally the level of gaseous decomposition products is kept low through the use of absorbers built into the switchgear. The detailed SOPs for SF6 use and controlled release is attached in **Annex-F.**

Mitigation Measures:

- The EPC contractor has comprehensive procedures for SF6 use and leakage detection and protection, which are also attached as an annexure. The following mitigation measure may be taken into consideration for SF_6 related operations and maintenance:
- The SF_6 Gas insulated switchgears design should comply with relevant IEC standards for the prevention of gas leakage.
- The manufacturer is bound to design the switchgear with leakage rate of SF_6 per annum for the whole grid station within 0.5-1%.
- Temperature compensated Pressure gauges will be installed for each compartment for monitoring of switchgear gas density and pressure.
- The GIS switchgear will be equipped with SF6 Alarm, tripping and monitoring system with efficient and quick leakage/loss detection system.
- Signals, usually wired up to the control room for operator attention in case of any minor or major loss of SF_6 e.g. loss of SF_6, SF_6 pressure rising, SF_6 minimum density, SF_6 1st stage, SF_6 2nd stage etc., so any loss of SF_6 will be noticed.

- During maintenance of switchgear or during SF_6 gas filling/recovery, a calibrated and purposely designed machine named DILO is used for proper transfer of Gas to and from Gas compartments or specially designed cylinders, also proper pressure is maintained as per manufacturer recommendations.
- Only the trained, designated or certified personnel are authorized to use the DILO machine for process of SF_6 Gas filling or recovery.
- Proper Safety measures and precautions should be taken prior to the start of work.

6.5.12 Transformer Oil and Lubricants Spill

Power Transformer installed in the grid station will have oil as cooling and insulating medium. Oil leakage may take place during operations or when changing insulating medium. Control measures will be needed for oily residues such as transformer oil and lubricants in the case of accidental or unexpected release. Oil spills are rare and are preempted by routine maintenance. Transformer oil may be supplied in drums from external source and tap tanks may be topped up as necessary on site. The detailed SOPs for transformer oil use and spill control are attached in **Annex-G.**

Mitigation Measures

- Stones are provided at the transformer base to protect from fire when an oil spill takes place.
- A reservoir may be constructed below transformer for oil containment and spill control in case of leakage or outflow of oil due to severe internal fault. Bunds may also be constructed in transformer area for further protection.
- Refueling and maintenance should take place in dedicated areas.
- Contaminated residues and waste oily residues should be sent to the manufacturer(s) or disposed in environment friendly manner in consultation with local authority.

6.5.13 Solid Waste Generation

During the operational phase, routine maintenance of the transmission line (e.g., tower inspections, vegetation management) could generate small amounts of waste, including packaging materials, broken parts, and cleaning materials. The grid station will generate solid waste, including packaging waste from spare parts, broken equipment, and potentially hazardous materials (e.g., insulation, oils, filters, etc.). Additionally, waste generated by staff (food wrappers, papers, etc.) would need to be managed properly. The staff colony will produce domestic waste, including organic waste, plastics, metals, glass, and other household garbage. Over time, the accumulation of solid waste could become a challenge, particularly if disposal infrastructure is not properly designed.

Solid Waste Management Plan:

- Implement a waste segregation system at the grid station and staff colony to ensure that recyclable materials (e.g., plastics, metals, paper) are separated from non-recyclable waste (e.g., organic waste).
- Establish waste storage facilities and ensure regular collection and transport of waste to a licensed disposal site.
- Encourage the use of biodegradable products in the staff colony to reduce plastic waste.

6.5.14 Liquid Waste/ Effluent Generation

The staff colony and grid station will produce sewage (from toilets) and greywater (from kitchens, sinks, and showers). If not treated and disposed of properly, this could lead to contamination of soil or nearby water sources (e.g., Keenjhar Lake).

The grid station may generate small amounts of hazardous liquid waste, including oils, chemicals, and coolant fluids used in transformers and other equipment. If not disposed of properly, these could leak into the ground or water sources, posing risks to the local ecosystem.

Mitigation Measures

- Install a sewage treatment plant (STP) at the staff colony and grid station to treat sewage and greywater before discharging it into the environment. This will help prevent contamination of nearby water sources, including Keenjhar Lake.
- Use a combination of biological and chemical treatment methods to meet the required water quality standards.
- Implement proper handling, storage, and disposal procedures for hazardous materials such as oils, solvents, and chemicals used at the grid station. This could include designing a dedicated hazardous waste disposal facility and ensuring periodic inspection of transformers and other equipment for leaks.
- Establish spill response protocols in case of oil or chemical leaks from the grid station equipment.

6.5.15 Labor Issues

Harassment of women in the work place

A Code of Conduct at the Workplace will be developed and enforced by CC to provide protection and safety to women against harassment. All workplace harassment and SEA - links to GRM incidents will be communicated by supervisors and workers to the Project Director as soon as they become aware of the incidents. All grievances will be recorded and within a stipulated time period, redressed

6.5.16 Positive Socioeconomic Impact

Project operation will result in some positive socio-economic impacts including:

- Generating short to medium-term employment for local people;
- Provision of electricity for K4 water supply project which will provide water for Karachi city.

7 Stakeholder Consultations

7.1 Overview

Public consultation and information disclosure is an essential component of the Environmental & Social 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.

7.2 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 7.1 - Tasks & 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 subject project include:

- Ensure all stakeholders are informed about the project's objectives, context, and scope, including the key design features of the power grid and transmission line and potential environmental and social implications.
- Promote active engagement with all 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.

- Adopt an inclusive, participatory, and transparent approach towards stakeholder engagement that provides opportunities for engagement with relevant stakeholders of all backgrounds, regardless of gender, race, ethnicity, income class, and ability
- Benefit from local community knowledge for enhancing strategic interventions for public space design and infrastructure improvement, and
- 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.

7.3 Stakeholder Identification & Analysis

The stakeholders for this project have been divided into two major categories which are outlined below:

- **Primary Stakeholders** – Persons, groups, and other entities within the project corridor of influence (COI) that are directly influenced (actually or potentially) by the project and/or have been identified as most susceptible to change associated with the project, and who need to be closely engaged with in identifying impacts and their significance, as well as in decision making
- **Secondary Stakeholders** – Individuals, groups, entities that may not experience direct impacts from the project but who consider or perceieve their interests as being affected by the project and/or who could affect the project and the process of its implementation in some way

Details regarding Primary stakeholders and their roles and responsibilities is represented in the table below:

Table 7.2 - Roles & Responsibilities of Primary Stakeholders

Project Stakeholder	Roles and Responsibilities
Sindh Transmission & Dispatch Company (STDC)	• Licensed by the National Electric Power Regulatory Authority (NEPRA) as a provincial grid company, allowing it to build and manage grid stations and transmission lines in the Sindh region • Will be the main proponent of project during the development phase and ensuring power is provided to the K-IV Project for its successful execution
Water & Power Development Authority (WAPDA)	• A government owned public utility agency maintaining hydropower and water in Pakistan • Tasked with the development of the K-IV Project to provide additional water supply to Karachi, where they will work in tandem with STDC to ensure the timely provision of power for the K-IV project
Karachi Water & Sewerage Corporation (KWSC)	• Incharge of the water supply and sewerage infrastructure for residents of the city of Karachi • Will take over the K-IV project once it is in the operational phase, and willl be incharge of its operations and maintenance
Sindh Environmental Protection Agency (SEPA)	• SEPA is the regulatory authority and mainly responsible for the development and implementation of environmental policies and strategies in ordr to integrate sustainable development and environmental conservation approaches into the legal and regulatory frameworks as per Sindh Environmental Protection Act, 2014 • EPA Sindh is responsible for the approval of the proposed project prior to implementation • EPA Sindh is responsible for the compliance of the ESMP and ultimately the preservation of environmental conditions in the area

Sindh Widlife Department	• Department in Sindh that focuses on promoting and raising awareness about wildlife and biodiversity in the region along with ensuring their protection • Given that the project is located in an area deemed as a Protected Area under the department's ambit due to the presence of both local and migratory fauna that makes the area an important biodivsersity area
Sindh Forest Department	• Department in Sindh that is incharge of all forest land in the province, including raising awareness about them and ensuring their protection • Given that the project is located in an area deemed as a Protected Area under the department's ambit due to the presence of both local and migratory fauna that makes the area an important biodivsersity area
Karachi Water & Sewerage Services Improvement Project (KWSSIP)	• KWSSIP is a project implementation unit formed under the KWSC which aims to bring targeted institutional and governance reforms in KWSC along with a massive strategic investment program for the improvement of water & sewerage infrastructure in Karachi • KWSSIP is the implementing agency of the K-IV augmentation project, which will connect the K-IV reservoirs with the existing water infrastructure of Karachi
Beneficiaries of the project	• Identification of issues, suggestions, and coordination for improvement of the project design • Support for implementation and aftercare of the project • Identification of project-related environmental and social issues and concerns • Identification of positive solutions for environmental and social sustainability of the project that are technically sound and cost-effective • Aftercare of the project

Similalry, the roles and responsibilities of secondary stakeholders for the project are also provided below:

Table 7.3 - Roles & Responsibilities of Secondary Stakeholders

Project Stakeholder	Roles and Responsibilities
Revenue Department	▪ Provide and verify land ownership data which includes but is not limited to the ownership record, land categorization, and price details of land around the project site
Provincial Government Departments	▪ Various government departments at both federal and provincial levels will provide regulatory oversight, ensure compliance with national and provincial policies, and support the implementation of necessary permits. ▪ They may also be involved in land issues, coordination for infrastructure development, and providing resources for the monitoring and management of the project's environmental and social impacts.
WWF Pakistan	• Ensure ecological sustainability and biodiversity conservation during project execution. ▪ Recommend mitigation measures to protect habitats and minimize environmental impact.
International Union for Conservation of Nature (IUCN) Pakistan	▪ Ensure ecological sustainability and biodiversity conservation during project execution. ▪ Recommend mitigation measures to protect habitats and minimize environmental impact.

Civil Society Groups (CSG)	▪ Civil society groups will advocate for the protection of local communities' rights, including environmental and social justice, ensuring that the concerns of the affected populations are addressed. ▪ They will also monitor the project's compliance with human rights and environmental standards, highlighting any negative impacts on vulnerable communities, flora and fauna.
Academia and Subject Specialists	▪ Academics and subject matter specialists will provide expert advice on technical, environmental, and social aspects of the project, including environmental sustainability and socio-economic impacts.
Local Councillors	▪ Elected union committee constitutents. Key link between constitutents and city legislature and executive ▪ Help in project implementation through raising awareness and increasing project acceptability through dialogue

7.4 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. For ascertaining the perceptions of different stakeholders about the project consultations/ meetings were carried out at following two levels:

• Consultations with Primary Stakeholders
• Consultations with Secondary Stakeholders

7.4.1 Consultations with Primary Stakeholders

In order to align with international standards and good practices, local level engagement was provided to all stakeholders. The main purpose of the exercise was to disseminate information to relevant stakeholders and solicit their feedback receieved at an early stage regarding potential issues and concerns based on the current project design and features.

Consultation meetings were conducted with identified stakeholders, where they were briefed about the background and scope of the project. Concerns and suggestions from the stakeholders was noted down by the team and pictures of the sessions were taken with the consent of the stakeholders. If the interviewees had any questions about the project, the team responded to their queries during the session.

For ascertaining the perceptions of different stakeholders, key informant interviews were held with primary stakeholders. These meetings were held in an open atmosphere, in which participants expresed their concerns and views freely.

7.4.2 Consultations with Secondary Stakeholders

Secondary stakeholders, identified in the form of departmental stakeholders, such as non-governmental organizations, government departments, and utility departments were approached seapartely for consultation on the project.

7.5 Consultation Feedback & Analysis

7.5.1 Primary Stakeholders

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

Details regarding Primary stakeholder's feedback and suggestions are represented in the table below:

Table 7.4 - Stakeholder Feedback from Primary Stakeholders

Stakeholder	Feedback & Suggestions
1. Sindh Environmental Protection Agency (SEPA)	Respondent: Mr. Imran Sabir, Director of Natural Resources Mr. Sabir emphasized that the primary role of SEPA is to implement the SEPA Act of 2014 and promote environmental conservation across Sindh. He explained that SEPA grants project approvals for a maximum of three years. If a project remains incomplete within this timeframe, the approval becomes void, requiring the project team to reapply. He further highlighted that SEPA conducts review mechanisms and post-monitoring of projects, with non-compliance subject to action under Section 19. Mr. Sabir emphasized the importance of regular monitoring for all diesel-operated generators to ensure they remain well-tuned. He highlighted the need to finalize suitable locations for the generators. The team should prioritize collecting primary data to accurately categorize the flora and fauna in the area. He also recommended conducting a detailed social baseline survey and hiring an environmentalist, ecologist, and sociologist to ensure the work is performed to a high standard. To maintain efficiency, the project timeline must be strictly adhered to, and the construction plan should be shared on social media for transparency. Continuous monitoring throughout the project's lifecycle is essential.
2. Karachi Water and Sewerage Services Improvement Project (KWSSIP)	Respondent: Mr. Masood, Environment Expert Mr. Masood highlighted that the K-IV Power Component Project is an associated facility of the Karachi Water and Sewerage Services Improvement Project (KWSSIP) and must adhere to all World Bank guidelines. He emphasized the importance of ensuring compliance with the Resettlement and Rehabilitation Law of 2023, should it be applicable to the project. Mr. Masood expressed his support for the project, acknowledging its significance and necessity for the region. However, he stressed that any loss of shrubs or agricultural land during construction should be properly compensated to mitigate the impact on local communities and maintain environmental and social balance.
3. Karachi Water & Sewerage Corporation (KWSC)	Respondent: Mr. Sikandar Zardari, Chief Engineer Mr. Zardari underscored the vital nature of the project as a building block in the overall successful implementation of the K-IV project and stated that the project should be carried out in the shortest time possible to ensure that the K-IV project is able to develop and function without any roadblocks.

4. Sindh Forest Department	Respondent: Mr. Usama Anwar, Divisional Forest Officer Mr. Anwar emphasized the importance of appropriately compensating for any ecosystem disturbances caused by the project. He suggested the development of a model mini-forest or park to provide a habitat for displaced animals and other species. If this is not feasible, he recommended involving the Sindh Wildlife Department to establish suitable alternatives. He highlighted the potential impact on forested areas, including rangeland forest areas, the Dhabeji Protected Forest, and the Dhando Protected Forest, emphasizing the need for proper planning to mitigate such effects. Mr. Anwar also raised concerns about the disturbance of migratory bird species due to lattice towers, referencing the example of the Jhimpir Power Station, where migratory birds ceased coming to the area during construction. He stressed that such disruptions should be avoided. Additionally, he noted that any trees cut during the project should be compensated by planting more trees in the surrounding areas to restore biodiversity and mitigate environmental impacts. He further stated that any forest land used for the project would require a No Objection Certificate (NOC) from the Sindh Forest Department. Drawing attention to existing practices, such as the SSGC pipeline in the area, which provides annual rent to the Forest Department, he insisted that this project must adhere to a similar arrangement. Lastly, Mr. Anwar emphasized the importance of securing the water pumped from PS1 and PS2 against theft to ensure the supply intended for Karachi's residents remains uncompromised
5. Sindh Wildlife Department	Respondent: Mr. Mumtaz Ali Soomro, Deputy Conservator Wildlife Mr. Soomro emphasized the importance of incorporating comprehensive monitoring and evaluation mechanisms throughout the project. He recommended that relevant departments be consulted to ensure proper oversight and alignment with regulatory frameworks. Regarding the potential removal of large trees, he underscored the need for timely notification to stakeholders and the implementation of appropriate compensation measures. He highlighted the relevant provisions under subsections 55, 56, 58, and 59 of the 2022 regulations, which pertain to the protection of forests and wildlife. Mr. Soomro further advised that any compensatory measures should prioritize reforestation efforts, ensuring the planting of additional trees to restore habitats and support the revival of bird and wildlife populations.

7.5.2 Secondary Stakeholders

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

Details regarding Secondary stakeholder's feedback and suggestions are represented in the table below:

Table 7.5 - Stakeholder Feedback from Secondary Stakeholders

Stakeholder	Feedback & Suggestions
1. Karachi University (KU)	Respondent: Mr. Moazzam, Professor The Environmental Sciences Department at Karachi University offers BS, MS, and PhD programs but has no direct involvement in the project. Mr. Moazzam acknowledged the project as a positive initiative that could improve Karachi's water supply. However, he highlighted potential challenges, including alignment issues with the K-IV water project and the risk of radiation from transmission lines. He also emphasized the need to manage noise pollution and ensure that nearby settlements remain undisturbed during project implementation.
2. NED University of Engineering and Technology	Respondent: Mr. Mahmood Ali, Acting Chairman Mr. Mahmood Ali commended the project, noting its significant potential to improve Karachi's water supply. He emphasized the importance of careful monitoring and evaluation of the transmission line to prevent power disruptions and praised the project for ensuring the right of way along the transmission route. He also stressed that the project should have no negative impact on farming activities in the area and recommended maintaining a focus on stability and continuity in power supply.
3. Sindh Tourism Development Corporation (STDC)	Respondent: Mr. Ayaz, Administrator Mr. Ayaz reported that the Sindh Tourism Development Corporation (STDC) has no direct involvement in the project, as there are no cultural heritage sites in the vicinity. However, he urged the project team to verify that no graveyards are located nearby. He also expressed support for the project, noting it as a positive initiative.
4. National Forum for Environment and Health (NFEH)	Respondent: Mr. Naeem Qureshi, President Mr. Naeem Qureshi highlighted that the National Forum for Environment and Health (NFEH) could play a role in facilitating consultations between local bodies and the project team. He emphasized the importance of considering the presence of migratory birds in the area, although he acknowledged the project's use of renewable energy as a positive aspect. He suggested incorporating an alternative to wind power, ensuring the project's height is carefully assessed, and providing adequate energy storage and backup generators. Additionally, he advised taking fluctuations in power supply into account to maintain operational stability.
5. International Union for Conservation of Nature (IUCN)	Respondent: Mr. Danish Rashdi, Head Karachi Programme Mr. Rashdi emphasized the critical role of conservation in the K-IV Project. He highlighted that IUCN focuses on data collection and analysis of species, maintaining the Red List of threatened species, and assessing the biodiversity of the project area, including the migration patterns of fauna and flora. He stressed the need to evaluate the potential impact of transmission towers on migratory birds, ensuring that their flight paths and nesting sites are not

	disrupted. Mr. Rashdi also recommended strict compliance with the World Bank's Environmental and Social Standards to align the project with global best practices. He underscored the importance of considering the 300 wetlands in the region, which serve as vital habitats for species like pelicans and egrets. Any construction near these wetlands should be carefully managed to prevent ecological damage. If protected sites or sensitive ecological areas are identified near the proposed route, he suggested rerouting the transmission line to avoid disturbance. Finally, he advised ensuring that the tower installation process is conducted smoothly and with minimal environmental impact, emphasizing the need for continuous stakeholder engagement and monitoring to mitigate any unforeseen issues.

Pictures of consultations carried out are provided below:

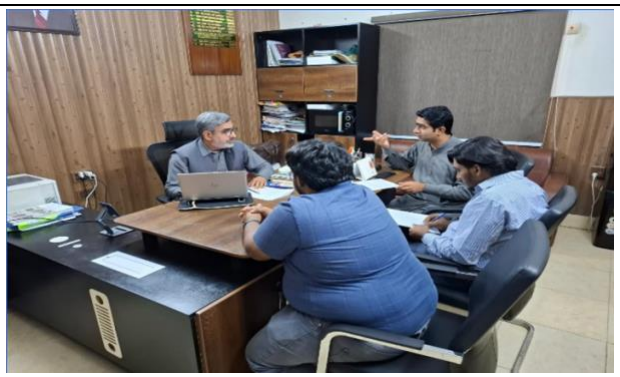
Table 7.6 - Pictures from Stakeholder Consultations

Consultation with IUCN	Consultation with Sindh EPA
Consultation with NED University	Consultation with University of Karachi

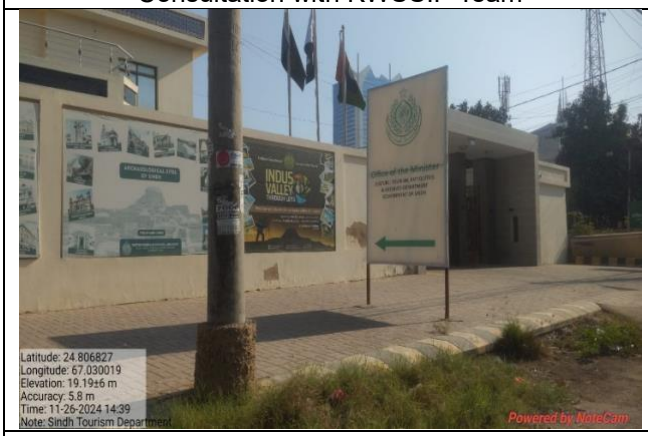
Consultation with Wildlife Department

Consultant with KWSC

Consultation with KWSSIP Team



Consultation with Forest Department



Consultation with Sindh Tourism and Development Corporation

8 Environmental & Social Management Plan

8.1 Introduction

General

This section discusses the implementation and management of mitigation measures that are required for the proposed project which include progressive report and techniques to ensure that all necessary environmental protection measures are carried out in the future as planned and to reduce residual impact to acceptable levels and achieve the expected outcomes of the project. The Environmental and Social Management Plan (ESMP) is based on the type, extent and duration of the identified environmental impacts.

Environmental management and monitoring are mandatory activities to be undertaken by the project administration over the entire project cycle showing its commitment towards meeting environmental regulations/standards as well as maintaining health and safety standards.

The ESMP is implemented from the very early stages of the planning and execution phases of the project. The authorization of the project is the point of initiation of the environmental management plan. The monitoring data, observations recorded and test results/ analyses are vital for the formulation of legal documents. All the data and legal documents are kept in safe custody and may be provided to the competent authority in accordance with the Sindh Environmental Protection Act 2014 when required.

ESMP stands for Environmental and Social Management Plan, which is a strategic framework used to identify, assess, and mitigate the environmental and social impacts of projects. It ensures compliance with environmental regulations and promotes sustainable practices.

The Proponent will be responsible for implementing the ESMP and ensuring that all personnel management are informed about the ESMP and the requirement to implement the procedures it contains. The ESMP is intended as a quick reference for Project personnel and regulators to monitor compliance.

8.2 Objectives of ESMP

The ESMP will serve as a principal execution module of the project that would not only mitigate adverse environmental impacts during the designing, construction, operational and maintenance phase of the project but also ensures that environmental standards and good housekeeping is maintained. Continuous environmental monitoring is exercised to ensure that preventive measures are in place and are effective; to sustain environmental integrity. Some of the key objectives of the ESMP are to:

Outline mitigation measures recommended in the ESIA and define the responsibility and implementation of these measures;

- To outline functions and responsibilities of personnel;
- To state and implement environmental standards, guidelines and legislations relevant to the project;
- To facilitate the implementation of mitigation measures according to the project details and proposed mitigation measures;

- To develop a monitoring mechanism for the identification of whether the monitoring parameters are being implemented completely and effectively
- To identify training requirements at various levels and provide a plan for the implementation of training sessions. It is important that the recommendations and mitigation measures are carried out according to the spirit of the environmental assessment process and in line with the guidelines. The ESMP are presented in Table 8.1 and Table 8.2. Screening of potential environmental and social impacts has played a vital role in reconfirming typical mitigation measures and in identifying any different approaches based on the feasibility and detailed design assumptions and any alternatives available at this stage.

8.3 Coverage of the ESMP

All activities ordained under the three stages of the proejct (pre-construction, construction, and operation) will be controlled and monitoried as per the guidelines of the ESMP.

8.4 Institutional Requirements

The institutional requirements for the construction and operation phases of the proposed project are elaborated upon in the following sections:

8.4.1 ESMP Preparation During Assessment Stage

This independent assessment and the ESMP that stems from it have been prepared by EMC Pakistan (Private) Limited, who were selected following a bidding process conducted by the STDC and Government of Sindh's procurement policies. This is in line with Paragraph 25 of ESS1 of the World Bank's ESF, which dictates:

25. The environmental and social assessment will be an adequate, accurate, and objective evaluation and presentation of the risks and impacts, prepared by qualified and experienced persons. For High and Substantial Risk projects, as well as situations in which the Borrower has limited capacity, the Borrower will retain independent specialists to carry out the environmental and social assessment.

EMC Pakistan (Pvt.) Limited, established in January 1997, is one of the pioneering consulting companies of Pakistan offering services in the field of Environment, Health & Safety and provides economic and technical solutions to Pakistan's rapidly expanding industrial & commercial sector. EMC comprises a team of highly talented professionals, who work in sync with clients ensuring that the defined assessment, survey, or reporting is executed with high level of efficiency.

The company was established with a vision to provide sound environmental services and practices to the industrial, municipal as well as government sector. The company is headquartered in Karachi, with more offices throughout the country, and has been providing consultancy services in various fields of environment. EMC is registered with Pakistan Engineering Council and is also ISO certified (ISO-9001-2015, ISO 14001-2015, and ISO 45001-2018). The company is also registered with the Asian Development Bank (ADB) & World Bank (WB), while also running its own, SEPA Certified, Environmental Laboratory Setup under the name of Quality Testing Services (QTS).

EMC has a proven successful track record of working with industry & institutions and in executing multi-faceted projects funded by organizations like UN-Habitat, Japan International Cooperation Agency (JICA), Asian Development Bank (ADB), International Finance Corporation (IFC) Bank, Overseas Private Investment Corporation (OPIC), Ministry of Environment, CDGK, KMC, amongst others. EMC Pakistan Pvt. Ltd has laid down new benchmarks in all its areas of strategic operations by our dedicated team of outstanding professionals and client-centric approach, clearly evident by the company's accomplishments and clients list.

8.4.2 ESMP Implementation During Pre-Construction

The project, and the works therein, will be executed by the STDC team during the pre-construction phase. In the organizational hierarchy of the company, the Chief Executive Officer (CEO) will be overall responsible for the design and pre-construction aspects of the proposed project. The Senior General Manager (GM) Technical will be responsible for the implementation of all aspects of the project, inlcuding the E&S measures listed out in this report. The responsibilities of STDC include the following:

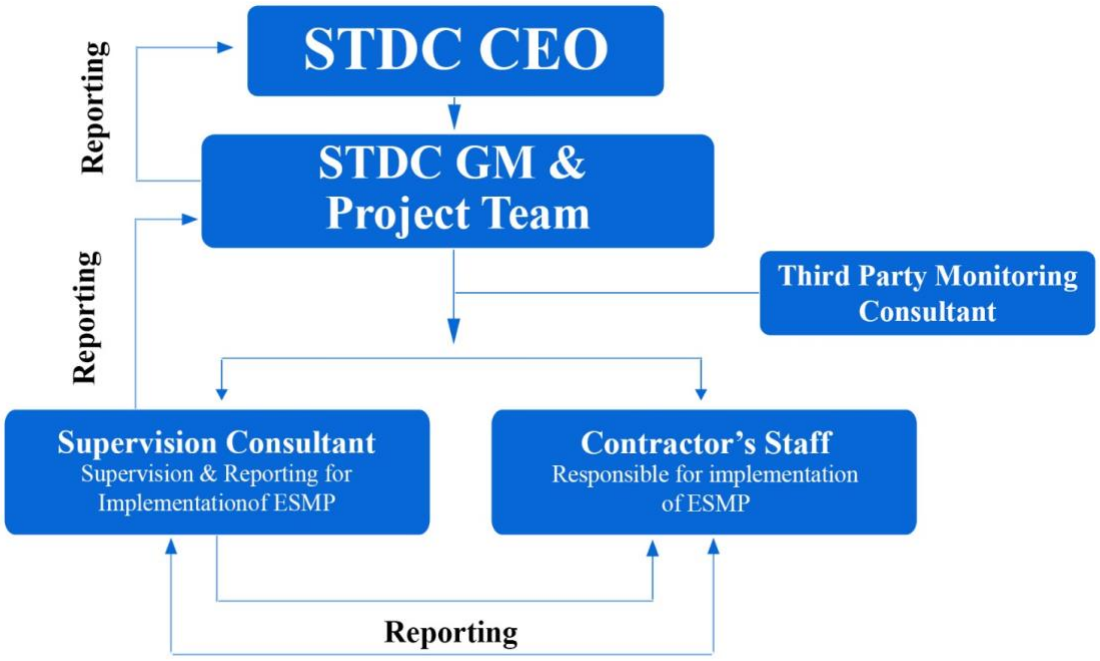
- Engaging in collaborative efforts to monitor environmental and social compliance in the pre-construction phase
- Providing regular reports on the status of the environmental and social compliance to the CEO
- Conducting assessments and implementing measures to address the long term environmental and social impacts of the proposed project
- Maintaining a productive partnership among relevant line departments and agencies identified in the stakeholders chapter to ensure ongoing collaboration

8.4.3 ESMP Implementation During Construction

The key stakeholders during the construction phase of the proposed project are STDC, SEPA, the Supervision Consultant (SC), the Third Party Monitoring Consultant, and the Contractor. The roles and responsibilities of all these parties are highlighted below:

- STDC (CEO)
- STDC GM & Project Team
- SC
- Third Party Monitoring Consultant
- Contractor's Staff

STDC will bound contractors through clauses in their contracts to implement the ESIA including ESMP, and other terms and conditions of the environmental approval issued by SEPA. The whole ESMP wil be included as a clause in the contractor's documents. Construction camps will be established after necessry approvals and submission of site specific ESMPs to be developed in light of the relevant agencies' requirements, prior to commencement of new works. The organizational setup for the implementation of the ESMP during construction is provided below:



8.4.4 Roles & Responsibilities

a) SEPA

In accordance with the Sindh Environmental Protection Act of 2014, the responsibility for environmental protection and pollution control lies with SEPA (Sindh Environmental Protection Agency). SEPA is tasked with approving the Environmental Impact Assessment (EIA) and Initial Environmental Examination (IEE) for all development projects falling under their jurisdiction. Additionally, SEPA will conduct audits of the proposed sub-project activities as necessary, ensuring adherence to the protocols outlined in the Environmental and Social Management Plan (ESMP) and obtaining environmental approval.

b) CEO STDC

The CEO of STDC serves as the principal authority overseeing the project. As an executive head, the CEO assumes responsibility for making crucial policy, administrative, and financial decisions to ensure the efficient and timely execution of the project in accordance with the approved framework and implementation schedules. In addition, the CEO bears the overall responsibility for project implementation, including environmental and social management aspects, as well as the selection and engagement of contractors and consultants.

c) STDC GM & Project Team

The GM and project team at STDC will oversee its day to day activities and overall implementation. This team will be responsible for the overall implementation of the ESMP, and other related tasks. They will also be responsible for ensuring the ESMPs are included in the contractors' bidding documents, along with the implementation supervision. This team will also manage environmental and social aspects of the project activities, including arranging for environmental and social monitoring and preparing compliance reports for submission to the CEO, and SEPA. The team will be responsible to ensure compliance of the ESMP during the construction phase. The team will also hire the services of an independent environmental and social consultancy firm as Third Party for Third Party Monitoring Team.

Furthermore, they shall be responsible for:

- Ensuring the provision of necessary environmental and social training to relevant personnel.
- Ensuring compliance with all contractual obligations pertaining to environmental and social standards.
- Conducting regular site visits to construction sites to assess the environmental and social performance of the Contractor(s).
- Regularly checking the proper implementation of the Environmental and Social Management Plan (ESMP) during the construction phase.
- Reviewing monitoring reports on the progress of environmental and social activities.
- Ensuring that the Contractor implements additional measures recommended by the Supervising Consultant (SC) in environmental and social monitoring reports.
- Documenting and disclosing monitoring results, identifying corrective and preventive actions in periodic reports, and monitoring the progress of these actions towards desired outcomes.
- Assisting the Contractor in ensuring timely payments of negotiated prices.
- Providing assistance to the Contractor in obtaining necessary approvals from relevant departments.
- Overseeing compliance with all monitoring programs outlined in the ESMP.
- Maintaining effective communication with other relevant departments and stakeholders.
- Reporting the status of ESMP implementation to the Sindh Environmental Protection Agency (SEPA).

d) Third Party Monitoring Team

The Third Party Monitoring Process will involve the engagement of independent Environmental and Social specialists, where they will be responsible for monitoring environmental and social factors including conducting field surveys at the construction sites to assess the level of compliance. Their role will entail conducting external and independent monitoring of the ESMP implementation. The external monitoring agency will perform biannual, annual, and final evaluations of the ESMP and provide recommendations for necessary changes to the team at STDC. Roles and responsibilities of the Third Party Monitoring Team will include:

- Conduct autonomous monitoring at crucial sites throughout the construction phase and oversee the implementation of the Environmental and Social Management Plan (ESMP) within the project area.
- Track the Grievance Redress Mechanism (GRM) and ensure the resolution of complaints.
- Promptly notify the STDC project team of any significant impacts that arise during the construction process.
- Observe and revise or prepare corrective action plans as necessary.
- Monitor the implementation of the plans in collaboration with the Project Implementation Consultant.

e) Supervision Consultant (SC)

STDC will engage a Supervision Consultant to oversee the proposed project, where the firm will be responsible for preparing monthly monitoring and envaluation reports for the site, which will then be submitted to the STDC team. The STDC team will then review these reports, hold discussions with the consulting firm and finalize findings accordingly. Should contractors fail to comply with the requirements, the SC has the authority to halt activities or impose penalties according to contractual terms. The SC will provide the final versions of the monitoring and evaluation reports to the STDC team as part of the periodic reporting mechanism outlined in the

upcoming section. The STDC will then submit these reports to the CEO STDC for their review and necessary actions. Additionaly, the reports will also be submitted to the Sindh Environmental Protection Agency (SEPA) in accordance with the specfied frequency outlined in the "Environmental Approval" requirements for the construction phase. The roles and responsibilities of the SC will be as follows:

- Conduct a thorough review and provide approval for the contractor's management plans.
- Oversee and supervise the contractor's performance to ensure compliance with the Environmental and Social Management Plan (ESMP).
- Ensure that the day-to-day construction activities adhere to environmentally and socially responsible practices.
- Maintain close coordination with the contractor and the STDC project team.
- Develop training materials and implement training programs.
- Verify the implementation of mitigation measures recommended in the ESMP.
- Supervise and monitor environmental and social activities at the construction site.
- Organize periodic training programs and workshops on environmental and social aspects for the consultant's and contractor's staff.
- Prepare regular reports as specified in the ESMP.
- Propose any additional mitigation measures that may be necessary.

f) Construction Contractor

Contractors will be obligated to hire on-site Environmental and Social Experts who possess appropriate education and experience for each construction site. It will be the responsibility of the contractors to execute measures that prevent or minimize any negative environmental and social effects during the construction phase. Prior to commencing work, contractors must develop a site-specific Environmental and Social Management Plan (SSESMP) that outlines their approach to meeting the ESMP requirements for each site. This plan must be submitted for approval to both the STDC project team and the Supervision Consultant (SC). The Environmental and Social Experts employed by the contractors will be responsible for undertaking the following activities:

- Develop the Site-Specific Environmental and Social Management Plan (SSESMP) and secure approval from the Supervision Consultant (SC).
- Implement the mitigation measures outlined in the ESMP and SSESMP at each construction site.
- Contractors are contractually obligated to comply with all the specific and general provisions stated in the contract document.
- Provide appropriate Personal Protective Equipment (PPE) to workers and train them on its proper usage.
- Prepare and submit monthly, quarterly, biannual, annual, and final progress reports to the Supervision Consultant (SC).
- Immediately report any accidents, incidents, including environmental and social incidents, to the Supervision Consultant (SC) and STDC project team.
- Conduct environmental and health and safety training for workers and laborers.
- Coordinate with the Supervision Consultant (SC) and STDC project team.

Regardless of the number of contractors, each contractor will be mandated to have adequately qualified and experienced persons to function as environmental, social, and OHS specialists to work in close liaison with the SC and STDC.

8.4.5 ESMP Implementation During Operations

The proposed project will be managed by STDC in the operational phase. In the organizational hierarchy of STDC, the CEO will be overall responsible for the O&M of the project. Project

operations may be outsourced to third parties also. The monitoring and compliance of the operational phase of the ESMP will be under the responsibilities of the engineers and plant managers at the project site. The staff will be responsible for the following:

- Coordinating to monitori environmental and social compliance during operations
- Advising on, and monitoring tree plantations at the project site
- Reporting on the O&M progress of environmental and social compliance to SEPA
- Assessing as well as mitigating the long term environmental and social impacts of the proposed project operation; and
- Sustaining a working partnership among SEPA, and other related public and private sector organizations

8.5 Environmental & Social Mitigation & Management Matrix

The Envrionmental and Social mitigation and management matrix is one of the central elements of the ESMP, where it will be used as the management tool for implementation of the above mentioned mitigation measures. The plan includes the following:

- Envisaged impacts as identified in the ESIA and their recommended mitigation measures
- The person/ organization directly responsible for adhering to or executing the required mitigation measures

Regardless of the different organizations being delegated responsibilities for execution and monitoring of the project, STDC will be the primary party responsible for ensuring the complete implementation of the ESMP. The following table provides information about all impacts anticipated from project activities during different phases. The contractor(s) will be responsible for the preparation of Site Specific Environmental and Social Management Plans (SSEMPs) on the same format as this ESMP along with site specific plans based on the guidelines provided in the annexures.

8.6 Environmental & Social Monitoring Plan

Environmental and social monitoring plays a crucial role in providing timely and valuable information to project management and implementation agencies. In essence, monitoring involves regularly checking and balancing the progress of project activities and the achievement of developmental targets during construction and operation. It aids in promptly identifying, analysing, and addressing any obstacles that may arise. Specific environmental parameters, encompassing physical, ecological, and social aspects, are carefully selected, and subjected to quantitative analysis. The results of this analysis are then compared against established guidelines, standards, and pre-project conditions to assess the effectiveness of the Environmental and Social Management Plan (ESMP) and its implementation in mitigating impacts. The objectives of the environmental and social monitoring plan throughout the construction and operation phases are as follows:

- Monitor the actual impacts of the project on physical, ecological, and socio-economic receptors.
- Provide recommendations for mitigation measures in case of unforeseen impacts or when the impact level exceeds the anticipated level stated in the Environmental and Social Impact Assessment (ESIA).
- Ensure compliance with legal and community obligations, including safety measures during the construction and operation phases.
- Ensure the proper disposal of excess construction materials, solid waste, water, wastewater, and gaseous emissions.
- Evaluate the adequacy of the ESIA in relation to the project's predicted long-term impacts on the physical, ecological, and socio-economic environment of the area.

- Assess the effectiveness of the mitigation measures proposed in the Environmental and Social Management Plan (ESMP) and recommend improvements if necessary.
- Compile data on periodic incidents and accidents to support analyses aimed at minimizing future risks.

The STDC project team will hold responsibility for all monitoring activities to be conducted (compliance and effects monitoring). All findings and results will form part of the monitoring report to be shared with SEPA.

8.6.1 Compliance Monitoring

Compliance monitoring of the proposed project activities will serve as a tool to ensure that the environmental and social control measures identified are strictly adhered to during project execution. This will be conducted by the E&S staff of the SC. The goals of the compliance monitoring will be to:

- Observe the activities carried out by the contractor(s) or other individuals involved in the proposed project in a systematic manner.
- Ensure that the activities are in accordance with the Environmental and Social Management Plan (ESMP).
- Document and communicate the observations to the STDC project team for prompt corrective actions, if necessary.
- Maintain a record of all environmentally and socially significant incidents, along with the corresponding actions and corrective measures taken.
- Establish communication with the local communities, gather their opinions and concerns, and discuss them during monthly meetings.
- Prepare regular reports on the environmental and social performance of the proposed project.

8.6.2 Effects Monitoring

The Environmental and Social Impact Assessment (ESIA) takes into account the projected impacts of the proposed project using available information and the interconnectedness of various environmental and social factors. Mitigation measures are incorporated based on this assessment to ensure that the expected residual effects remain within acceptable thresholds. However, it is important to recognize that despite full implementation of mitigation measures, there is a possibility that the project's negative impacts may exceed predicted levels or acceptable limits. To address these concerns, an effects monitoring program will be implemented during the project activities, aiming to effectively manage environmental and social risks and uncertainties. The objectives of the effects monitoring program can be outlined as follows:

- To ensure that the impacts of the proposed project remain within acceptable thresholds, thereby establishing trust and confidence among the public.
- To promptly alert the project team about any unforeseen adverse impacts or sudden changes in impact trends, enabling swift corrective actions such as modifications to project activities or the implementation of additional mitigation measures.
- To provide information that assists in planning and controlling the timing, location, and intensity of specific project activities, with the aim of minimizing their effects.
- To support research and development efforts by documenting the effects of the proposed project, which can be used to validate impact prediction methods and enhance the accuracy of future project assessments.

The contractor(s) holds the primary responsibility for conducting effect monitoring under the supervision of the SC and the STDC team, covering the entire project. The effect monitoring

program has been meticulously developed, taking into account the identified impacts outlined in Chapter-5. Some adjustments may be made to this program, including potential changes in frequency, based on insights gained from the project's one-year operation, documented in the Change Record Register.

8.7 Training & Capacity Building

To strengthen the capabilities of both the Proponent and the Contractor, comprehensive training will be provided regarding the environmental and social aspects of the proposed project, implementation of mitigation measures, and the protocols and reporting mechanisms for monitoring.

In-house training will be conducted for the project staff, including the contractor, consultant, and the supervision staff of the Proponent. This training will consist of a one-day basic training and a one-day advanced training, focusing on the environmental and social considerations of development projects in general, as well as the specific implementation requirements and responsibilities of the STDC project team and the contractor staff in executing the environmental and social management and monitoring plan. The training protocols will encompass the following areas:

- Methods for monitoring air quality parameters and implementing measures to prevent or minimize air pollution, specifically from sources like haul trucks.
- Procedures for monitoring water quality parameters and implementing measures to prevent or minimize water pollution, particularly from wastewater effluent generated by workshops, machinery washing yards, and the use of harmful chemicals.
- Safe practices for waste management and disposal.
- Ensuring noise levels from construction machinery and equipment are within acceptable limits.
- General guidelines for maintaining cleanliness and good housekeeping.
- Addressing communicable diseases and implementing measures to prevent their spread.
- Safety measures to protect the workforce and local communities from hazards associated with construction activities.
- Enforcing the use of safety equipment by the workforce.
- Other environmental and social topics necessary for the effective implementation of the ESMP.

8.8 Communication & Documentation

Communication and documentation are essential features of the ESMP, where the key features are:

8.8.1 Data Recording & Maintenance

Standardized formats will be used for documenting information during environemntal and social monitoring, ensuring consistency and compatibility with the designed database. To streamline data entry, check boxes, will be incorporated wherever applicable. Additionally, a tracking system wil be established for each form to facilitate efficient management and organization of collected data.

8.8.2 Database

The database include the following information:

- Training Programs

- Staff Deployment
- Non-compliances
- Corrective Actions
- List of Environmental & Sovial Data on soil and land pollution
    - Disposal of waste
    - Water resources
    - Fuel oil and chemical spills
    - Vegetation record
    - Wastewater treatment records
    - Noise pollution
    - Air and dust pollution
    - Socio-economic data
    - Ecological sensitivities

8.8.3 Meetings & Reporting

During the constructino phase, the SC will convene montlhy site meetings to address regular activities, non-compliance issues, and their corresponding corrective actions. Periodic reports, as outlined in the table below will be generated specifying the responsible individuals for report preparation and review. Furthermore, meeting minutes will be included in routine environmental and social reports to ensure comprehensive documentation:

Table 8.1 - Periodic Reporting Mechanism

S. No	Report Category	Prepared by	Submitted To	Reviewed by
1.	Monthly	Contractors' environmental and social staff	STDC	STDC / SC
2.	Quarterly	Contractors' environmental and social staff	STDC	STDC / SC
3.	Quarterly Environmental and Social Monitoring Report	CSC	STDC	STDC / SC
4.	Semi-Annual External Environmental and Social Monitoring Report (SAEESMR)	Third Party Monitoring and Evaluation Consultant	STDC	STDC / SC
5.	Annual Report	Contractors' environmental and social staff	STDC	STDC / SC
6.	Completion Report	Contractors' environmental and social staff	STDC	STDC / SC

8.8.4 Photographic Records

Contractors will be required to maintain photographic documentation throughout the implementation of the project. This photographic record should encompass essential elements such as site photographs, road infrastructure, camp sites, monitoring activities, and more.

8.8.5 Non-Compliance of the ESMP

The successful implementation of the proposed ESMP relies on the collaboration of various stakeholders. The Contractor holds primary responsibility for ensuring the execution of the mitigation measures outlined in the ESMP, which will be included in the contractual agreements. The environmental mitigation costs will be factored into the overall project budget, and the Contractor will receive payment based on monthly compliance reports. However, failure to comply with the ESMP implementation and timely submission of compliance reports may result in deductions from the Contractor's payments allocated for environmental and social components.

The compliance status of the ESMP will also be periodically submitted to SEPA for review, as mandated by their environmental approval requirements. Non-compliance may lead to the withdrawal of the environmental approval.

8.8.6 Review of Recorded Data

The SC and STDC will periodically review and examine all data and communications documented and maintained by the Contractor. Based on their assessment, appropriate actions and recommendations will be provided to the Contractor to enhance the quality of recording and documenting practices.

8.9 Contractor's Obligation & Management

The Contractor will bear primary responsibility for ensuring the effective implementation of the proposed mitigation measures outlined in the ESIA, including the Environmental and Social Management Plan (ESMP). The necessary details of the ESMP will be included in the bidding document and subsequently incorporated into the contract documents of the Contractor. The costs associated with environmental and social mitigation will be included in the overall project budget, and payments to the Contractor will be based on monthly compliance reports, actual work completed on-site, and resource allocation. Additionally, the Contractor will be accountable for developing and executing a site-specific ESMP, also known as the Contractor-ESMP, in accordance with the guidelines specified in the ESIA. Prior approval from the SC and STDC project team will be required for the Contractor's ESMP and all associated sub-plans. Furthermore, the Contractor will ensure the presence of an Environmental and Social (E&S) staff on-site from the project's commencement, and the proposed organizational structure will be subject to dual approval from the SC and STDC.

8.9.1 Table 8-1 (a): Environmental Management Plan for construction and operation of transmission line

Environmental Aspect	Impacts	Mitigation Measures	Responsibility
Designing Phase			
Land acquisition and resettlement	Resettlement is not required for the project	• ROW will be obtained from authorities prior to construction of Transmission Lines.	STDC
Birds	Chance of Collision of Birds with the conductor string	• All suspension poles shall have detachable bird protection devices, over each suspension insulator string. • All angle poles having jumper insulator strings will also be furnished with bird protection devices.	CC
Temporary Construction Camps	Deterioration of air & water quality, and social impacts	• Sanitation facilities in the camps, if provided, should be mobile & collect its wastewater or connected to the local sewerage system; • Water conservation practices shall be adopted.	CC
Contract clauses	Contractor may not perform the work in environmentally friendly manner	• The Construction/Waste Contractor is responsible for properly disposing of excavated earth, ensuring it is not dumped near open areas, stormwater drains, or residences, and must dispose of it at a designated landfill site. • A proper site rehabilitation plan shall be made by the contractor which includes the spoil / excavated earth disposal arrangements • Contractors shall also be made responsible through contract documents to follow Sindh Environmental Quality Standards (SEQS) and applicable standards during all the construction operations and ensure compliance of the same through periodic environmental monitoring reports. • Contractors shall be made responsible through contract documents to follow Standard Practices and Standard Operating Procedures (SOPs) to ensure health & safety of workers at the site and public during all construction operations. • As the work is usually completed by contractors and sub-contractors, STDC should monitor their works to ensure proper task completion.	STDC

Table 8-1 (a): Environmental Management Plan for construction and operation of transmission line

Environmental Aspect	Impacts	Mitigation Measures	Responsibility
Construction Phase			
Excavation, storage of soil and waste, generation of waste	Soil Erosion	• Construction activities should be scheduled to avoid runoff due to rain; • The dredged soil must be contained in an enclosure to reduce the chances of runoff during the seasons of precipitation; • Stock piles of fine material should be wetted or covered with tarpaulin especially during windy weather conditions; • Cut material should be used to level the site area or be disposed at designated spoil disposal sites; • Waste should only be directed to designated disposal areas; no disposal in waterways is allowed.	CC
Water Resources	Impact on Surface and ground water sources	• All excavated soil left after backfilling should be completely removed; • Debris and vegetation clogging pipelines, and drains should be regularly cleared; and • Soil runoff from the site leading to off-site contamination (particularly during rainy season) should not be allowed. • Spillage of oil and grease from the vehicles should be avoided.	CC
Fuel, Oil & Chemical handling, storage and disposal	Soil contamination	• Chemicals and oils should be stored in secure designated areas with temporary impermeable bunds; • Refueling, oil changing and engine maintenance of machinery, equipment and vehicles should be avoided at construction site; • Oil contaminated materials should be disposed at designated waste disposal facilities.	CC
Construction Waste Disposal	Unmanaged waste can be harmful for the environment	• A Comprehensive Waste Management Plan for Construction phase should be developed and implemented; • Construction sites should be equipped with temporary refuse bins, and construction wastes should be collected on a daily basis and contained in a temporary designated waste storage area on each site;	CC

Table 8-1 (a): Environmental Management Plan for construction and operation of transmission line

Environmental Aspect	Impacts	Mitigation Measures	Responsibility
		• Any hazardous waste should be separated and stored in areas clearly designated and labeled, and disposal through EPA certified waste contractor in environmentally friendly manner. • Non-hazardous waste should be routinely collected from the designated area(s) and disposed in an environmentally friendly manner or recycled or reused;	CC
Dust Emissions	Deterioration of local Air Quality	• Dust emissions from soil piles and aggregate storage stockpiles should be reduced by keeping the material wet by sprinkling water at appropriate frequency and erecting windshield walls on three sides of the piles; • Vehicular movement should be restricted to a specific time for dumping of supplies and construction materials; and • Workers should wear PPEs including dust masks and safety goggles, especially during dry and windy weather conditions to avoid health risk.	CC
Exhaust Emissions	Deterioration of local Air Quality	• All vehicles, generators and other equipment used during the construction will be properly tuned and maintained in good working condition in order to minimize emission of pollutants; • Emissions from the machinery and vehicles will be monitored on regular basis to ensure compliance of SEQS; • Excessive engine idling will be discouraged and machinery causing excessive pollution (i.e. visible clouds of smoke) will be banned from sites; • Standby generators for power supply will be kept away from pathways and will be placed at locations where probabilities of human intervention are limited; and • The stack height of the generators used will be at least 3 m above the ground as the generators are **below 1000 KVA Dg**	CC
Noise and Vibration	Construction activities are expected to produce noise (80 – 95 dB) and may cause discomfort to local residents	• Machinery operation and high noise activities should be carefully planned and scheduled; • Vehicles and machinery will be equipped with silencers. Contractors will be required to fit noise shields on high noise construction machinery;	

Table 8-1 (a): Environmental Management Plan for construction and operation of transmission line

Environmental Aspect	Impacts	Mitigation Measures	Responsibility
Noise and Vibration	Construction activities are expected to produce noise levels (80 – 95 dB) and may cause discomfort to local residents	• Site labor working in high noise area such as where noise level exceeds 80 dB (A), will wear earplugs; • The stationary sources of noise such as concrete mixers, batching plant, power generators and pumps will be selected and segregated from work areas and residents; and	CC
RoW Clearance	Impacts on Ecology (Flora and Fauna), clearing of crop land	• Restoration of damaged vegetation • Offer compensation to farmers for their crop land destruction • Avoid disrupting cropland by placing equipment and machinery on barren land.	CC
Safety Precautions for the Workers	The construction and civil works pose an inherent risk of injury to workers from accidents and hazardous working environment.	• Preventive and protective measures including modification, substitution, or elimination of hazardous conditions, with particular attention to live power lines, working at height, working above water, high noise levels, and exposure to chemicals will be made; • Measures for the management and appropriate disposal of hazardous wastes will be undertaken to ensure protection of the workforce and the prevention and control of releases and accidents; • Appropriate fire extinguishers and fire response plans will be available at the site; • Appropriately stocked first-aid equipment and stations at both work sites and temporary construction camps, including appropriately trained first aid staff on site and adequate transport facilities for moving injured persons to the nearest hospital will be available; • Training for workers and appropriate incentives to use and comply with health and safety procedures and PPE will be provided; • Procedures for documenting and reporting occupational accidents, diseases, and incidents; • Emergency prevention, preparedness, and response arrangements will be in place;	CC

Table 8-1 (a): Environmental Management Plan for construction and operation of transmission line

Environmental Aspect	Impacts	Mitigation Measures	Responsibility

		• There will be strict safety requirements for personnel assigned to construction work;
		• Workers will not be interacted with the local populace.
		• To maintain safe conditions for the general public, construction camps will be fenced and gated; and
		• To protect workers from heat stress
		  • Move to a cool place e.g., cool shady area;
		  • Provide plenty of drinking water;
		  • Break the working in shifts	

Traffic Movement near construction site	Traffic flow in the locality of project will slightly increase during construction activities of the project. The traffic flow can deteriorate the quality of Air in the project location and cause air pollution.	• Traffic management plan will be developed and implemented during the construction phase; • The movement of equipment (trucks) during the construction of the proposed project will be limited to daytime; • Raw materials for construction work will be adequately covered within the trucks to prevent any escaping into the air and along the roadway; • Vehicles will be maintained regularly to reduce the exhaust emissions; and	CC

Social Impacts	Community health & safety issues	• Procedures for interaction with local and regional emergency and health authorities should be made; • Erection of towers and poles for the overhead TLs should be barricaded and crane movement should be assessed prior to the operation near the communities; • Proper lighting at night near trenches will be ensured; and diversions, danger points and works at culverts, bridges and construction sites will have appropriate warning signs; this is particularly important at night to avoid accidents. • Complaints register will be maintained.	CC

Table 8-1 (a): Environmental Management Plan for construction and operation of transmission line

Environmental Aspect	Impacts	Mitigation Measures	Responsibility
Impact on Flora and Fauna	Vegetation removal is minimal.	• Implement the best practice for vegetation clearing and disposal practices to minimize the environmental risk associated with clearing and disturbance of vegetation communities.	CC
Operational and Maintenance Phase			
Wind, fire and earthquakes	Electricity arcing poles and towers dislodgment	• Transmission towers have been designed as per relevant national building codes which include earthquake resistance and loading requirements related to wind conditions. • Transmission support structures such as tower foundations have also been designed to withstand different combinations of loading conditions including extreme winds that generally exceed earthquake loads • System protection features designed to safeguard the public and line protection systems will consist of Transmission Line relays and circuit breakers that are designed to rapidly detect faults and cut-off power to avoid shocks and fire hazards. • Electricity arcing from power lines can be a fire hazard. To mitigate against fire hazards: ○ The fire hazards risk will be minimized through the use of tall towers and wide ROW. ○ System protection features designed to safeguard the public and line protection systems will consist of Transmission Line relays and circuit breakers that are designed to rapidly detect faults and cut-off power to avoid shocks and fire hazards. ○ Regular maintenance of the protection system including conductors and circuit breakers will be undertaken.	STDC

Electromagnetic Interference	Corona from overhead conductors and high-frequency currents can interfere with broadcast signals and electronics.	• Standard design guidelines have been adopted to limit the conductor surface gradients so as to minimize electronic interference.	STDC
Gaseous Emissions	Air pollution	• All vehicles, power generators and other equipment used during the maintenance work will be properly tuned and maintained in good working conditions in order to minimize emission of pollutants	STDC

Table 8-1 (a): Environmental Management Plan for construction and operation of transmission line

Environmental Aspect	Impacts	Mitigation Measures	Responsibility
Electrocution hazard	High voltage transmission lines may pose electrocution hazard for unauthorized person(s) attempting to climb the tower(s).	• Each tower shall be fitted with an anti-climbing device to prevent unauthorized persons from climbing the tower. The anti-climbing device shall be the ACD spiked type barbed wire or other approved type, and shall be fixed at a height not less than 3 meters above ground. • Reduction in the Resistance to Ground of the grounding system • Proper placement of ground conductors	STDC
GHG Emissions	Fossil fuel-based plants contribute significantly to greenhouse gas emissions, potentially exacerbating climate change	• Switch to low-emission fuels (e.g., natural gas or biomass) or invest in carbon capture and storage (CCS) technologies to minimize greenhouse gas emissions. • Install electrostatic precipitators or fabric filters to capture particulate matter and prevent air pollution	STDC

Solid Waste	The maintenance activities may generate some hazardous and non-hazardous waste such as wires and wild vegetation etc.	• A Waste Management Plan for this phase should be developed separately; • Ensure that all solid waste generated during operational or maintenance work is collected and segregated • non-hazardous waste should be disposed of in an approved disposal site or recycled or reused. • Any hazardous waste should be separated and stored in areas clearly designated and labeled, and disposal in environmentally friendly manner through EPA certified waste contractor.	STDC
Impacts on birds	Displacement or death of birds	• Creating buffer zones around critical wetland areas to reduce the disturbance from human activities and infrastructure. • Regular monitoring of bird populations and the surrounding environment to assess the effects of the power project and adjust management strategies accordingly. • Implementing measures to reduce light pollution in the area, such as using low-impact lighting and shielding light sources. • Install bird replant devices on each cross arm over insulator strings. The bird-repellent devices shall be spiking type galvanized and fitted with bolts and nuts.	STDC

Notes STDC= Sindh Transmission and Dispatch company; CC = Construction Contractor; SEQS = Sindh Environmental Quality Standards; PM = Particulate Matter, TL = Transmission Line

Table 8.1(b): Environmental Management Plan for construction and operation of Grid station

Environmental Aspect	Impacts	Mitigation Measures	Responsibility
Designing Phase			
Social Impacts	Land acquisition & resettlement	• Land acquisition shall be achieved as per the national rules.	CC
Waste disposal	Inadequate disposal of all wastes including transformer oil, residual contaminated soils, empty paint bucket and scrap metal.	• Create waste management policy and plan to identify sufficient locations for and storage of waste generated from construction camps and disposal of residual contaminated soils and scrap metal; and • Designate disposal sites in the contract and cost unit disposal rates accordingly.	CC
Contract clauses	Contractor may decline to work in an environmentally friendly manner	• Include provisions of this EMP in tender documentation and make contractors liable to implement mitigation measures by reference to IEE in contract;	STDC

		• Require environmental accident checklist and a list of controlled chemicals / substances to be included in the contractor's work method statement and tender documentation.	
Seismic Hazards	Project Area lies in Zone 2A where minor to moderate damage can occur due to earth quakes.	• An earthquake proof design will be developed so that little or no intensification of the basic accelerations associated with the frequency spectrum of the seismic disturbance is encountered.	CC
Construction Phase			
Social Impacts	Community health & safety issues	• In order to minimize traffic congestion (if applicable), deliveries of materials and equipment will avoid peak traffic hours; • Dust emission from soil piles and aggregate storage stockpiles shall be reduced by keeping the material wet by sprinkling of water at appropriate frequency; • Vehicular movement shall be restricted to a specific time for dumping of supplies and construction material. • Complaints register will be maintained.	CC
Water Resources	Water is used in numerous construction activities such as concreting, curing, plastering, domestic etc. Water required for such activities is being met from external sources such as water tankers supplying water to the construction site	• Regular monitoring of water consumption and quality; • Use of leak proof water storage tanks; and	CC
Air quality	Deterioration of Air Quality	• All vehicles, generators and other equipment used during the construction will be properly tuned and maintained in good working condition in order to minimize emission of pollutants; • Emissions from the machinery and vehicles will be monitored on regular basis to ensure compliance to SEQS; • Standby generators for power supply will be kept away from pathways and will be placed at locations where probabilities of human intervention are limited; and • The stack height of the generators used will be at least 3 m above the ground.	CC
Noise and Vibration	Construction activities are expected to produce noise levels in the range of 80 – 95	• As far as possible, those machinery and equipment would be selected that create less noise and vibration;	CC

	dB and may cause discomfort to workers and local fauna	• Vehicles and machinery will be equipped with silencers. Contractors will be required to fit noise shields on high noise construction machinery; • Site labor working in high noise area such as where noise level exceeds 80 dB (A), will wear earplugs; • Occupational health, safety and environmental procedures and Environmental management plan for proposed project will be followed.	
Construction Waste Disposal	This waste has the potential to cause negative impact on the surroundings if not properly managed and disposed of.	• A Comprehensive Waste Management Plan for Construction phase will be developed and implemented; • Construction sites will be equipped with temporary refuse bins, and construction wastes will be collected on a daily basis and contained in a temporary designated waste storage area on each site; • Designated waste storage areas will not be within 50 m of water ways; • Any hazardous waste will be separated and stored in areas clearly designated and labeled, and disposed in environmentally friendly manner through EPA certified contractor • Non-hazardous Wastes will be routinely collected from the designated area and disposed in an environmentally friendly manner or recycled or reused; and • Upon completion of activities at a construction site all solid wastes will be completely removed and the site will be re-contoured or prepared for natural revegetation.	CC
Safety Precautions for the Workers	The construction and civil works pose an inherent risk of injury to workers from accidents and hazardous working environments.	• Preventive and protective measures including elimination, substitution, or modification of hazardous conditions, with particular attention to live power lines, working at height, EMFs, high noise levels, and exposure to chemicals will be made; • Measures for the management and appropriate disposal of hazardous wastes will be undertaken to ensure protection of the workforce and the prevention and control of releases and accidents; • Appropriate fire extinguishers and fire response plans will be available at the site; • Appropriately stocked first-aid equipment and stations at both work sites and temporary construction camps, including appropriately trained first-aid staff on site and adequate transport facilities for moving injured persons to the nearest hospital shall be available; • Training for workers and appropriate incentives to use and comply with health and safety procedures and PPEs will be provided; • Procedures for documenting and reporting occupational accidents, diseases, and incidents;	CC

		• Emergency prevention, preparedness, and response arrangements will be in place; • There will be strict safety requirements for personnel assigned to construction work; • Workers will not be interacted with the local populace. • To maintain safe conditions for the general public, all substations will be fenced and gated; and, • Appropriate signage will be posted that shows the owner of the grid station, the hazardous nature of the substation and contact information.	
Traffic Movement near construction site	Traffic flow in the locality of project will slightly increase during construction activities of the project. This increase in traffic may cause some accidental injuries and deteriorate the air quality of ambient air.	• Traffic management plan will be developed and implemented during the construction phase; • Adequate and appropriate road signs will be erected to warn road users along the ROW of transmission line; • The movement of equipment (trucks) during the construction of the proposed project will be limited to daytime; • Raw materials for construction work will be adequately covered within the trucks to prevent any escaping into the air and along the roadway; • Vehicles will be maintained regularly to reduce the exhaust emissions; and • Any complaint launched by community member will be responded and appropriate action will be taken to avoid it in future.	CC
Impact on Flora and Fauna	Destruction of habitat due to land levelling & vegetation removal. Onsite vegetation clearance will be required only within the boundaries of proposed grid station. Therefore, the impact on ecology of area from construction activities is minimal.	• Implement the best practice for vegetation clearing and disposal practices to minimize the environmental risk associated with clearing and disturbance of vegetation communities. • Compensatory plantation shall be provided at a ratio of 1:10 for the removed trees (Sindh Forest Department) • Selection of plants for landscaping should consider the habitat suitability, trees of national interest, flowering trees and shrubs;	CC
Operational and Maintenance Phase			
Transformer Oils & Fuel Spills	Pollution of soil	• Chemicals and oils will be stored in secure designated areas with permanent impermeable layer; • Transformer oil will be supplied in drums from an imported source and tap tanks will be topped up as necessary at the above noted secure designated areas;	CC

		• A reservoir may be constructed below transformer for oil containment and spill control in case of leakage or outflow of oil due to severe internal fault. Bunds may also be constructed in transformer area for further protection. • Contaminated residues and waste oily residues will be disposed at an appropriate site approved by the relevant local environmental authority.	
Human Exposure to Electromagnetic Fields (EMF)	Adverse health effects	• Principles of careful avoidance will be adopted to ensure exposure levels are well below the generally accepted standards;	CC
Electrocution	Direct contact with high-voltage electricity or from contact with tools, vehicles, ladders, or other devices.	• The addition of resistive surface layer • Use of insulating protective equipment inside safety boots or standard class safety shoes to provide protection against electrocution, during wet season. • Keep extra safety margin from live part during wet season. • There should be strict safety requirements for personnel assigned to work in substation. • To maintain safe conditions for the plant workers, substation should be fenced. • A grounding (earthing) system must be designed. The total ground potential rise, and the gradients in potential during a fault (called touch and step potentials) must be calculated to protect passers-by during short-circuit. Where the substation has a metallic fence, it should be properly grounded to protect the workers from this hazard.	CC
Fire and Earthquake	Risk of Fire and Earthquake	• Maintenance and monitoring of electrical equipment will be done to prevent faults; • Arrangement will be done to prevent the flying Bats and birds to come into contact with the Grid Station; • Fire extinguishing arrangements will be ensured; • Designing of structures will be made earthquake resistant; and • Emergency response plans will be developed.	CC
Noise	Noise Pollution	• Vehicles and other maintenance equipment will comply with SEQS and other international standards for noise and are maintained to meet standards; • If possible, all noise generating equipment will be locked up by acoustic barrier to minimize the extent of impact area; • All operational or maintenance staff will wear mufflers/earplugs while operating or working near high noise sources; and • Back-up power generators will be maintained regularly.	CC

Solid Waste	The operation and maintenance activities of proposed project may generate some hazardous and non- hazardous waste such as wires, metal scrap etc. which if not disposed of properly could have adverse impacts on the environment.	• All solid waste collected during operational or maintenance work will be disposed of in an appropriate disposal site in the locality. • A Waste Management Plan for operation phase should be developed; • Grid station site should be equipped with temporary refuse bins, and waste should be collected on a daily basis and contained in a designated waste storage area; • Any hazardous waste should be separated and stored in areas clearly designated and labeled, and disposal in environmentally friendly manner through EPA certified contractor. • Non-hazardous waste should be routinely collected from the designated areas and disposed at designated waste disposal site or recycled or reused.	CC
Notes: SEQS = Sindh Environmental Quality Standards; PM = Particulate Matter			

8.9.2 Table 8.1 (c): Environmental Management Plan for construction and operation of staff colony

Environmental Aspect	Impact	Mitigation Measures	Responsibility
Construction Phase			
Air Quality	Exhaust emissions from the operation of generators, construction machinery and transportation vehicles. Dust emissions due to movement of heavy vehicles.	• Smoke releasing machinery will not be allowed • Regular water sprinkling will be ensured to suppress dust • For better dispersal of air emissions, high exhaust pipes will be used in generators • Emission level of generators will be monitored • Movement of vehicles will be allowed on specific routes only. • Truck loads should be covered with tarpaulin. • Construction site, including soil and material piles at the site, should be adequately barricaded to avoid material escape, generation of dust. • Ready-mix can be used in the stages of the project wherever and whenever required and deemed appropriate. • Standby generators for power supply will be kept away from pathways and will be placed at locations where probabilities of human intervention are limited.	CC

Excavation, storage of soil and waste, generation of waste	check lifting of waste material, check waste management plan	• A Comprehensive Waste Management Plan for Construction phase should be developed; • Construction sites should be equipped with temporary refuse bins, and construction wastes should be collected on a daily basis and contained in a temporary designated waste storage area on each site; • Any hazardous waste should be separated and stored in areas clearly designated and labeled, and disposal in environmentally friendly manner; • All type of wastes should be routinely collected from the designated area and disposed at designated waste disposal site(s); and • Upon completion of activities at a construction site all solid wastes should be completely removed and the site should be re-contoured or prepared for natural re-vegetation	CC
Fuel (diesel) storage and disposal	Inappropriate handling, storage and disposal of fuels, oils and chemicals at construction sites may lead to contamination of soil.	• Chemicals and oils should be stored in secure designated areas with temporary impermeable bunds at distance of at least 100 m from any water course; • Refueling, oil changing and maintenance of machinery, equipment and vehicles should only be carried out at designated areas within the construction site; • Oil contaminated materials should be disposed at designated waste disposal facilities.	CC

Table 8.1 (c): Environmental Management Plan for construction and operation of staff colony

Environmental Aspect	**Impact**	**Mitigation Measures**	**Responsibility**
Construction Phase			

Construction Waste Disposal	Domestic waste, Hazardous waste – Chemical waste	• All hazardous wastes should be disposed of according to local regulations, ideally by certified waste management contractors. • Spill prevention measures (e.g., secondary containment for fuel storage) should be implemented. • Develop and implement a soil management plan that includes strategies for stockpiling and reusing topsoil, reducing compaction, and restoring soil health post-construction • Once construction activities are completed, the site should be revegetated with native plants to help restore soil structure, prevent erosion, and enhance biodiversity.	CC
Seismic Impact	The Project Area is in Seismic Zone 2A (2A=upper limit of moderate damage). A low to moderate intensity earthquake impacting the Project site can have adverse impacts	The proposed project and the associated structures should be designed and constructed as per Seismic Building Code of Pakistan 2007 (SBC-07) to comply with minimum requirements for seismic safety of structures.	CC
Noise and Vibration	Noise Intensity (dB) at the project site as generators and machinery used during construction will create loud noises	• Machinery operation and high noise activities should be carefully planned and scheduled; • To the extent practical, batching plants and construction areas should not be located within 500 meters of a settlement; • Where that is not possible, high noise activities should cease between 22:00 and 06:00 hrs (Night time hours given in SEQS for Noise) at any construction site within 500 meters of a settlement, or if noise complaints are received from settlement residents. • Vehicles and machinery will be equipped with silencers. Contractors will be required to fit noise shields on high noise construction machinery;	CC

Table 8.1 (c): Environmental Management Plan for construction and operation of staff colony

Environmental Aspect	**Impact**	**Mitigation Measures**	**Responsibility**
Construction Phase			
		• Site labor working in high noise area such as where noise level exceeds 80 dB (A), will wear earplugs; • Occupational health, safety and environmental procedures and Environmental	

		management plan for proposed project would be followed. Vibration monitoring will be carried out during construction phase by the contractor near the settlements as well as all the sensitive receptors in the AOI.	
Safety Precautions for the Workers	Accidents, PPE, Annoyance, Fire Hazards, Safety Protocols, Spill on Land and Spill on Water	• Provide and enforce the use of appropriate PPE (hard hats, safety boots, gloves, goggles, high-visibility vests, ear protection, etc.). • Install guardrails, safety nets, and personal fall arrest systems for workers working at heights. • Ensure scaffolding is properly erected, maintained, and inspected regularly. • Use cranes, hoists, and forklifts that are inspected and operated by certified personnel for material handling. • Limit site access to authorized personnel, especially in high-risk areas (e.g., crane zones). • Use clear safety signage for hazards like falling objects, electrical risks, and restricted areas. • Offer regular safety training and site inductions for all workers, including emergency response protocols. • Maintain on-site first aid kits and ensure the presence of trained first aid personnel.	CC
Water consumption and conservation	Water is used in numerous construction activities such as concreting, curing, plastering, domestic etc.	• Regular monitoring of water consumption, conservation and quality; • Use of leak proof water storage tanks;	CC
Table 8-1 (c): Environmental Monitoring Plan for construction and operation of staff colony			
Environmental Aspect	**Impact**	**Mitigation Measures**	**Responsibility**
Construction Phase			
Soil erosion/ dust	Excavation carried out during foundation work of the infrastructure would generate heaps of soil which may result in soil erosion.	• Debris should be collected during construction and disposed of in low lying areas near the site; • Cut material should be used to level the site area where required or be disposed at designated spoil disposal sites; • Chemicals and oils should be stored in secure designated areas with temporary impermeable bunds at distance of at least 100 m from any water course;	CC

		• Refueling, oil changing and maintenance of machinery, equipment and vehicles should only be carried out at designated areas within the construction site; • Oil contaminated materials should be disposed at designated waste disposal facilities.	
Impact on Traffic Flow	Traffic flow in the locality of project slightly increases during construction activities. However, as the project area is not frequented by heavy and light traffic, adverse impact of general traffic conditions in area would be minimal.	• Traffic management plan will be developed and implemented during the construction phase; • Construction activities will be scheduled to reduce the chances of traffic congestion; • Adequate and appropriate road signs will be erected to warn road users along the ROW of transmission line; • Raw materials for construction work will be adequately covered within the trucks to prevent any escaping into the air and along the roadway; • Vehicles will be maintained regularly to reduce the exhaust emissions; and • Any complain launched by community member will be responded and appropriate action will be taken to avoid it in future.	CC
Effluent management/ discharge of waste water	Wastewater generated during construction phase can affect nearby if not discharged properly	• Ensure untreated water is not discharged directly into the environment	CC
Community Health and Safety	The construction of transmission line may pose a modest risk to local communities from emergency events such as entry of local people in dangerous working environment i.e., close to transmission line infrastructure.	• Emergency response plan should be prepared and implemented during entire phase of construction; • In order to minimize traffic congestion (if applicable), deliveries of materials and equipment should avoid peak traffic hours; • Diversions, hazard points and works at construction sites will have appropriate warning signs; this is particularly important at night to avoid accidents.	CC
Electrocution hazards	Generators if operating under wet environment can cause electrocution hazard	• Use of insulating protective equipment inside safety boots or standard class safety shoes to provide protection against electrocution, during wet season. • Keep extra safety margin from live part during wet season.	CC
Operational phase			

Waste water discharge	The staff colony will produce sewage (from toilets) and greywater (from kitchens, sinks, and showers). If not treated and disposed of properly, this could lead to contamination of soil or nearby water sources (e.g., Keenjhar Lake).	• Install septic tanks as septic tanks collect sewage and allow solids to settle while the liquid effluent is filtered through soil preventing the overflow of waste and contamination of nearby water bodies.	CC
Disposal of solid waste	The staff colony will produce domestic waste, including organic waste, plastics, metals, glass, and other household garbage.	• Implement a waste segregation system at the staff colony to ensure that recyclable materials (e.g., plastics, metals, paper) are separated from non-recyclable waste (e.g., organic waste). • Establish waste storage facilities and ensure regular collection and transport of waste to a licensed disposal site. • Encourage the use of biodegradable products in the staff colony to reduce plastic waste.	CC
Wind, Fire and Earthquake Hazards	Wind, fire and earthquakes pose risks to the project operation and the likelihood of occurrence consider medium with significance of impact is major.	• Transmission towers have been designed as per relevant national building codes which include earthquake resistance and loading requirements related to wind conditions. • Transmission support structures such as tower foundations have also been designed to withstand different combinations of loading conditions including extreme winds that generally exceed earthquake loads. • The fire hazards risk will be minimized through the use of tall towers and wide ROW. • System protection features designed to safeguard the public and line protection systems will consist of Transmission Line relays and circuit breakers that are designed to rapidly detect faults and cut-off power to avoid shocks and fire hazards. • Regular maintenance of the protection system including conductors and circuit breakers should be undertaken.	CC
Flood risk	Jhimpir II grid station is situated in a low-risk flood zone, indicating that it is less likely to be affected by flood-related issues	• Use flood-resistant materials and construction techniques for buildings to withstand flood events. • Develop water retention or detention ponds to manage excess rainwater and reduce the flow of water into the project area. • Enhance the local drainage system to efficiently manage and redirect excess water away from the power supply infrastructure.	CC

		• Install flood forecasting and monitoring systems to provide early warnings, enabling timely action to safeguard infrastructure. • Develop and implement flood emergency response plans for rapid evacuation of personnel and securing equipment if needed.	
Visual Impacts	Introduction of residential buildings in an undeveloped area can lead to visual impacts on the project site	• Plantation around the area can restore natural aesthetics of the project site.	CC

8.9.3 Table 8-2 (a): Environmental Monitoring Plan for construction and operation of transmission line

Environmental Aspect	Monitoring Parameters	Monitoring Location	Monitoring Frequency	Responsibility
Construction Phase				
Air Quality	Priority parameters (as per SEQS)	Near Construction sites/camps	Monthly	CC
Excavation, storage of soil and waste, generation of waste	Check any obstruction in existing drains due to construction, check lifting of waste material, check waste management plan	At construction site	Monthly	CC
Fuel, Oil & Chemical handling, storage and disposal	Check contamination on the ground, check waste disposal	Vehicles/ machinery in working areas	Monthly	CC
Construction Waste Disposal	Domestic waste, Hazardous waste – Chemical waste, electro waste, Paper and Polythene material waste and Wood	Collection, handling, storage areas and disposal	Monthly	CC
Exhaust Emissions	Parameters as per SEQS	Construction vehicles	Monthly	CC
Noise and Vibration	Noise Intensity (dB)	Near Construction site	Monthly	CC

Drinking water	Priority parameters	Water coolers	Monthly	CC
ROW Clearance	Check tree cutting, compensatory plantation, inventory of cleared trees / plants	At construction alignment	Monthly	CC
Safety Precautions for the Workers	Accidents, PPE, Annoyance, Fire Hazards, Safety Protocols, Spill on Land and Spill on Water	All construction areas	Monthly	CC
Birds monitoring	Birds Population dynamics, displacement and death of birds	Around Keenjhar Lake and project site	Monthly	CC
Traffic Movement near construction site	Traffic flow, timing of activities, near misses and injuries records and reporting	At crossroads and along transmission line Right of Way	Monthly	CC

Table 8-2 (a): Environmental Monitoring Plan for construction and operation of transmission line

Project Aspect	**Monitoring Parameters**	**Monitoring Location**	**Monitoring Frequency**	**Responsibility**
Social Impacts	Review of complaint register Local Consultations	Near Construction site	Monthly	CC
	Surface topography, Proper backfilling and carpeting	All excavated areas	Continuous monitoring	CC
Operational and Maintenance phase				
Human Exposure to Electromagnetic Fields (EMF)	EMF value	Transmission line Corridor	Annually & record is maintained	STDC

8.9.4 Table 8.2(b): Environmental Monitoring Plan for Grid Station

Monitoring Areas	Monitoring Parameter	Monitoring Locations	Monitoring Frequency	Responsibility
Construction Phase				
Air Quality	Priority parameters (as per SEQS)	Construction sites/camps	Monthly	CC
Wastewater	Priority parameters (as per SEQS)	Outlet of the wastewater discharge	Monthly	CC
Soil	Soil contamination (Oil & Grease)	All construction areas	Monthly	CC
Water Consumption	Liters	Construction sites/camps	Monthly	CC
Solid Waste	Domestic waste, Hazardous waste –Chemical waste, electro waste, Paper and Polythene material waste and Wood	Segregation & Collection, handling, storage areas and disposal	Monthly	CC
Health & Safety of Workers	Accidents, PPEs, Annoyance, Fire Hazards, Safety Protocols, Spill on Land	All construction areas	Monthly	CC
Noise Quality	Noise Intensity (dB)	All construction areas	Monthly	CC
Operational and Maintenance Phase				
Electromagnetic Field (EMF)	EMF value	Grid Station	Annually & record is maintained	PD

8.9.5 Table 8.2 (c): Environmental Monitoring Plan for construction and operation of staff colony

Environmental Aspect	Monitoring Parameters	Monitoring Location	Monitoring Frequency	Responsibility
Construction Phase				
Air Quality	Exhaust emissions from the operation of generators, construction machinery and transportation vehicles. Dust emissions due to movement of heavy vehicles.	Near Construction sites (staff colony)	Monthly	CC
Excavation, storage of soil and waste, generation of waste	check lifting of waste material, check waste management plan	At construction site	Monthly	CC
Fuel (diesel) storage and disposal	Check contamination on the ground	Vehicles, machinery and generators in working areas	Monthly	CC
Construction Waste Disposal	Domestic waste, Hazardous waste – Chemical waste, Paper and Polythene material waste and Wood	Collection, handling, storage areas and disposal	Monthly	CC
Exhaust Emissions	Parameters as per SEQS	Construction vehicles	Monthly	CC
Noise and Vibration	Noise Intensity (dB) at the project site as generators and machinery used during construction will create loud noises	Near Construction site	Monthly	CC
Drinking water	Priority parameters	Water coolers	Monthly	CC
ROW Clearance	Check tree cutting, compensatory plantation, inventory of cleared trees / plants	At construction site	Monthly	CC
Safety Precautions for the Workers	Accidents, PPE, Annoyance, Fire Hazards, Safety Protocols, Spill on Land and Spill on Water	All construction areas	Monthly	CC

Water consumption and demand	Water required for numerous construction activities will be fulfilled from tankers. Usage of bad quality water may lead to poor construction.	At project site	Monthly	CC
Traffic Movement near construction site	Traffic flow, timing of activities, near misses and injuries records and reporting	At construction site	Monthly	CC

Table 8-2 (c): Environmental Monitoring Plan for construction and operation of staff colony

Environmental Aspect	**Monitoring Parameters**	**Monitoring Location**	**Monitoring Frequency**	**Responsibility**
Construction Phase				
Weather conditions	Weather parameter which includes temperature, humidity and wind are important parameters and their variation can have impact on construction and workers heath.	During construction phase	Continuous monitoring	CC
Soil erosion/ dust	Excavation carried out during foundation work of the infrastructure would generate heaps of soil which may result in soil erosion.	At construction site (staff colony)	Monthly	CC
Effluent management/ discharge of waste water	Proper effluent discharge and disposal	At project site	Monthly	CC
Social Impacts	Review of complaint register Local Consultations	Near Construction site	Monthly	CC
	Surface topography, Proper backfilling and carpeting	All excavated areas	Monthly	CC
Electrocution hazards	Generators are placed under a shed and are not wet while operating	At project site	Continuous monitoring	CC

Operational phase				
Waste water discharge	Wastewater discharged from the project will be domestic in nature and unsafe disposal of wastewater may also contaminate the surrounding water body (Keenjhar Lake)	At staff colony	Monthly	CC

Table 8-2 (c): Environmental Monitoring Plan for construction and operation of staff colony

Environmental Aspect	**Monitoring Parameters**	**Monitoring Location**	**Monitoring Frequency**	**Responsibility**
Operation Phase				
Disposal of solid waste	Solid waste segregation and management, proper dumping/ disposal of waste	At staff colony	Monthly	CC
Consumption of resources	Monitoring the water quality, quality of pipelines, gas cylinder to prevent leakages which can harm the staff and the environment	At project site	Monthly	CC
Fire hazards	Fire-fighting equipment inspection and refilling record of portable extinguishers	At project site	Continuous monitoring	CC

Table 8-3: Environmental Training Plan

Staff	Responsibilities	Areas	Schedule
Project staff	Contractor/HSE Officer	• Findings of ESIA • Mitigation Measures • EMP • Waste disposal procedures • Camp Operation • Social and Cultural values of the Project areas • Environmental sensitivity of the Project area • Flora and Fauna of the area • Emergency Response Plan • Community Issues	Prior to the starting of Project activities
Drivers	Contractor/HSE Officer	• Road safety • Road restrictions • Defensive driving	Before and during construction activities
Camp/Site Staff	Safety Officer	• Waste Disposal • Housekeeping	Before and during construction activities

9 Conclusion

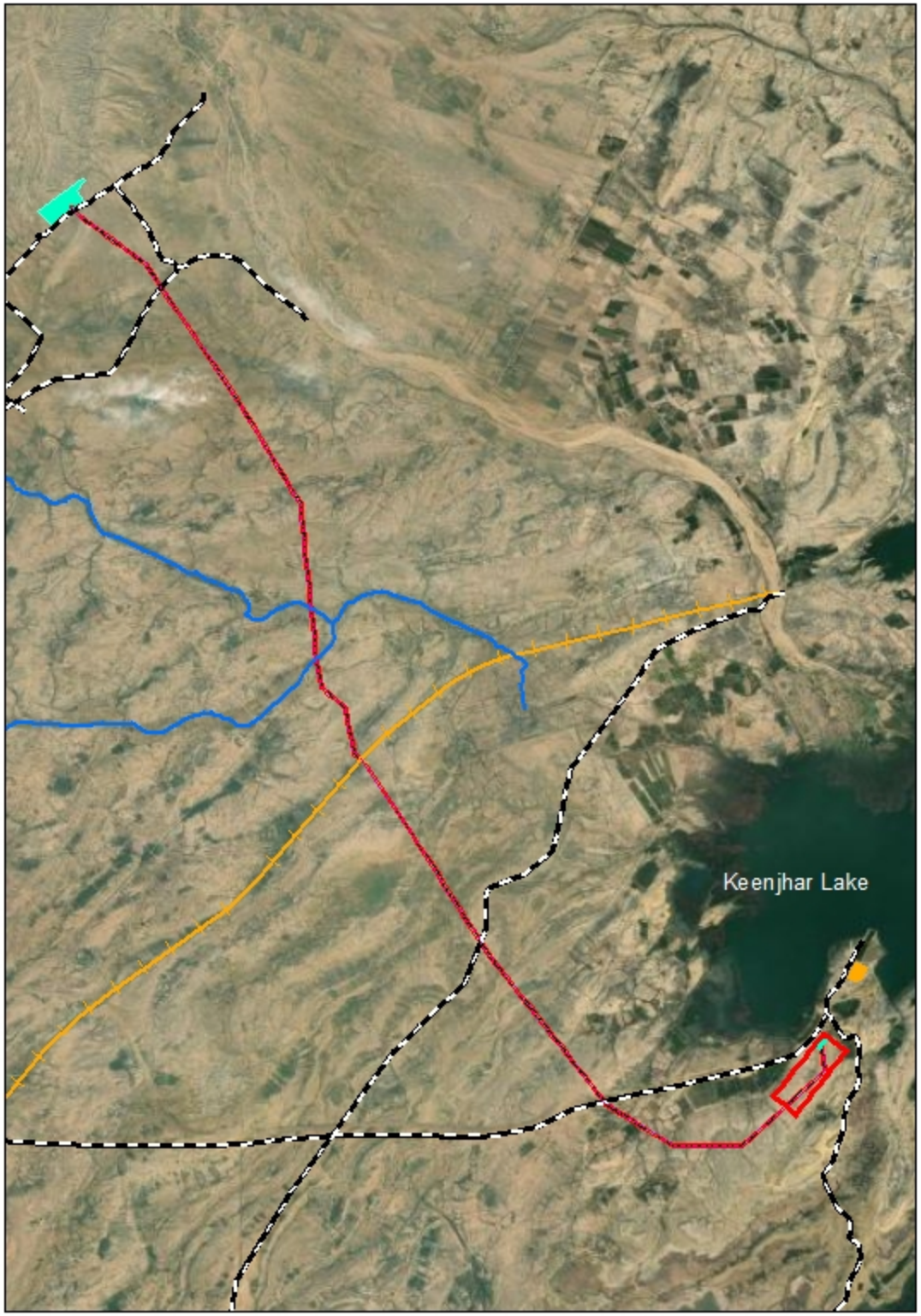
The ESIA study for proposed project has identified potential impacts that are likely to arise during construction and operational phases of the project. Potential environmental impacts are associated with air quality, solid waste, Wastewater, water quality, soil quality, terrestrial ecology, health and safety, as well as socio-economic impacts. The project is expected to bring a positive change in the socioeconomic setup of the area through short to medium term employment creation and providing power to the K-IV project.

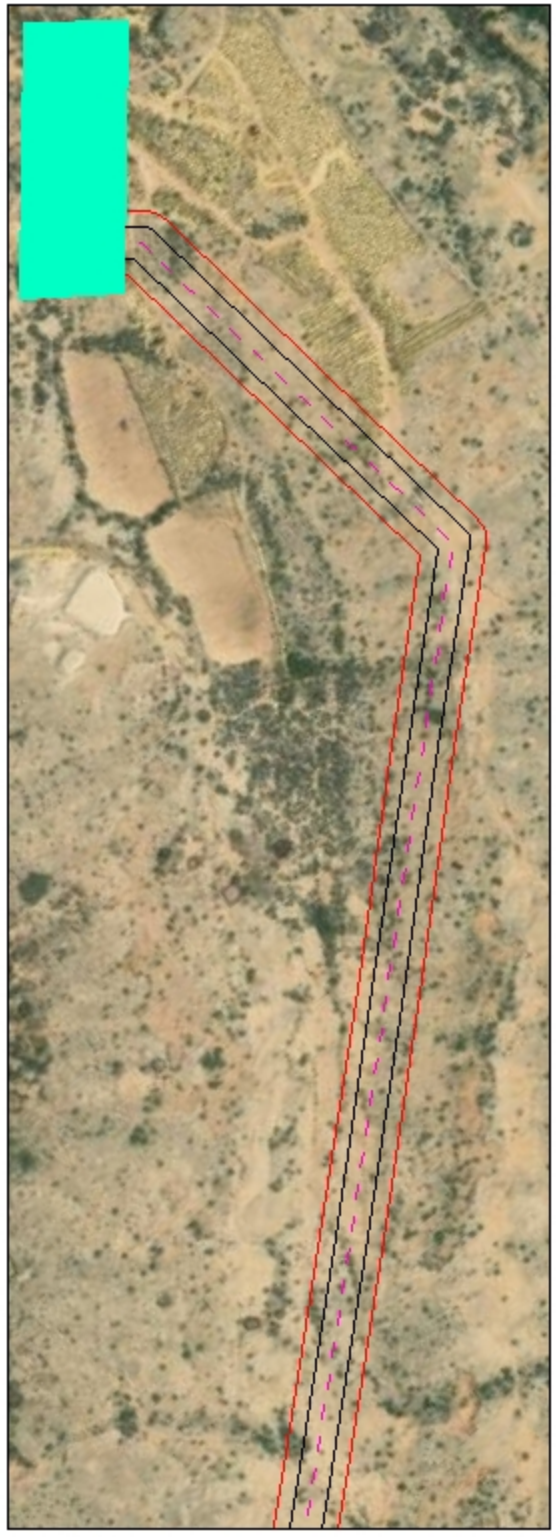
Potential Project impacts have been identified related to the project construction and operation phases. Impact predictions are based on the consultants' previous experiences on similar projects; professional judgment; data collected in the field; discussions with local communities, relevant government officials and relevant technical specialists. Many of the mitigation measures are related to good design practices, others with good construction and housekeeping practices.

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

The implementation of the mitigation measures detailed in the Environmental & Social Impact Assessment report and listed in the Environmental & Social Management Plan (EMP) of the ESIA Report, including monitoring, will provide a basis for ensuring that the potential positive and negative impacts associated with the establishment of the development are enhanced and mitigated to a level which is deemed adequate for the development to proceed.

Annex I - Detailed Land Use Maps





Legend

- Grid Stations
- Staff Colony
- T L (Transmission Line)
- COI 100feet
- Row 50feet
- Roads
- Railway Track

N E S W

0 20 40 80 Km

Location Map
01 of 17

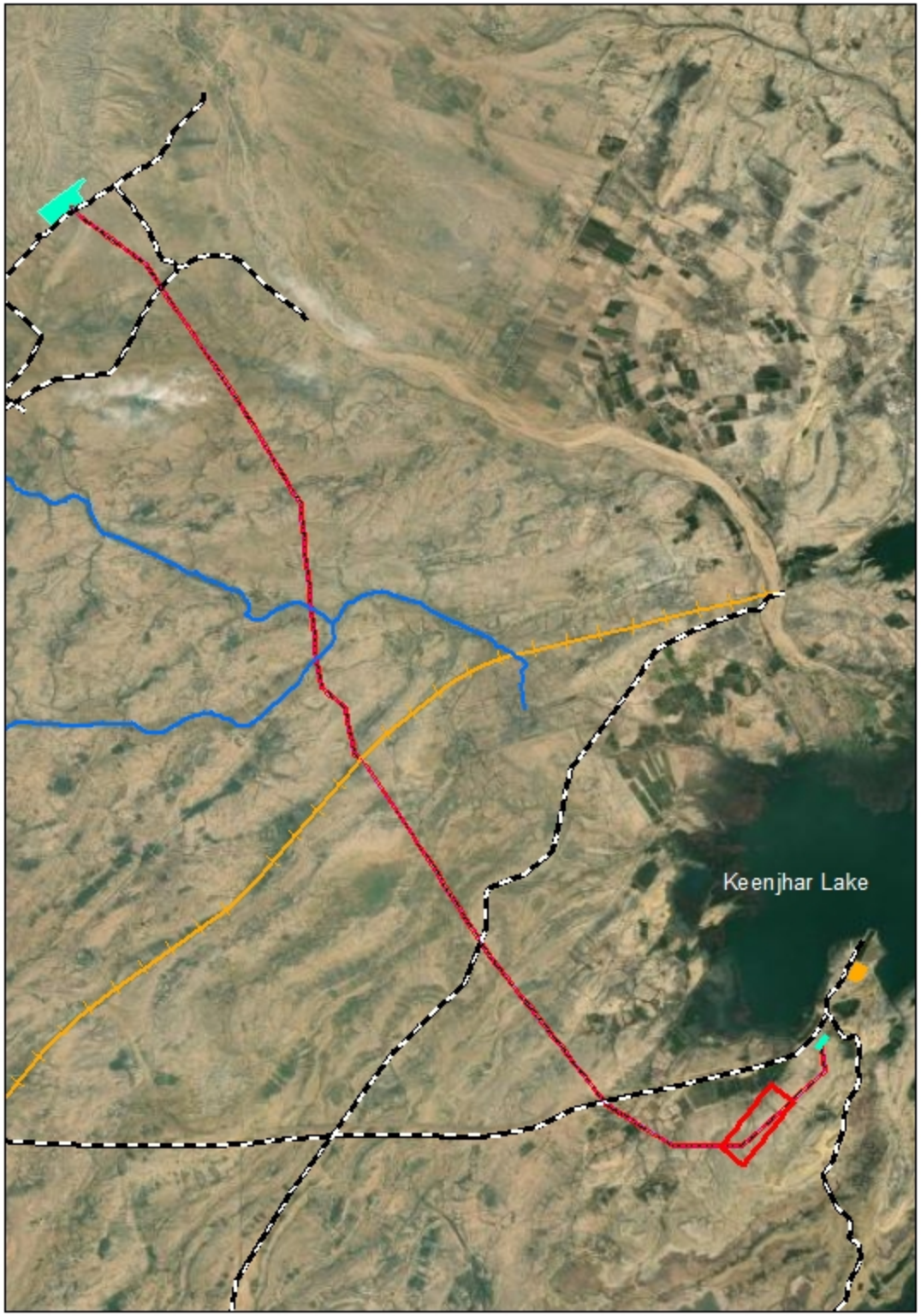
ESIA
Construction of Grid & Transmission Line for K-IV Power Component

Consultant

Client

Prepared by: Shahab Uddin

Approved by: M.Omar Arif Syed



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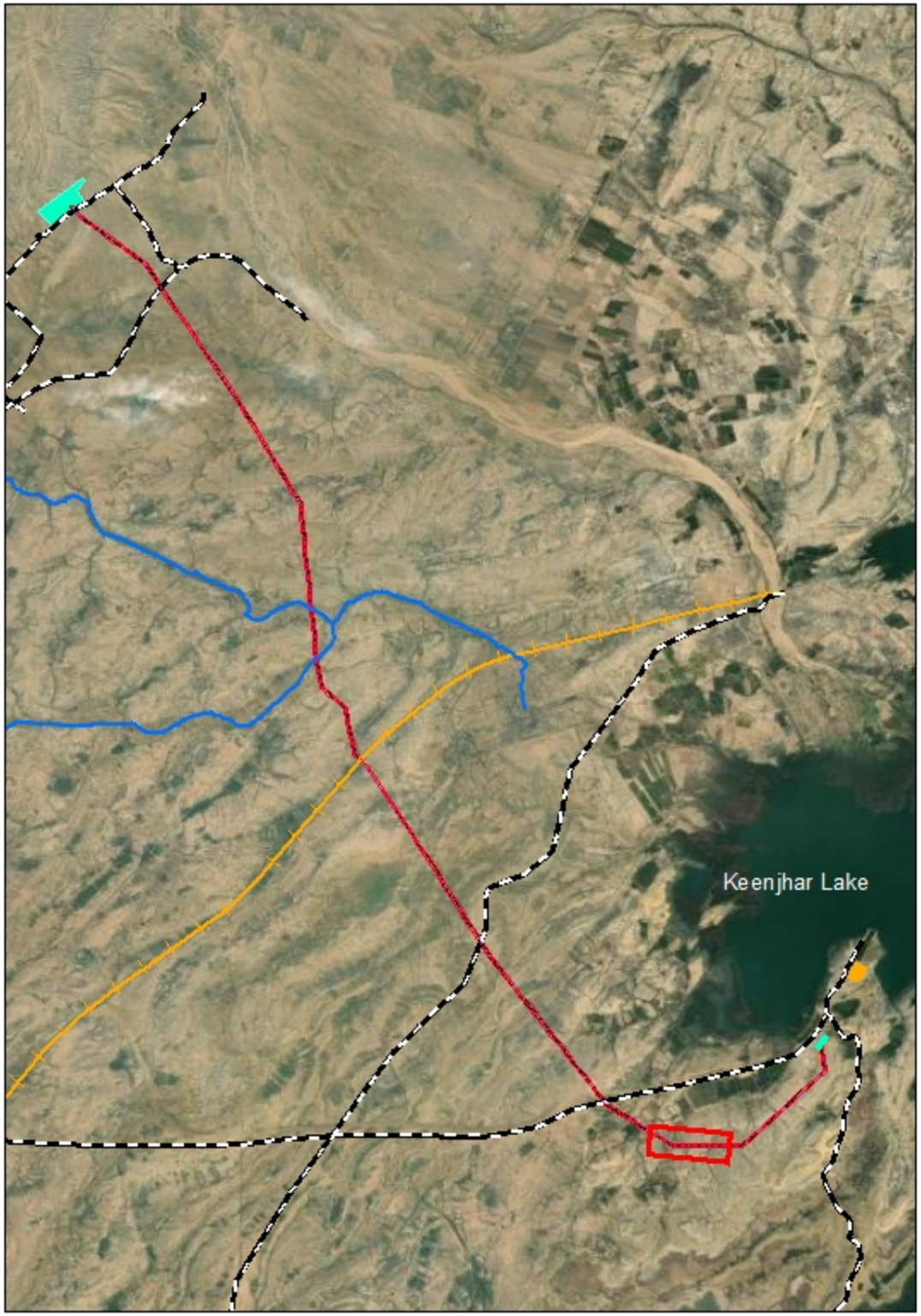

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Location Map
03 of 17

ESIA
Construction of Grid & Transmission Line for K-IV Power Component

Consultant

Client

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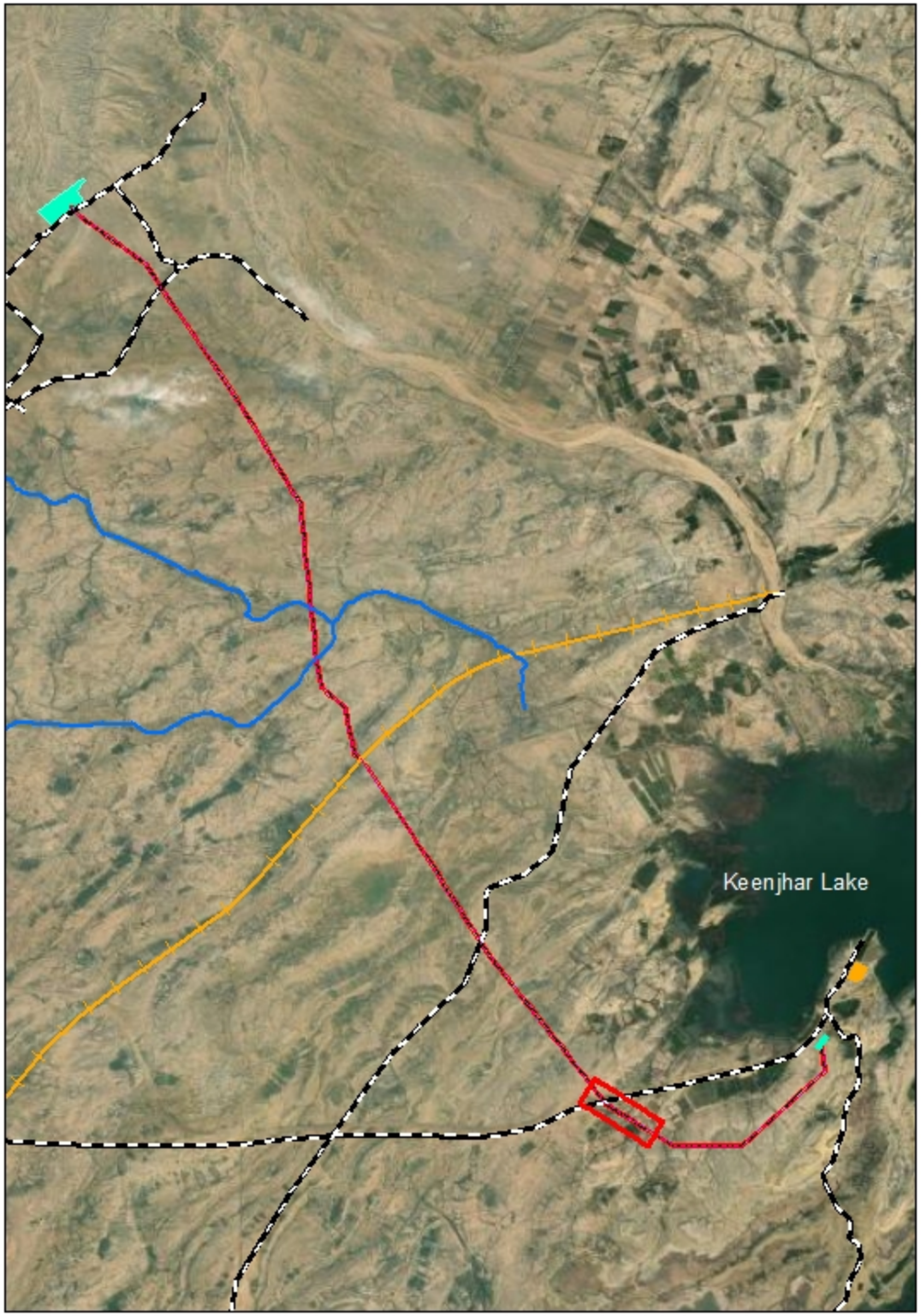

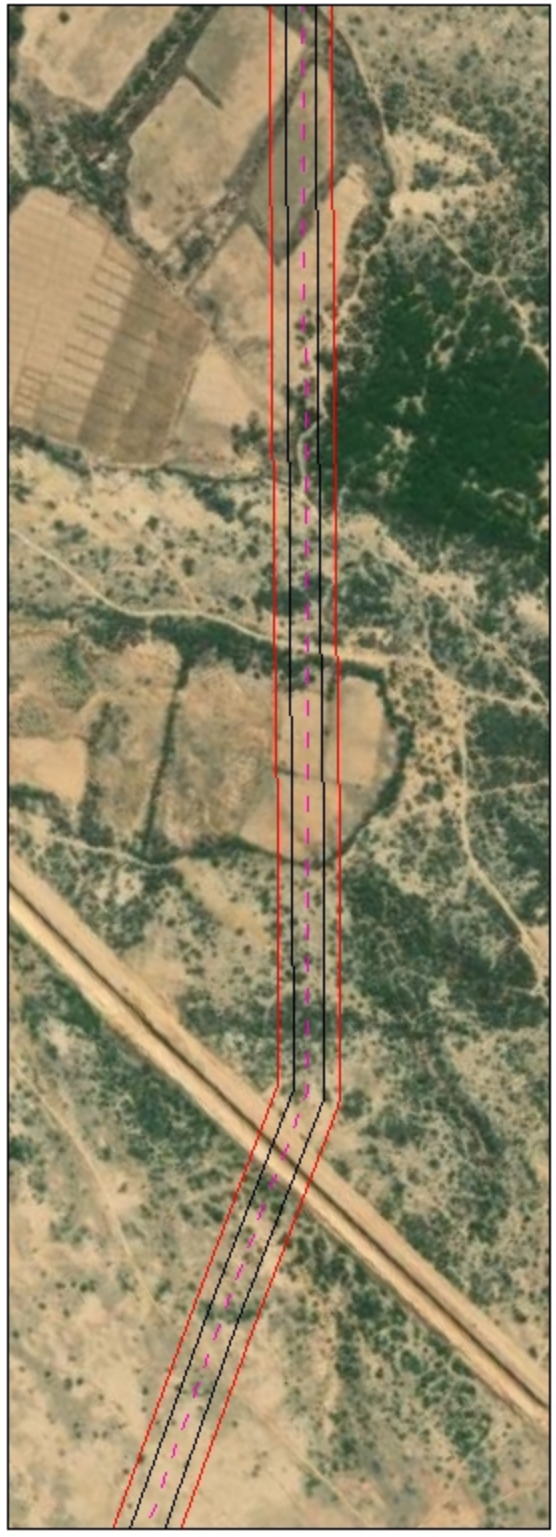

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N E S W

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Location Map
04 of 17

ESIA
Construction of Grid & Transmission Line for K-IV Power Component

Consultant

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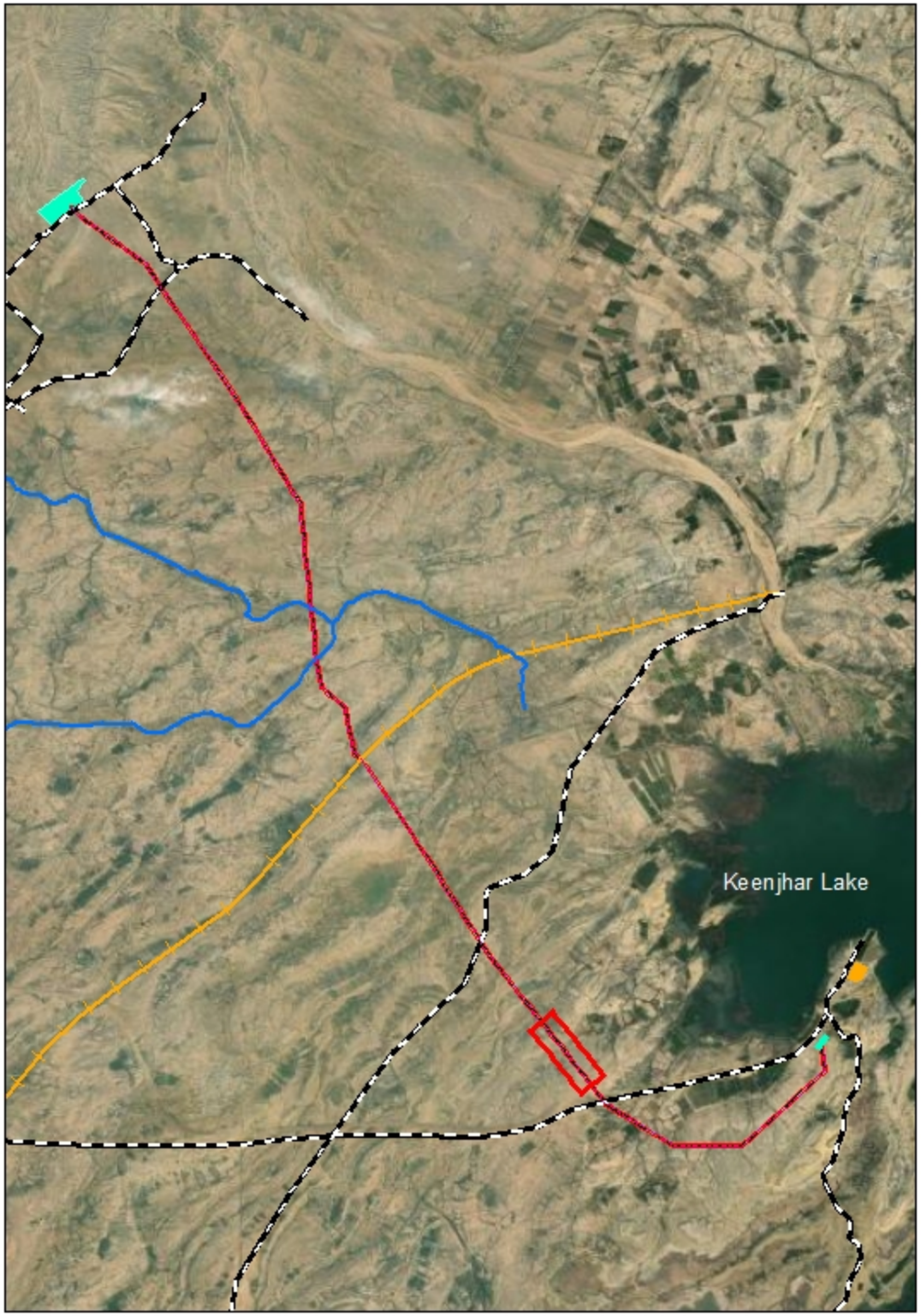

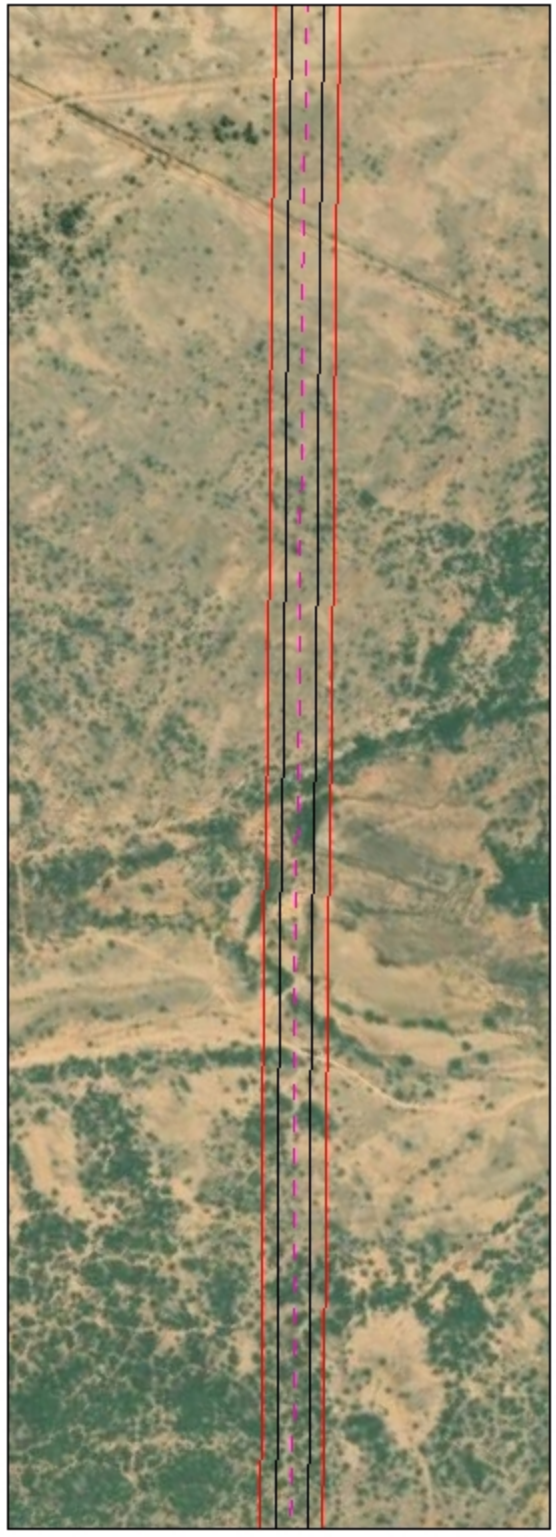

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N S E W

0 20 40 80 Km

Location Map
05 of 17

ESIA
Construction of Grid & Transmission Line for K-IV Power Component

Consultant

Client

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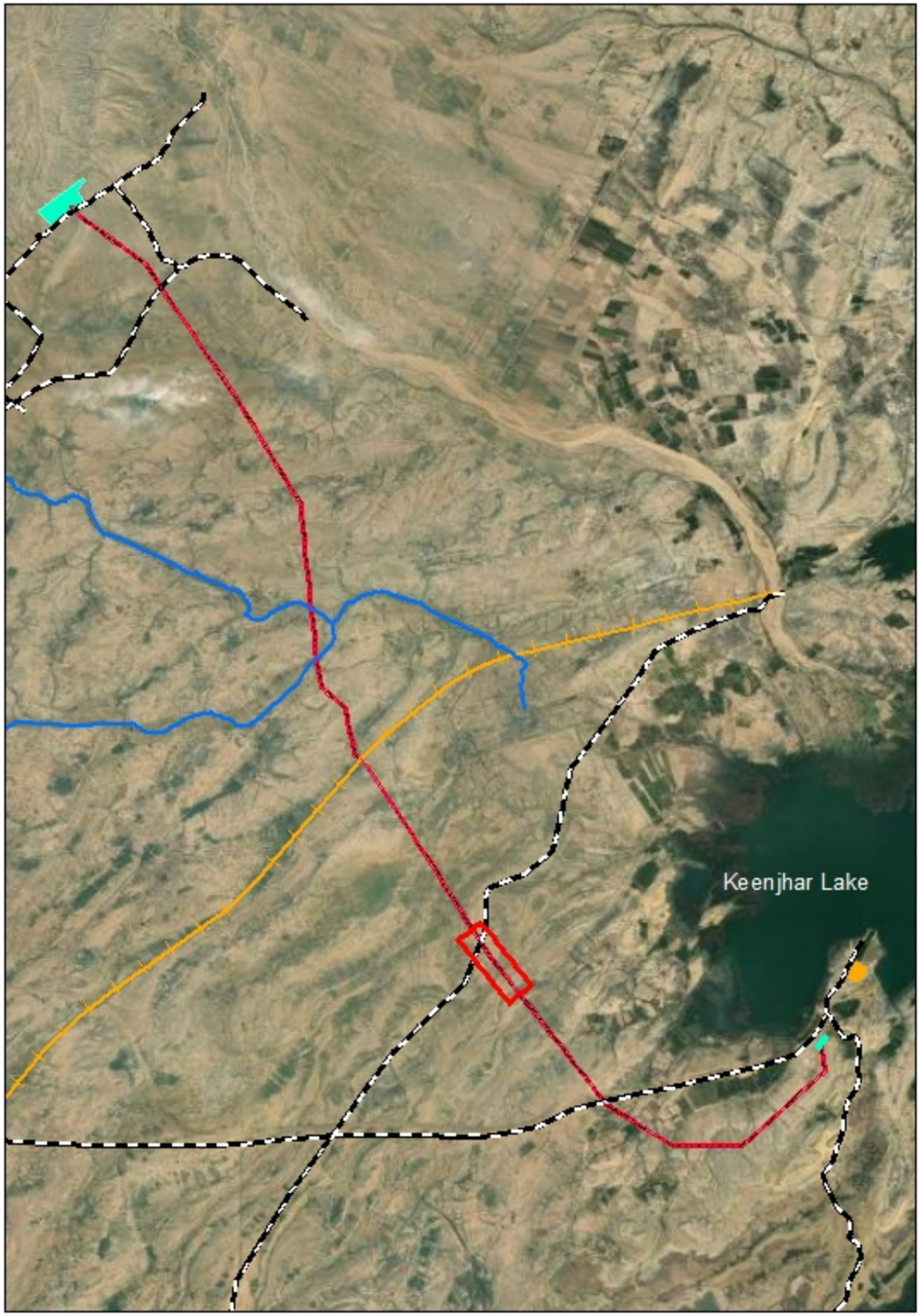
Approved by: M.Omar Arif Syed



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Location Map
06 of 17

ESIA
Construction of Grid & Transmission Line for K-IV Power Component

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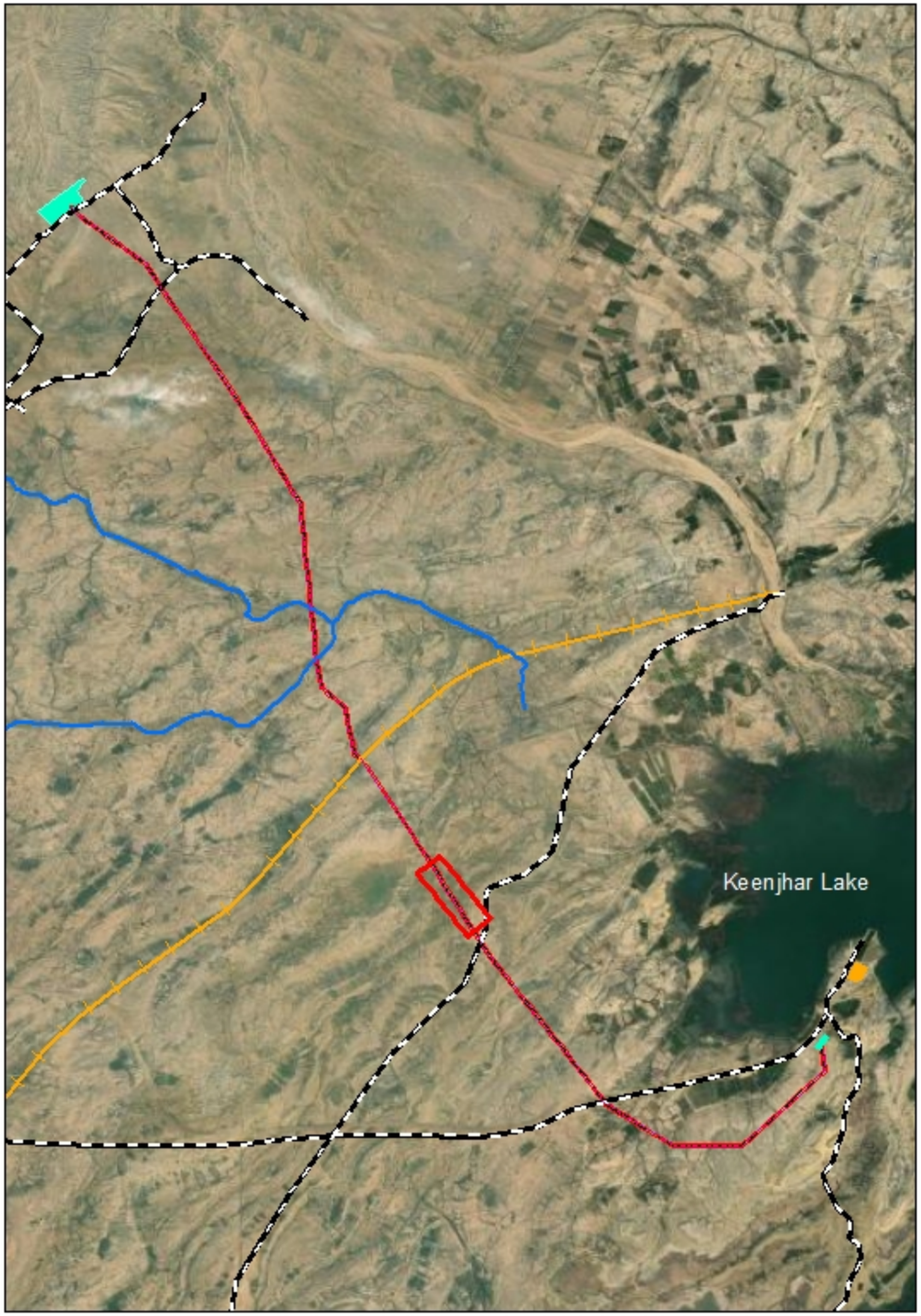

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Location Map
07 of 17

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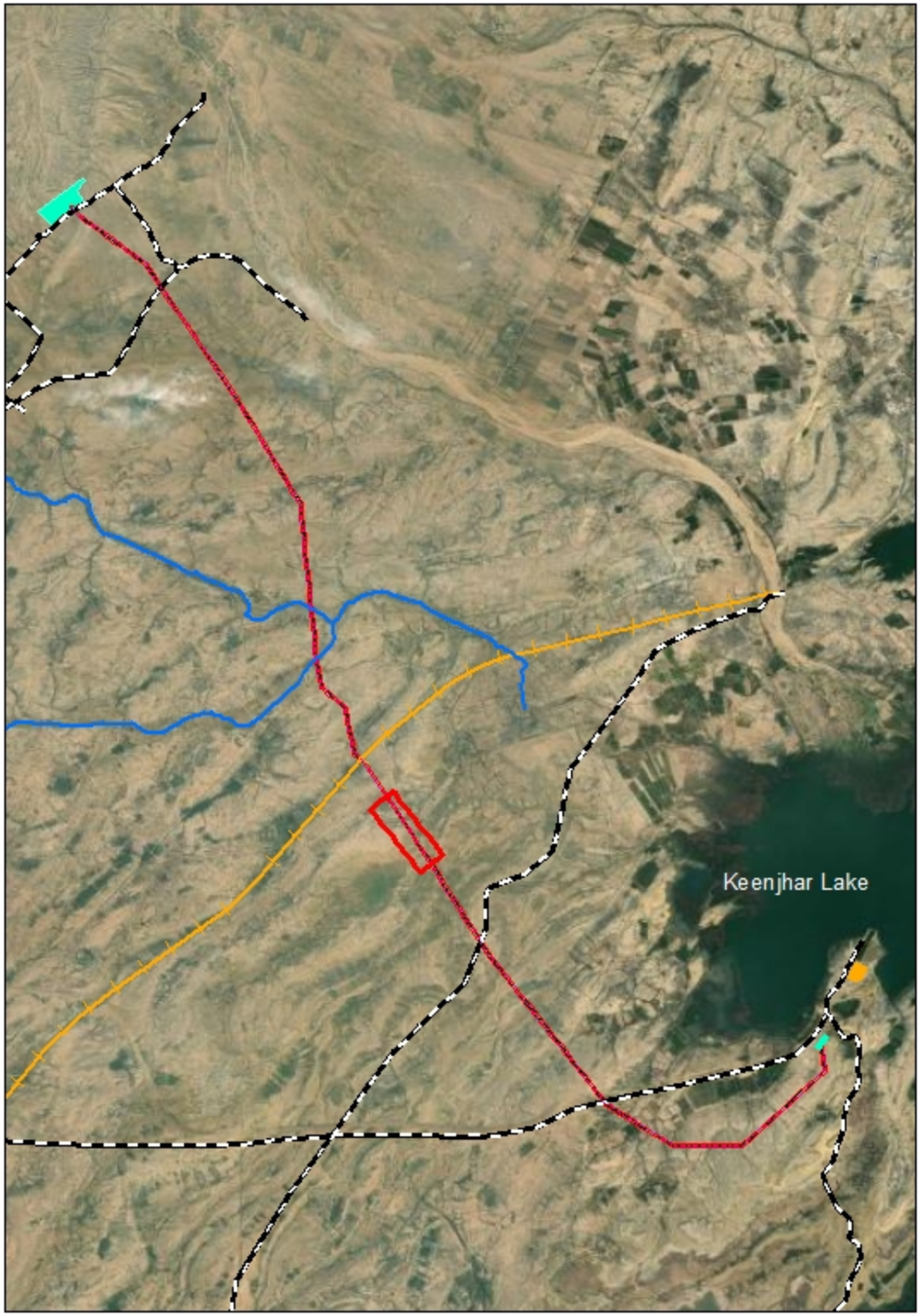

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Location Map
08 of 17

ESIA
Construction of Grid & Transmission Line for K-IV Power Component

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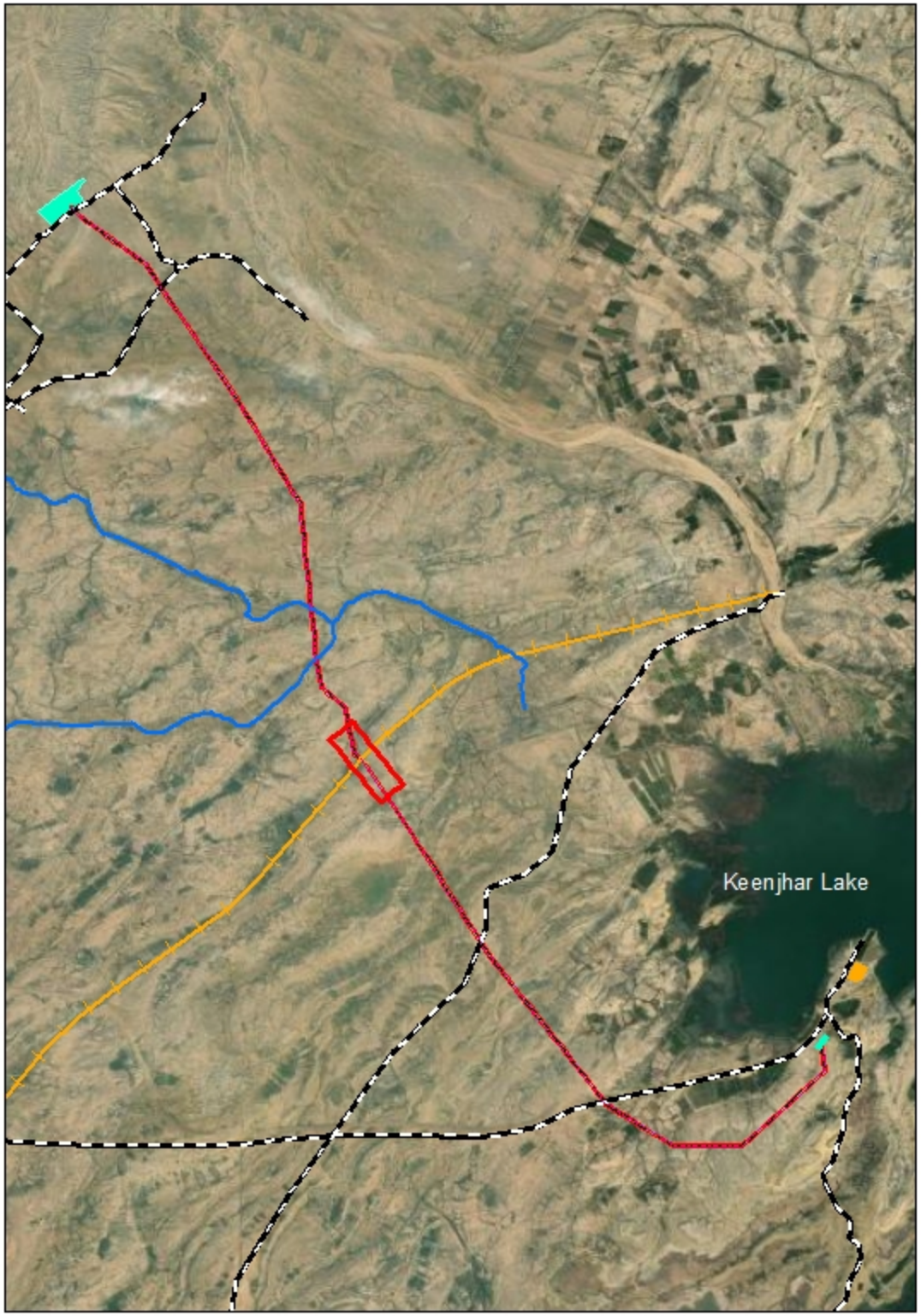

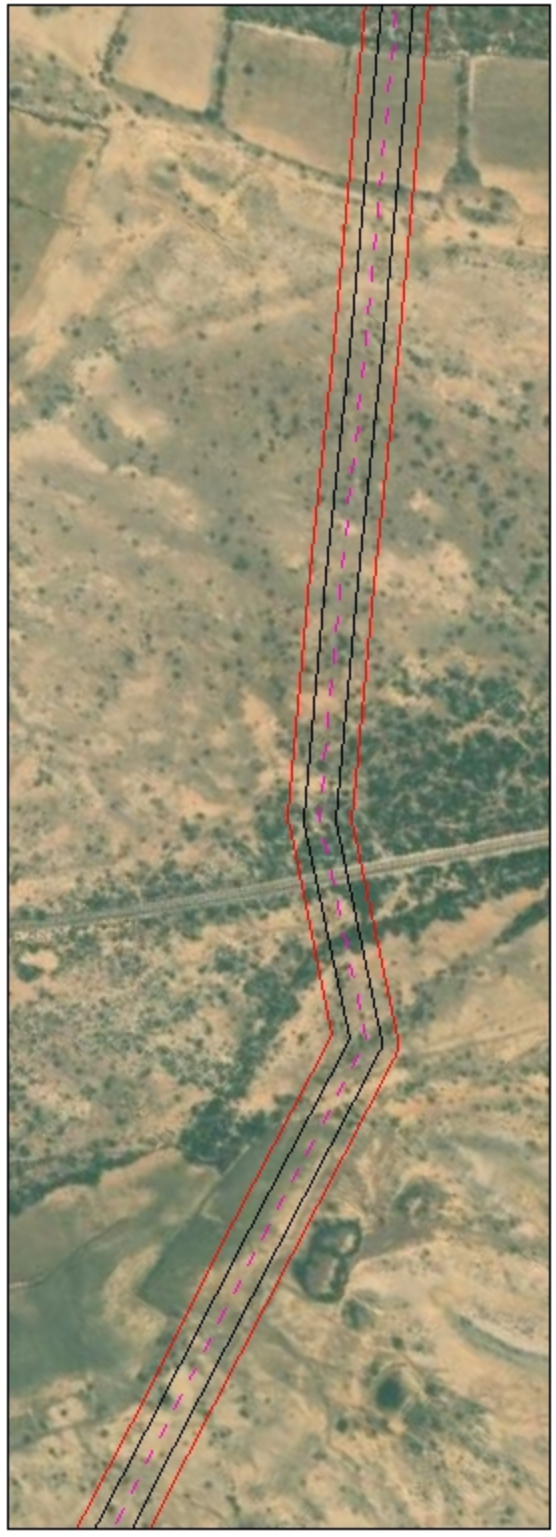

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N E S W

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Location Map
09 of 17

ESIA
Construction of Grid & Transmission Line for K-IV Power Component

Consultant

Client

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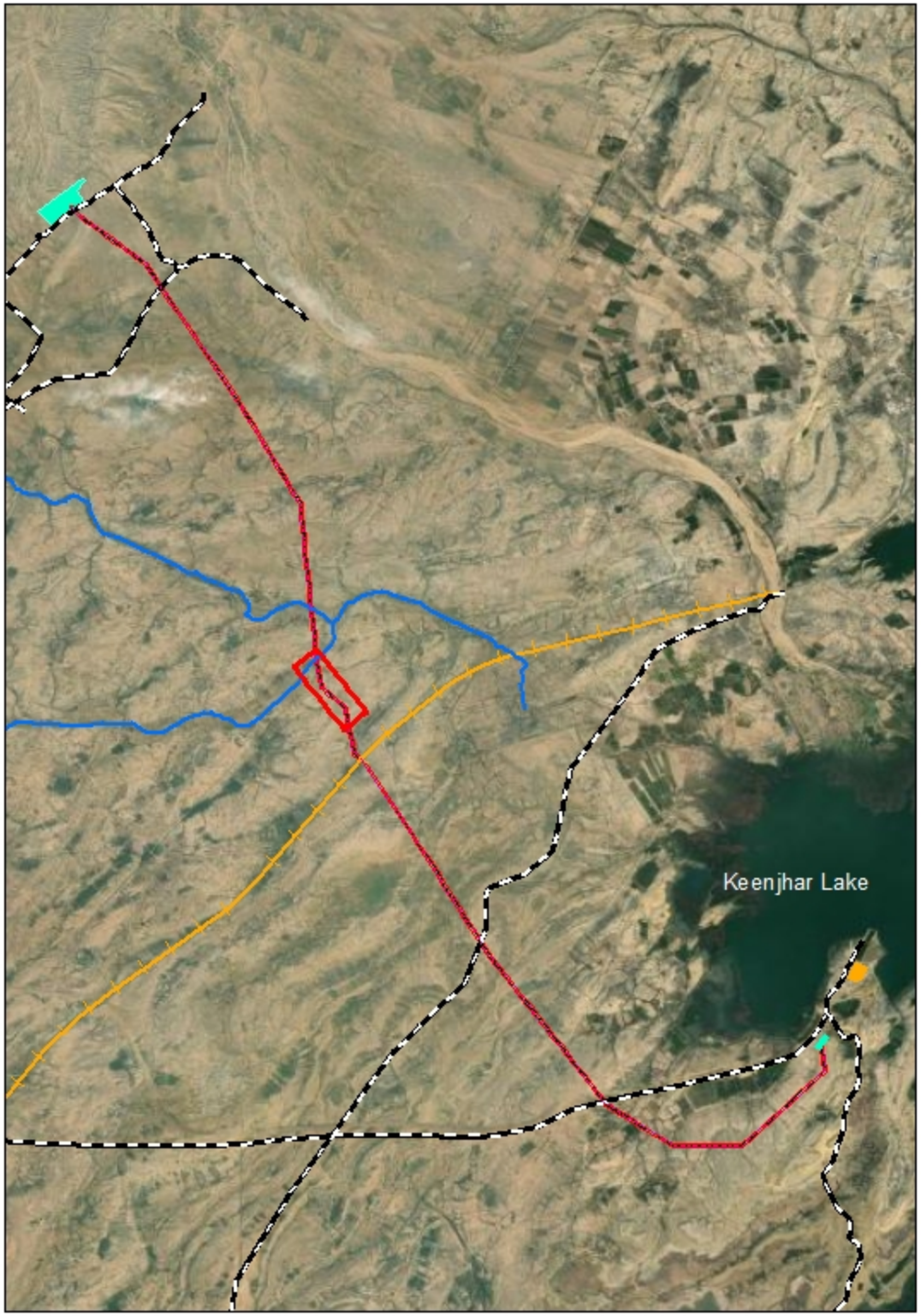
Approved by: M.Omar Arif Syed



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Location Map
10 of 17

ESIA
Construction of Grid & Transmission Line for K-IV Power Component

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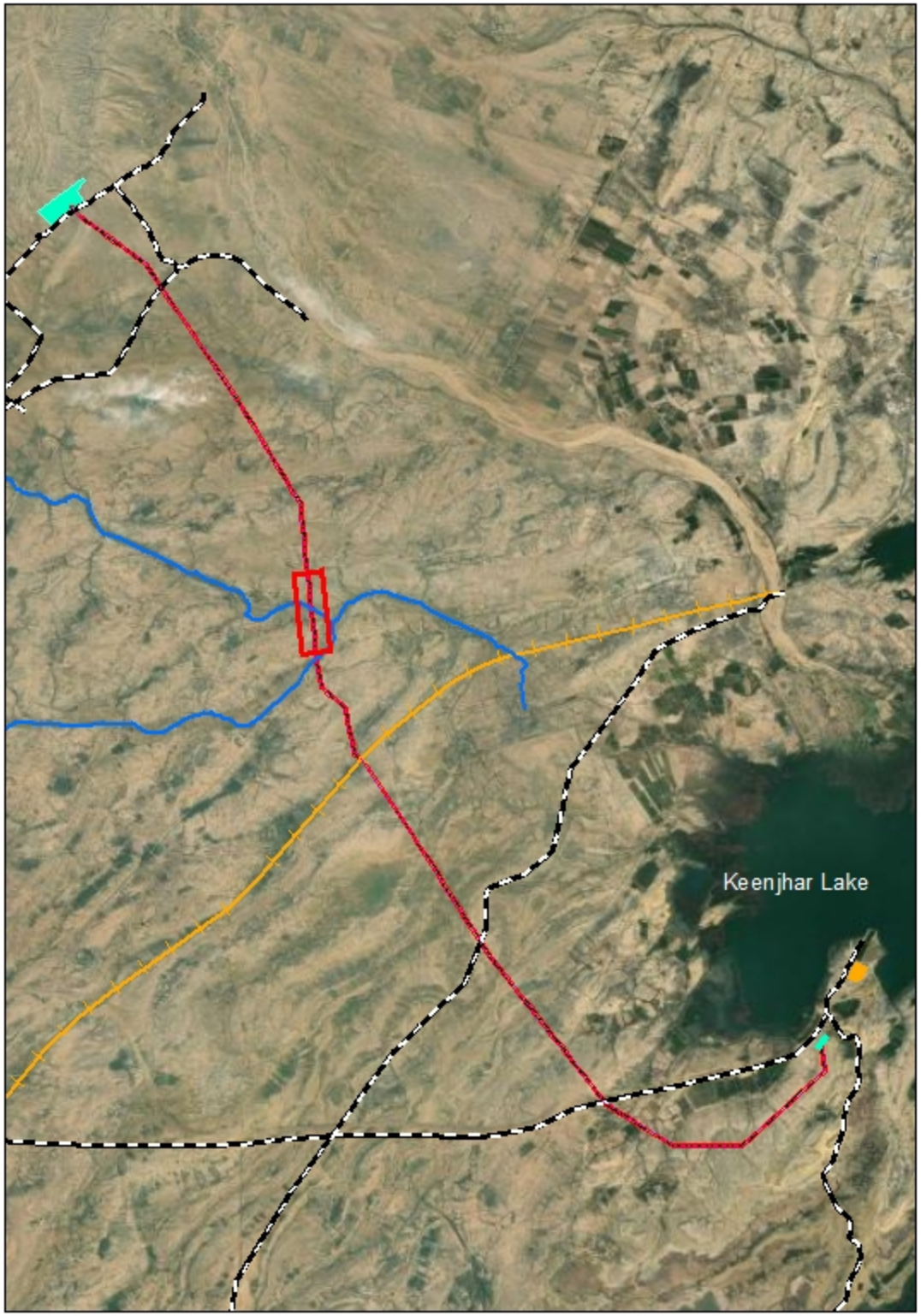

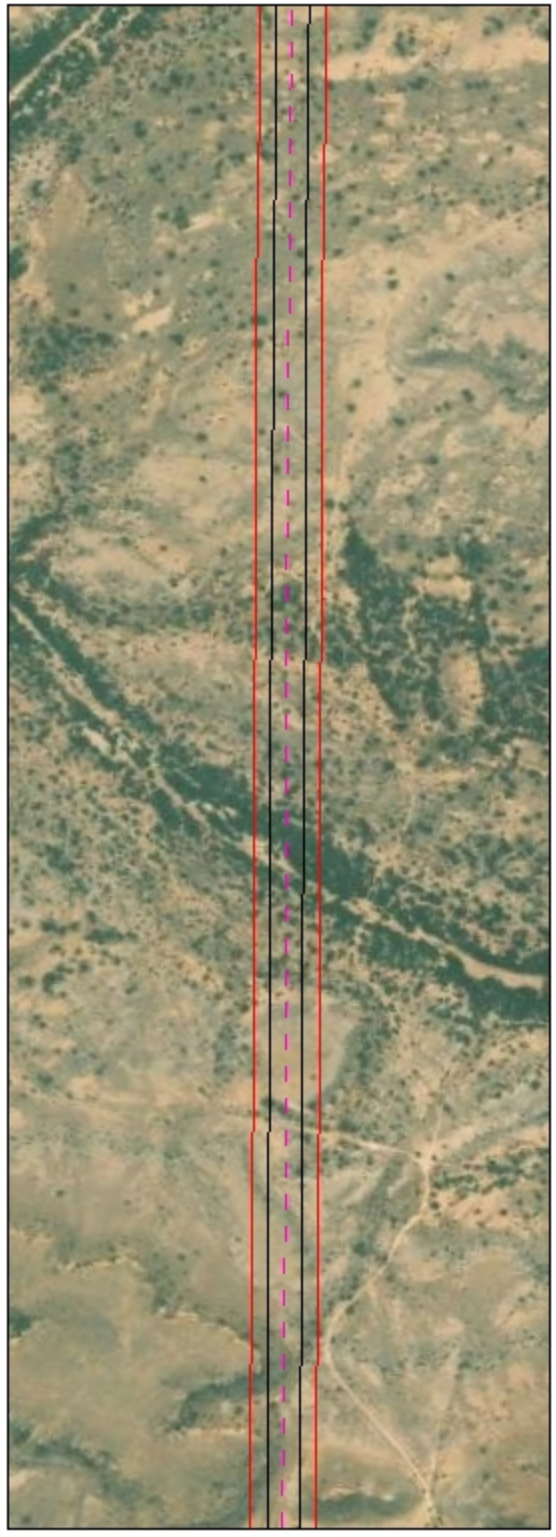

Legend

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Location Map
11 of 17

ESIA
Construction of Grid & Transmission Line for K-IV Power Component

Consultant

Client

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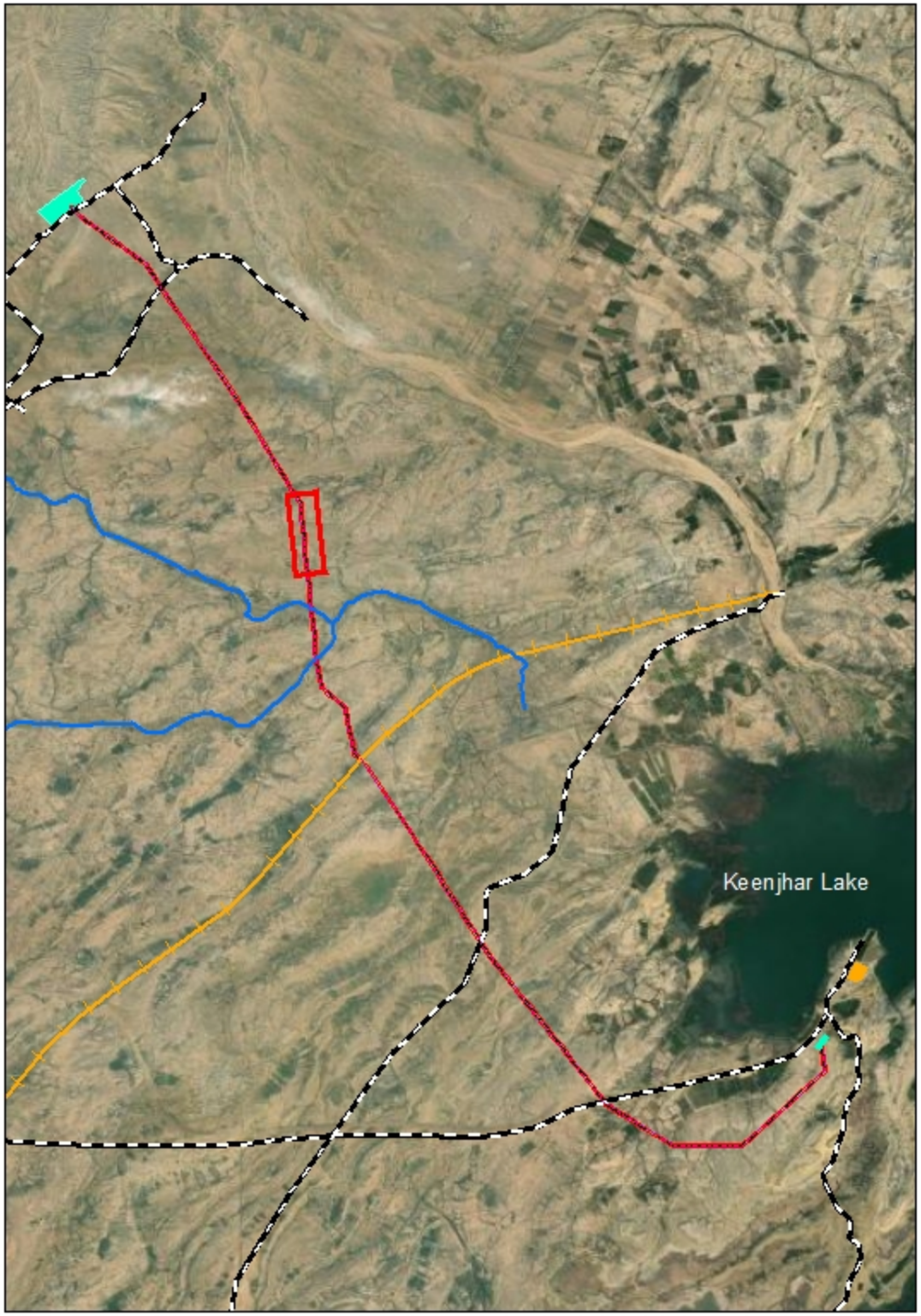
Approved by: M.Omar Arif Syed



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Location Map
02 of 17

ESIA
Construction of Grid & Transmission Line for K-IV Power Component

Consultant

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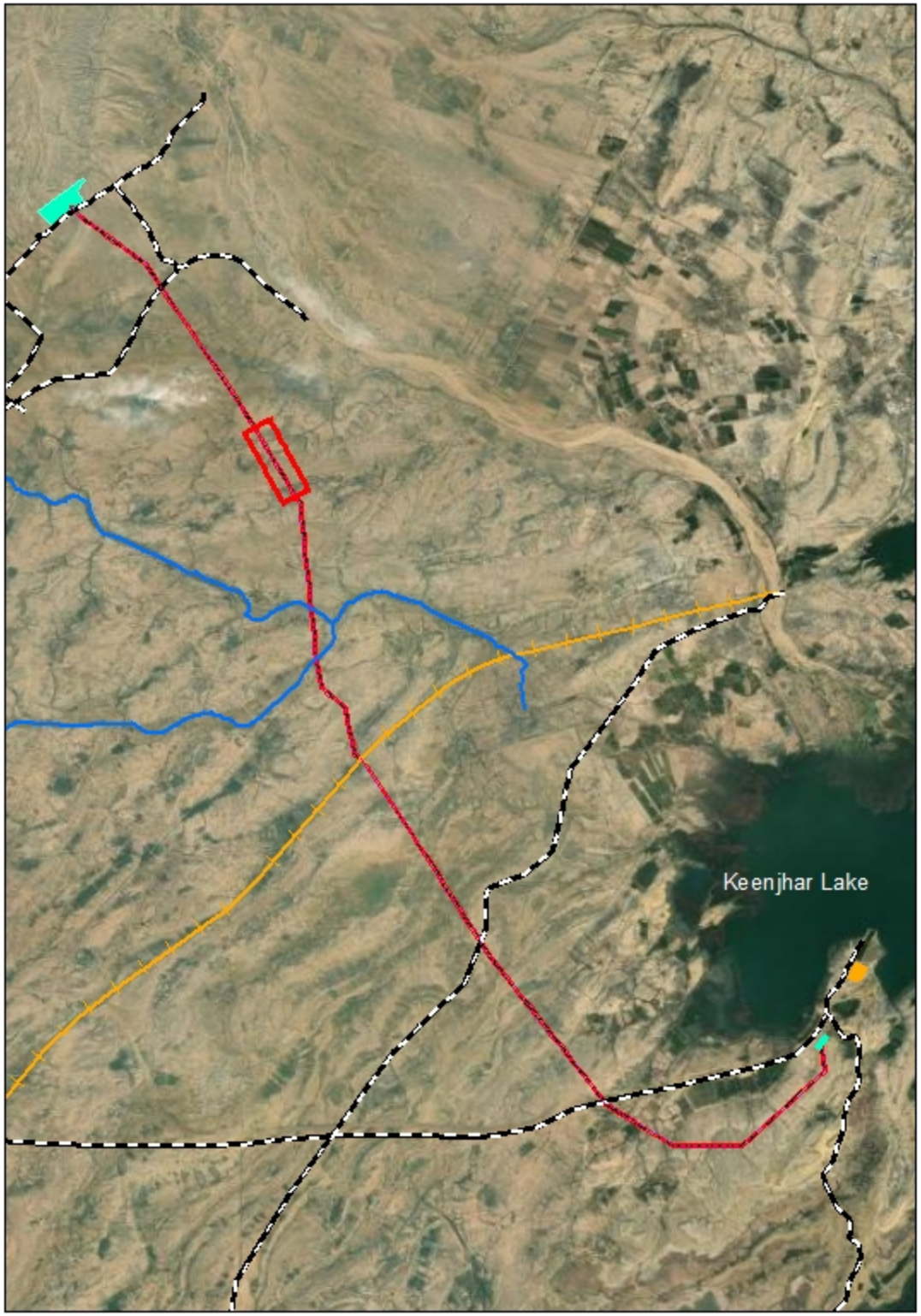

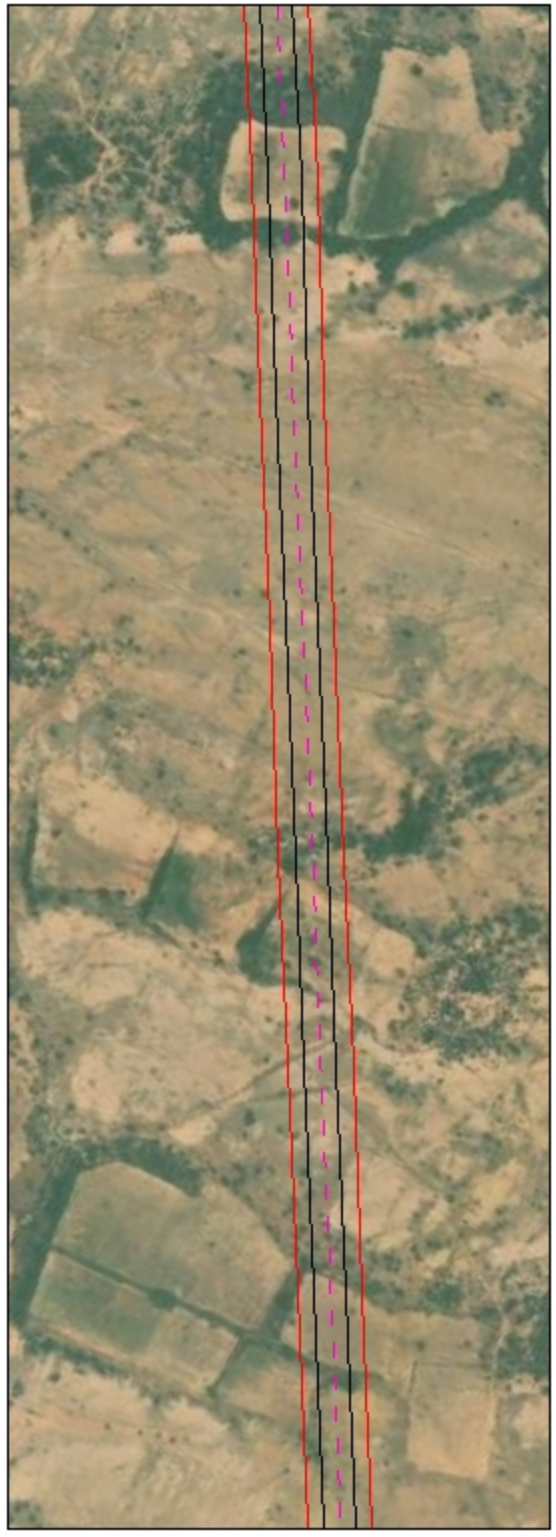

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Location Map
03 of 17

ESIA
Construction of Grid & Transmission Line for K-IV Power Component

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Client

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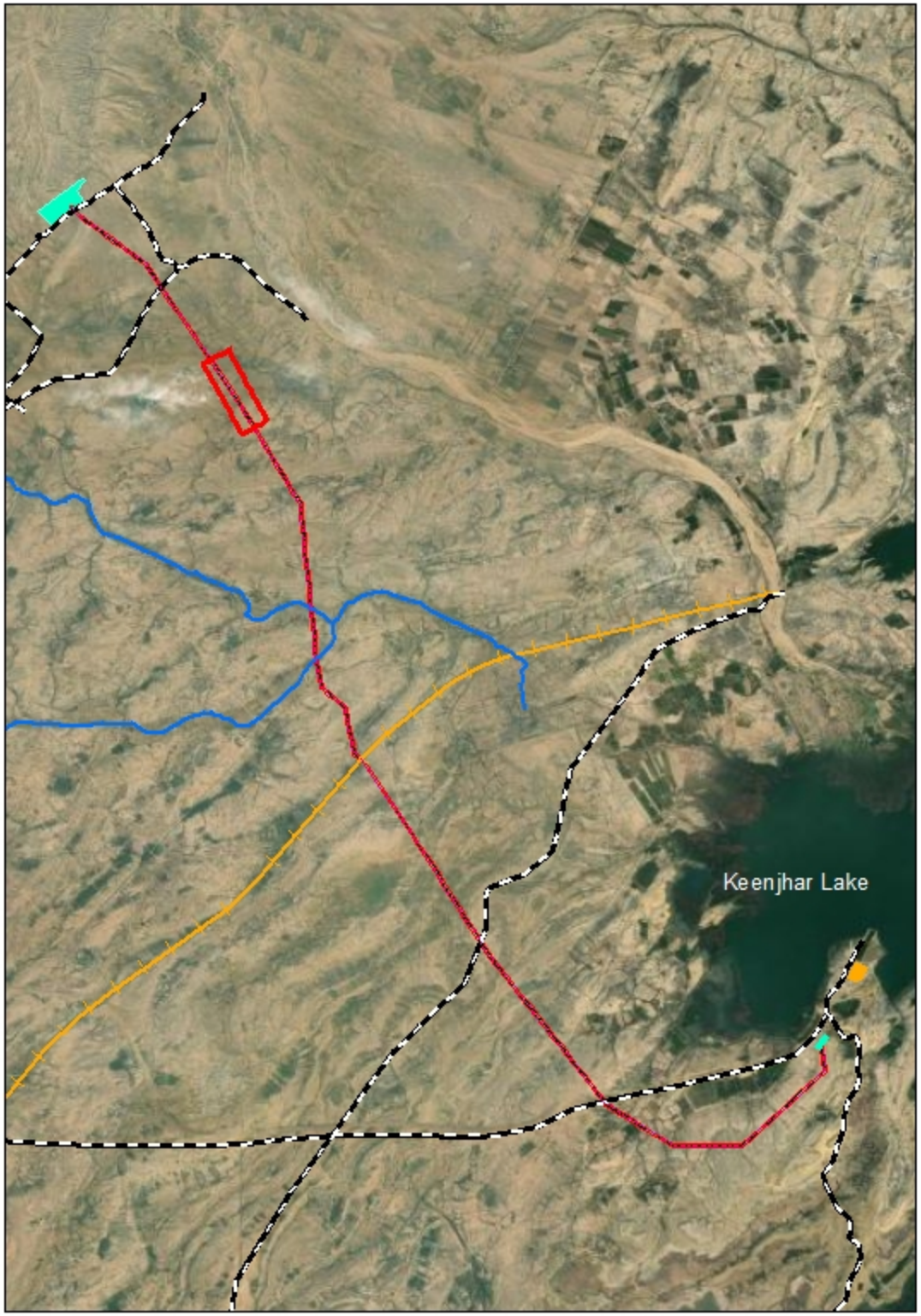

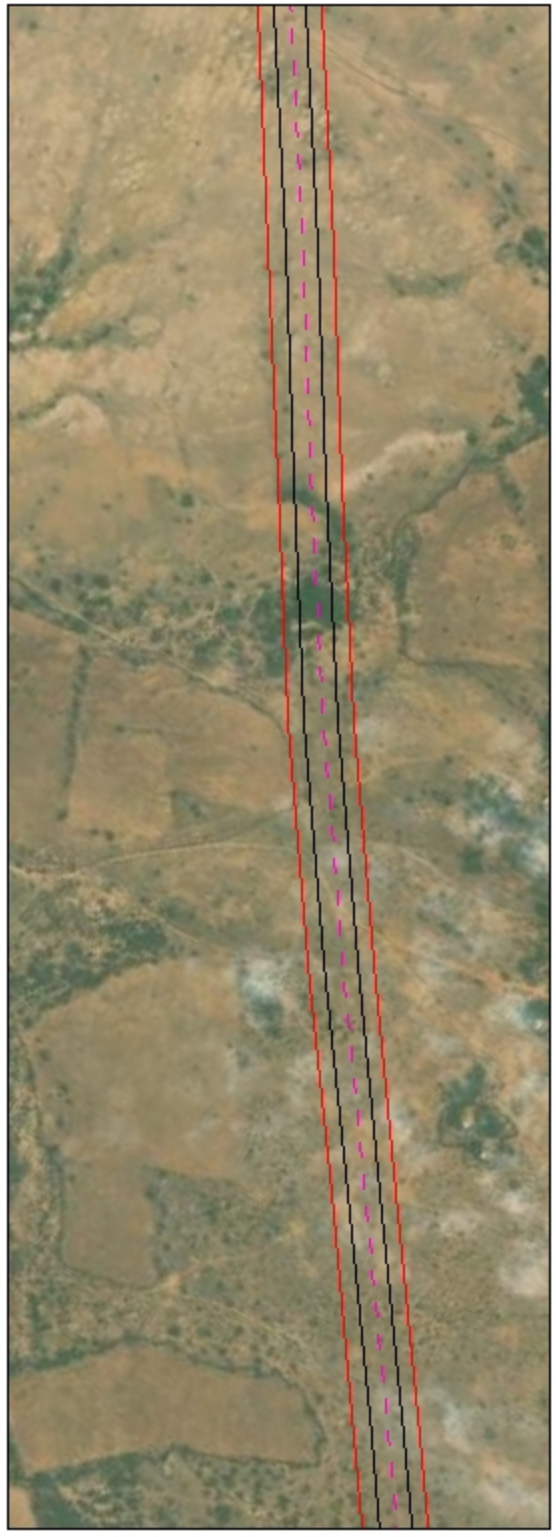

Legend

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0 20 40 80 Km

Location Map
14 of 17

ESIA
Construction of Grid & Transmission Line for K-IV Power Component

Consultant

Client

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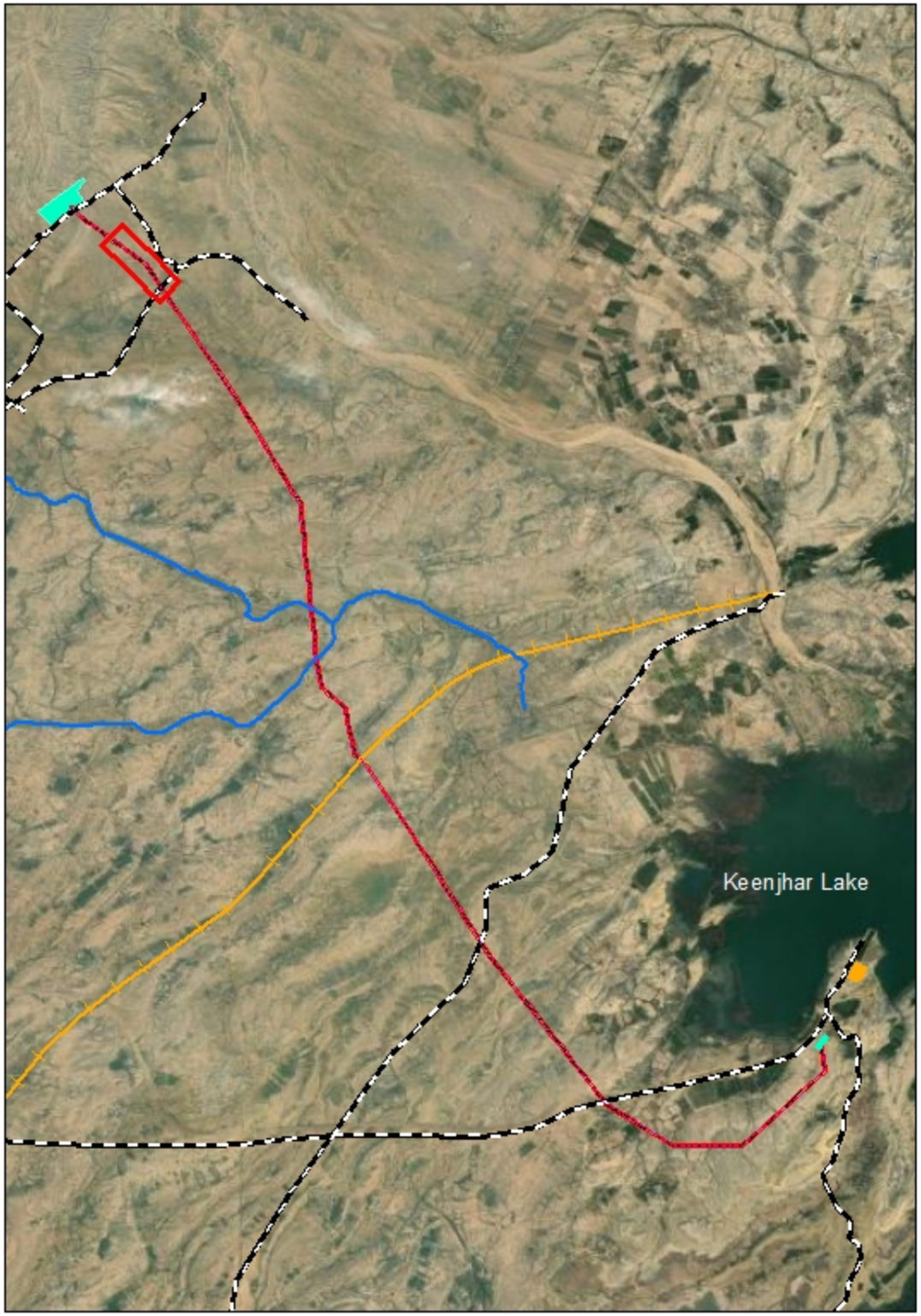
Approved by: M.Omar Arif Syed



Legend

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N E S W

0 20 40 80 Km

Location Map
16 of 17

ESIA
Construction of Grid & Transmission Line for K-IV Power Component

Consultant

Client

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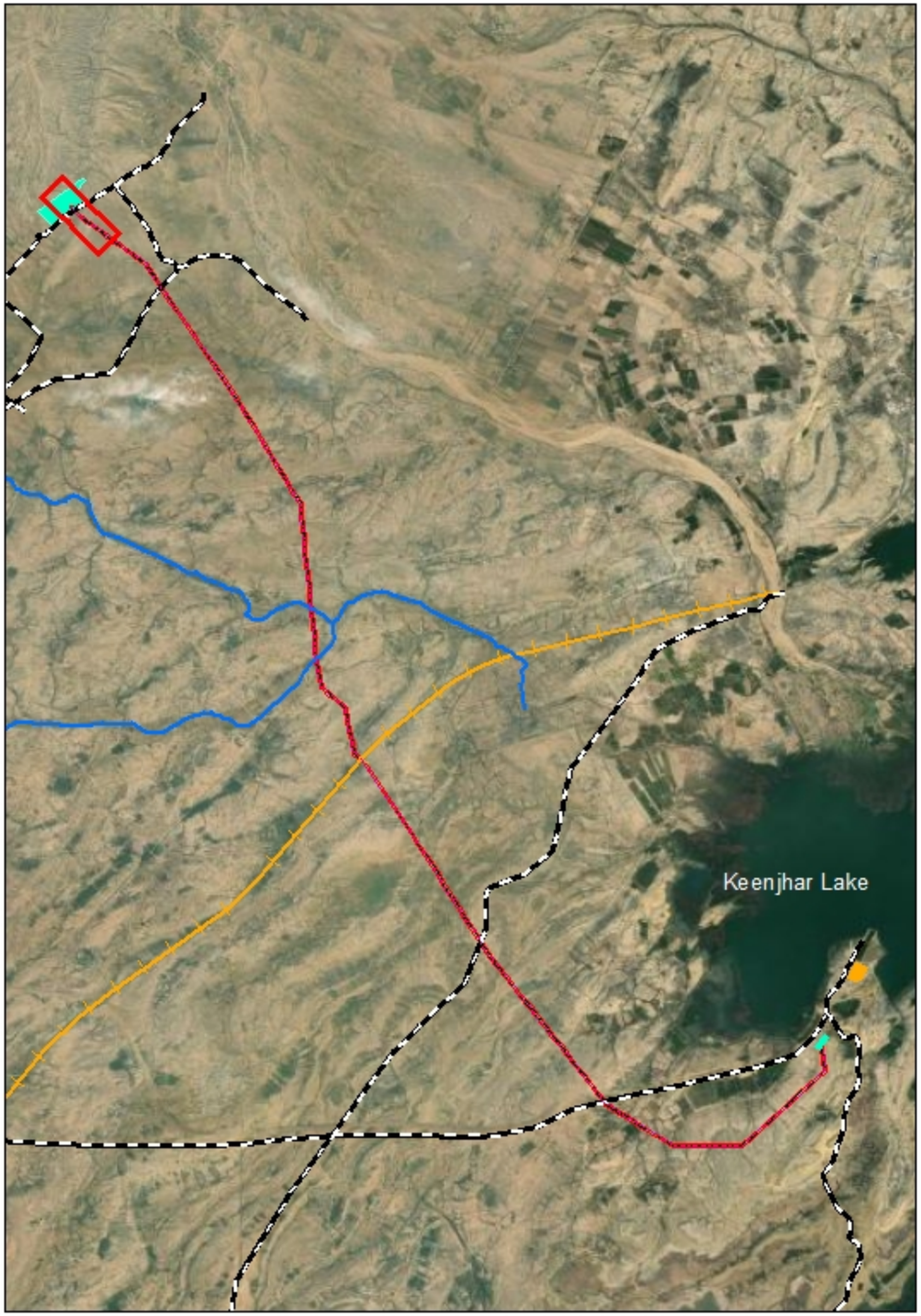

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Location Map
17 of 17

ESIA
Construction of Grid & Transmission Line for K-IV Power Component

Consultant

Client

Prepared by: Shahab Uddin

Approved by: M.Omar Arif Syed

Annex II - Environmental Monitoring Reports

Lab Report Ref. No.: QTS/K4/2024/1438 Reporting date: 25/11/2024
project Name: **60 MW Power Supply Component of K-IV Project (Transmission Line & Grid Station)**
Client: **Sindh Transmission & Dispatch Company (STDC)**

SAMPLE DESCRIPTION

Sample ID: Drinking Water
Sampling Method: APHA 1060-A & B
Sample Type: Grab Sample
Sample Coordinate: 24°53'37.6"N 67°57'32.4"E
Sample Collected/Submitted by: QTS Representative
Sampling Date: 18/11/2024

ANALYTICAL TEST REPORT

S. NO.	PARAMETERS TO BE ANALYZED	STANDARDS SSDWQ - LIMITS	LDL	UNITS	RESULTS	TEST METHOD
1	pH value	6.5 – 8.5	0.01	-	8.23	USEPA 150.1
2	Oduor	Non-Objectionable/ Acceptable	-	Physical	Acceptable	Physical
3	Taste	Non-Objectionable/Acceptable	-	Physical	Acceptable	Physical
4	Color	≤ 15	1.0	TCU	BDL	APHA-2020 B/C
5	Turbidity	< 5	0.01	NTU	NIL	APHA-2130 B
6	Total Dissolved Solids (TDS)	< 1000	1.0	mg/L	355	Hach 8160
7	Total Hardness as $CaCO_3$	< 500	0.1	mg/L	250	EDTA Titration.Hach-8213
8	Fluoride (as F^-)	≤ 1.5	0.01	mg/L	NIL	USEPA 340.1
9	Chloride (as Cl^-)	< 250	0.1	mg/L	88	Hach 8206
10	Nitrate (NO_3)	≤ 50	0.01	mg/L	0.1	Hach -8039
11	Nitrite (NO_2)	≤ 3	0.001	mg/L	2	Hach - 8153
12	Cyanide (as CN-) total	≤ 0.05	0.001	mg/L	BDL	Hach 8027
13	Phenolic Compound as (Phenols)	-	0.001	mg/L	BDL	USEPA-420.1
14	Aluminum (Al)	≤ 0.2	0.001	mg/L	BDL	APHA-3111 D
15	Antimony (Sb)	≤ 0.005	0.001	mg/L	BDL	APHA-3111 B
16	Arsenic	≤ 0.05	0.01	mg/L	BDL	APHA-3120 B
17	Cadmium	0.01	0.001	mg/L	BDL	ASTM D-3557
18	Chromium ,Total	≤ 0.05	0.01	mg/L	0.02	ASTM D-1687
19	Copper	2	0.01	mg/L	0.030	Hach 8506
20	Lead	≤ 0.05	0.001	mg/L	BDL	ASTM D-3559
21	Mercury	≤ 0.001	0.001	mg/L	BDL	ASTM D-3223
22	Selenium	0.01	0.001	mg/L	BDL	ASTM D-3859
23	Nickel	≤ 0.02	0.01	mg/L	BDL	ASTM D-1886
24	Boron	0.3	0.01	mg/L	BDL	ASTM D-3082
25	Residual Chlorine	0.2-0.5 at Consumer End	0.01	mg/L	0.010	Hach - 8167
26	Zinc	5.0	0.01	mg/L	0.19	USEPA 3500 Zn B
27	Manganese	≤ 0.5	0.01	mg/L	0.98	Hach 8034
28	Barium	0.7	0.01	mg/L	0.5	Hach 8014
39	Total Coliform	0cfu/100ml	0	cfu	3	APHA-SM9221B
3	Fecal Coliform	0cfu/100ml	0	cfu	NIL	APHA-SM9221E
35	Escherichia Coli(E-Coli)	0cfu/100ml	0	cfu	NIL	APHA-SM9221F

SSDWQ = Sindh Standard for Drinking Water Quality
USEPA = United State Environmental Protection Agency method
Hach USA, method
BDL= Below Detection Limit
ND= Not Detected
LDL= Least Detectable Value

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- 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**

Quality Testing Services Karachi Q.T.S

Lab Report Ref. No.: QTS/K4/2024/1439 Reporting date: 25/11/2024
project Name: **60 MW Power Supply Component of K-IV Project (Transmission Line & Grid Station)**
Client: **Sindh Transmission & Dispatch Company (STDC)**

SAMPLE DESCRIPTION

Sample ID: Bore Water
Sampling Method: APHA 1060-A & B
Sample Type: Grab Sample
Sample Coordinate: 24°54'42.2"N 67°55'57.0"E
Sample Collected/Submitted by: QTS Representative
Sampling Date: 18/11/2024

ANALYTICAL TEST REPORT

S. NO.	PARAMETERS TO BE ANALYZED	STANDARDS SSDWQ - LIMITS	LDL	UNITS	RESULTS	TEST METHOD
1	pH value	6.5 – 8.5	0.01	-	7.02	USEPA 150.1
2	Oduor	Non-Objectionable/Acceptable	-	Physical	Acceptable	Physical
3	Taste	Non-Objectionable/Acceptable	-	Physical	Acceptable	Physical
4	Color	≤ 15	1.0	TCU	BDL	APHA-2020 B/C
5	Turbidity	< 5	0.01	NTU	NIL	APHA-2130 B
6	Total Dissolved Solids (TDS)	< 1000	1.0	mg/L	3980	Hach 8160
7	Total Hardness as $CaCO_3$	< 500	0.1	mg/L	1400	EDTA Titration.Hach-8213
8	Fluoride (as F^-)	≤ 1.5	0.01	mg/L	0.62	USEPA 340.1
9	Chloride (as Cl^-)	< 250	0.1	mg/L	2450	Hach 8206
10	Nitrate (NO_3)	≤ 50	0.01	mg/L	1.5	Hach -8039
11	Nitrite (NO_2)	≤ 3	0.001	mg/L	1	Hach - 8153
12	Cyanide (as CN-) total	≤ 0.05	0.001	mg/L	BDL	Hach 8027
13	Phenolic Compound as (Phenols)	-	0.001	mg/L	BDL	USEPA-420.1
14	Aluminum (Al)	≤ 0.2	0.001	mg/L	BDL	APHA-3111 D
15	Antimony (Sb)	≤ 0.005	0.001	mg/L	BDL	APHA-3111 B
16	Arsenic	≤ 0.05	0.01	mg/L	BDL	APHA-3120 B
17	Cadmium	0.01	0.001	mg/L	BDL	ASTM D-3557
18	Chromium, Total	≤ 0.05	0.01	mg/L	0.06	ASTM D-1687
19	Copper	2	0.01	mg/L	5.84	Hach 8506
20	Lead	≤ 0.05	0.001	mg/L	BDL	ASTM D-3559
21	Mercury	≤ 0.001	0.001	mg/L	BDL	ASTM D-3223
22	Selenium	0.01	0.001	mg/L	BDL	ASTM D-3859
23	Nickel	≤ 0.02	0.01	mg/L	BDL	ASTM D-1886
24	Boron	0.3	0.01	mg/L	BDL	ASTM D-3082
25	Residual Chlorine	0.2-0.5 at Consumer End	0.01	mg/L	0.011	Hach - 8167
26	Zinc	5.0	0.01	mg/L	0.06	USEPA 3500 Zn B
27	Manganese	≤ 0.5	0.01	mg/L	0.5	Hach 8034
28	Barium	0.7	0.01	mg/L	0.6	Hach 8014
39	Total Coliform	0cfu/100ml	0	cfu	8	APHA-SM9221B
3	Fecal Coliform	0cfu/100ml	0	cfu	NIL	APHA-SM9221E
35	Escherichia Coli(E-Coli)	0cfu/100ml	0	cfu	NIL	APHA-SM9221F

SSDWQ = Sindh Standard for Drinking Water Quality
USEPA = United State Environmental Protection Agency method
Hach USA, method
BDL= Below Detection Limit
ND= Not Detected
LDL= Least Detectable Value

- This report is not valid for any negotiations
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- 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

Quality Testing Services Karachi Q.T.S

Lab Report Ref. No.: QTS/K4/2024/1440 Reporting date: 25/11/2024
project Name: **60 MW Power Supply Component of K-IV Project (Transmission Line & Grid Station)**
Client: **Sindh Transmission & Dispatch Company (STDC)**

SAMPLE DESCRIPTION

Sample ID: Waste Water
Sampling Method: APHA 1060-A & B
Sample Type: Grab Sample
Sample Coordinate: 24°54'42.8"N 67°55'56.1"E
Sample Collected/Submitted by: QTS Representative
Sampling Date: 18/11/2024

ANALYTICAL TEST REPORT

S.NO.	PARAMETERS TO BE ANALYZED	STANDARD SEQS	LDL	UNITS	RESU4TS	TEST METHOD
1	Temperature	40	1.0	^{0}C	30.6	Thermometer
2	pH value	6-9	0.01	-	7.58	USEPA 150.1
3	Biochemical Oxygen Demand $(BOD)_5$ at 20^{0}C	200	0.1	mg/L	79.3	Hach 8043
4	Chemical Oxygen Demand (COD)	400	1.0	mg/L	173	Hach 8000
5	Total Suspended Solids (TSS)	200	1.0	mg/L	823	Hach 8006
6	Total Dissolved Solids (TDS)	3500	1.0	mg/L	916	Hach 8160
7	Cyanide (as CN-) total	1	0.001	mg/L	0.028	Hach 8027
8	Ammonia (NH_3)	40	0.1	mg/L	2.4	Hach 10031
9	Cadmium	0.1	0.001	mg/L	BDL	ASTM D-3557
10	Chromium (trivalent & hexavalent)	1	0.01	mg/L	0.07	ASTM D-1687
11	Copper	1	0.01	mg/L	0.06	Hach 8506
12	Lead	0.5	0.001	mg/L	BDL	ASTM D-3559
13	Nickel	1	0.001	mg/L	BDL	ASTM D-1886
14	Zinc	5	0.01	mg/L	0.08	USEPA 3500 Zn B
15	Oil & Grease	10	0.001	mg/L	0.58	APHA 5520-D
16	Fluoride (as F^-)	10	0.01	mg/L	0.25	USEPA 340.1
17	Phenolic compounds (as phenol)	0.1	0.001	mg/L	0.044	USEPA 420.1
18	Chloride (as Cl^-)	-	0.01	mg/L	232	Hach 8206
19	Mercury	0.01	0.001	mg/L	BDL	ASTM D-3223
20	Iron	8	0.01	mg/L	NIL	Hach 8008
21	An-ionic detergents (as MBAS)	20	0.001	mg/L	1.0	Method 5540 C
22	Manganese	1.5	0.1	mg/L	0.22	Hach 8034
23	Boron	6	0.01	mg/L	0.87	ASTM D-3082
24	Barium	1.5	0.1	mg/L	8	Hach 8014
25	Sulphate (SO_4^{-2})	-	1.0	mg/L	65	USEPA 375.4
26	Selenium	0.5	0.01	mg/L	BDL	ASTM D-3859
27	Total toxic metals	2	-	mg/L	0.026	-
28	Sulphide(S^{2-})	1	0.001	mg/L	0.25	Hach 8131
29	Silver	1	0.001	mg/L	BDL	ASTM D-3866
30	Arsenic	1	0.01	mg/L	0.020	Hach method
31	Chlorine	1	0.01	mg/L	BDL	Hach 80021

SEQS=Sindh Environmental Quality Standards
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
LDL= Least Detectable Value
NoGL=No Guideline Limits Available

- 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

Quality Testing Services Karachi Q.T.S

Lab Report Ref. No.: QTS/K4/2024/1441-A Reporting date: 25/11/2024
project Name: **60 MW Power Supply Component of K-IV Project (Transmission Line & Grid Station)**
Client: **Sindh Transmission & Dispatch Company (STDC)**

SAMPLE DESCRIPTION

Sample ID: Surface Water 01
Sampling Method: APHA 1060-A & B
Sample Type: Grab Sample
Sample Coordinate: 24°55'52.1"N 67°55'48.9"E
Sample Collected/Submitted by: QTS Representative
Sampling Date: 18/11/2024

ANALYTICAL TEST REPORT

S.NO.	PARAMETERS TO BE ANALYZED	STANDARD SEQS	LDL	UNITS	RESU4TS	TEST METHOD
1	Temperature	40	1.0	^{0}C	30.2	Thermometer
2	pH value	6-9	0.01	-	8.00	USEPA 150.1
3	Biochemical Oxygen Demand $(BOD)_5$ at 20^{0}C	200	0.1	mg/L	37	Hach 8043
4	Chemical Oxygen Demand (COD)	400	1.0	mg/L	73	Hach 8000
5	Total Suspended Solids (TSS)	200	1.0	mg/L	35	Hach 8006
6	Total Dissolved Solids (TDS)	3500	1.0	mg/L	122	Hach 8160
7	Cyanide (as CN-) total	1	0.001	mg/L	BDL	Hach 8027
8	Ammonia (NH_3)	40	0.1	mg/L	BDL	Hach 10031
9	Cadmium	0.1	0.001	mg/L	BDL	ASTM D-3557
10	Chromium (trivalent & hexavalent)	1	0.01	mg/L	0.09	ASTM D-1687
11	Copper	1	0.01	mg/L	NIL	Hach 8506
12	Lead	0.5	0.001	mg/L	BDL	ASTM D-3559
13	Nickel	1	0.001	mg/L	BDL	ASTM D-1886
14	Zinc	5	0.01	mg/L	0.10	USEPA 3500 Zn B
15	Oil & Grease	10	0.001	mg/L	NIL	APHA 5520-D
16	Fluoride (as F^-)	10	0.01	mg/L	0.01	USEPA 340.1
17	Phenolic compounds (as phenol)	0.1	0.001	mg/L	BDL	USEPA 420.1
18	Chloride (as Cl^-)	-	0.01	mg/L	30	Hach 8206
19	Mercury	0.01	0.001	mg/L	BDL	ASTM D-3223
20	Iron	8	0.01	mg/L	0.07	Hach 8008
21	An-ionic detergents (as MBAS)	20	0.001	mg/L	BDL	Method 5540 C
22	Manganese	1.5	0.1	mg/L	1.0	Hach 8034
23	Boron	6	0.01	mg/L	BDL	ASTM D-3082
24	Barium	1.5	0.1	mg/L	0.5	Hach 8014
25	Sulphate (SO_4^{-2})	-	1.0	mg/L	93	USEPA 375.4
26	Selenium	0.5	0.01	mg/L	BDL	ASTM D-3859
27	Total toxic metals	2	-	mg/L	1.7	-
28	Sulphide(S^{2-})	1	0.001	mg/L	0.03	Hach 8131
29	Silver	1	0.001	mg/L	BDL	ASTM D-3866
30	Arsenic	1	0.01	mg/L	0.013	Hach method
31	Chlorine	1	0.01	mg/L	BDL	Hach 80021

SEQS=Sindh Environmental Quality Standards
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
LDL= Least Detectable Value
NoGL=No Guideline Limits Available

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Sample Analyzed by: AFAQ AHMED

Signature of Laboratory In charge:
Name: Haseeb Arshad

Quality Testing Services Karachi Q.T.S

Lab Report Ref. No.: QTS/K4/2024/1441-B Reporting date: 25/11/2024
project Name: **60 MW Power Supply Component of K-IV Project (Transmission Line & Grid Station)**
Client: **Sindh Transmission & Dispatch Company (STDC)**

SAMPLE DESCRIPTION

Sample ID: Surface Water 02
Sampling Method: APHA 1060-A & B
Sample Type: Grab Sample
Sample Coordinate: 25°02'09.1"N 67°52'54.5"E
Sample Collected/Submitted by: QTS Representative
Sampling Date: 18/11/2024

ANALYTICAL TEST REPORT

S.NO.	PARAMETERS TO BE ANALYZED	STANDARD SEQS	LDL	UNITS	RESU4TS	TEST METHOD
1	Temperature	40	1.0	^{0}C	30.2	Thermometer
2	pH value	6-9	0.01	-	7.90	USEPA 150.1
3	Biochemical Oxygen Demand $(BOD)_5$ at 20^{0}C	200	0.1	mg/L	33	Hach 8043
4	Chemical Oxygen Demand (COD)	400	1.0	mg/L	77	Hach 8000
5	Total Suspended Solids (TSS)	200	1.0	mg/L	65	Hach 8006
6	Total Dissolved Solids (TDS)	3500	1.0	mg/L	385	Hach 8160
7	Cyanide (as CN-) total	1	0.001	mg/L	BDL	Hach 8027
8	Ammonia (NH_3)	40	0.1	mg/L	BDL	Hach 10031
9	Cadmium	0.1	0.001	mg/L	BDL	ASTM D-3557
10	Chromium (trivalent & hexavalent)	1	0.01	mg/L	0.10	ASTM D-1687
11	Copper	1	0.01	mg/L	0.04	Hach 8506
12	Lead	0.5	0.001	mg/L	BDL	ASTM D-3559
13	Nickel	1	0.001	mg/L	BDL	ASTM D-1886
14	Zinc	5	0.01	mg/L	0.08	USEPA 3500 Zn B
15	Oil & Grease	10	0.001	mg/L	0.48	APHA 5520-D
16	Fluoride (as F^-)	10	0.01	mg/L	BDL	USEPA 340.1
17	Phenolic compounds (as phenol)	0.1	0.001	mg/L	0.02	USEPA 420.1
18	Chloride (as Cl^-)	-	0.01	mg/L	75	Hach 8206
19	Mercury	0.01	0.001	mg/L	BDL	ASTM D-3223
20	Iron	8	0.01	mg/L	NIL	Hach 8008
21	An-ionic detergents (as MBAS)	20	0.001	mg/L	BDL	Method 5540 C
22	Manganese	1.5	0.1	mg/L	0.8	Hach 8034
23	Boron	6	0.01	mg/L	BDL	ASTM D-3082
24	Barium	1.5	0.1	mg/L	0.8	Hach 8014
25	Sulphate (SO_4^{-2})	-	1.0	mg/L	NIL	USEPA 375.4
26	Selenium	0.5	0.01	mg/L	BDL	ASTM D-3859
27	Total toxic metals	2	-	mg/L	1.61	-
28	Sulphide(S^{2-})	1	0.001	mg/L	0.022	Hach 8131
29	Silver	1	0.001	mg/L	BDL	ASTM D-3866
30	Arsenic	1	0.01	mg/L	0.016	Hach method
31	Chlorine	1	0.01	mg/L	BDL	Hach 80021

SEQS=Sindh Environmental Quality Standards
USEPA=United State Environmental Protection Agency method
Hach USA, method
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Sample Analyzed by: AFAQ AHMED

Signature of Laboratory In charge:
Name: Haseeb Arshad

Quality Testing Services Karachi Q.T.S

Ambient Air Quality and Noise
Test Report

Project Name:	**60 MW Power Supply Component of K-IV Project (Transmission Line & Grid Station)**	**Test Report No**	**QTS/K4/24/1442-A**
Client:	**Sindh Transmission & Dispatch Company (STDC)**	**Sampling Duration**	**24hrs.**
Sampling Description:	**Ambient Air Monitoring-AQ/N1**	**Site Coordinates:**	**24°54'13.0"N 67°59'48.8"E**
Location:	**Near Proposed Grid Station/Tower No:115**		

PARAMETERS										
Date	**Time**	**CO (mg/m^3)**	**NO ($\mu g/m^3$)**	**NO_2 ($\mu g/m^3$)**	**SO_2 ($\mu g/m^3$)**	**PM 10 ($\mu g/m^3$)**	**PM 2.5 ($\mu g/m^3$)**	**SPM ($\mu g/m^3$)**	**Lead ($\mu g/m^3$)**	**Noise dB(A)**
18.11.2024	10:00	0.05	10	32	13	144	101	288		53.2
	11:00	0.07	11	34	16	149	108	296		53.4
	12:00Pm	0.08	13	35	17	156	109	303		53.0
	1:00	0.09	15	36	19	162	112	312		52.8
	2:00	0.13	14	37	22	166	115	314		53.3
	3:00	0.15	16	38	23	171	118	317		53.4
	4:00	0.17	17	39	24	177	119	319		53.1
	5:00	0.18	19	42	25	189	123	323		52.6
	6:00	0.19	21	44	26	202	132	334		53.9
	7:00	0.22	23	45	28	205	134	338		53.7
	8:00	0.23	22	46	29	209	127	343		53.9
	9:00	0.24	21	47	32	213	122	345		52.3
	10:00	0.25	20	44	34	218	118	348	ND	53.4
	11:00	0.26	18	40	35	214	116	351		52.8
19.11.2024	12:00Am	0.29	17	38	37	202	110	355		53.3
	1:00	0.31	19	36	39	208	109	356		52.7
	2:00	0.34	20	35	36	206	111	364		54.6
	3:00	0.36	21	32	35	199	107	361		52.3
	4:00	0.39	19	30	34	196	102	358		52.2
	5:00	0.36	18	29	31	187	97	354		54.1
	6:00	0.31	17	28	29	181	88	349		52.8
	7:00	0.28	16	26	27	176	78	341		51.9
	8:00	0.25	15	28	26	165	73	339		53.3
	9:00	0.22	13	29	28	156	67	329		54.8
	10:00	0.21	14	32	29	145	72	314		52.9
MIN		0.05	10	26	13	144	67	288		51.9
MAX		0.39	23	47	39	218	134	364	*ND	54.8
AVG		0.22	17.1	36.1	27.6	183.6	106.2	333.4		53.18
SEQS		05	40	80	120	150	75	500	1.5	55
LDL-Limits		0ppm	0ppm	0ppm	0ppm	10µg/m3	2.5µg/m3	1µg/m3	-	25dB(A)

Quality Testing Services Karachi Q.T.S

Ambient Air Quality and Noise
Test Report

Project Name:	**60 MW Power Supply Component of K-IV Project (Transmission Line & Grid Station)**	**Test Report**	**QTS/K4/24/1442-A**
Client:	**Sindh Transmission & Dispatch Company (STDC)**	**Sampling Duration**	**24hrs.**
Sampling Description:	**Ambient Air Monitoring-AQ/N1**	**Site Coordinates :**	**24°54'13.0"N 67°59'48.8"E**
Location:	**Near Proposed Grid Station/Tower No:115**		

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m3	24 Hours	0.22	5.0	0.01	Non-Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m3	24 Hours	17.1	40.0	1.00	Chemiluminescence
Nitrogen Dioxide (NO2)	µg/m3	24 Hours	36.1	80.0	1.00	
Sulphur Dioxide (SO2)	µg/m3	24 Hours	27.6	120.0	1.00	Ultraviolet Fluorescence Method
Ozone (O3)	µg/m3	01 Hour	22.9	130.0	0 ppm	Non-Dispersive UV Absorption Method
Particulate Matter (PM10)	µg/m3	24 Hours	*183.6	150.0	1.00	β Ray Absorption Method
Particular Matter (PM2.5)	µg/m3	24 Hours	*106.2	75.0	1.0	
Total Suspended Particles (TSP)	µg/m3	24 Hours	333.4	500.0	1.0	
Lead	µg/m3	24 Hours	ND	1.5	-	ASS Method
Noise	dB(A)	24 Hours	53.18	55	25	Sound Level Meter/SLM

*SEQS= Sindh Environmental Quality Standards.
(24 Hours Standard for all the parameters Except O3 and CO),
µg/m3= Micrograms per Cubic Meter
mg/m3= Milligrams per Cubic Meter
ppm = Parts per million
ND= Not Detected

Remarks:

*The average concentration of PM-10 and PM-2.5 Exceed the SEQS Limits of Ambient Air Quality.

Sample Analyzed By: Ather Adil	**Signature of Laboratory Incharge:** _____ **Name: Haseeb Arshad**

Quality Testing Services Karachi Q.T.S

Ambient Air Quality and Noise
Test Report

Project Name:	**60 MW Power Supply Component of K-IV Project (Transmission Line & Grid Station)**	**Test Report No**	**QTS/K4/24/1442-B**
Client:	**Sindh Transmission & Dispatch Company (STDC)**	**Sampling Duration**	**24hrs.**
Sampling Description:	**Ambient Air Monitoring-AQ/N2**	**Site Coordinates:**	**24°53'37.4"N 67°57'34.6"E**
Location:	**Near Proposed Tower No:93**		

PARAMETERS										
Date	**Time**	**CO (mg/m^3)**	**NO ($\mu g/m^3$)**	**NO_2 ($\mu g/m^3$)**	**SO_2 ($\mu g/m^3$)**	**PM 10 ($\mu g/m^3$)**	**PM 2.5 ($\mu g/m^3$)**	**SPM ($\mu g/m^3$)**	**Lead ($\mu g/m^3$)**	**Noise dB(A)**
19.11.2024	10:30	0.08	16	24	14	105	45	213		52.4
	11:30	0.09	18	26	15	109	49	216		52.9
	12:30	0.15	19	28	17	110	55	219		53.3
	1:30	0.18	22	29	91	113	62	223		52.8
	2:30	0.22	23	34	20	116	66	229		54.0
	3:30	0.24	25	35	21	119	69	234		52.3
	4:30	0.27	27	37	20	123	74	240		53.4
	5:30	0.29	29	41	21	126	78	244		53.7
	6:30	0.34	32	43	22	134	81	247		52.9
	7:30	0.36	30	45	23	139	88	256		51.4
	8:30	0.38	27	47	24	143	91	261		53.1
	9:30	0.41	26	49	25	156	94	266		54.5
	10:30	0.44	25	53	26	165	90	269	ND	53.8
	11:30	0.45	24	50	24	171	89	276		53.2
20.11.2024	00:30	0.48	22	48	23	178	84	280		51.2
	1:30	0.39	20	46	20	183	80	283		51.7
	2:30	0.37	18	43	18	188	76	280		52.1
	3:30	0.36	17	40	71	177	70	275		53.8
	4:30	0.35	15	38	16	171	67	271		52.3
	5:30	0.33	14	34	15	167	65	267		51.0
	6:30	0.32	16	31	14	164	61	260		54.2
	7:30	0.30	17	29	15	169	66	256		52.1
	8:30	0.29	18	27	13	170	68	250		53.3
	9:30	0.27	19	25	12	162	69	249		52.5
	10:30	0.25	20	27	11	158	63	244		52.3
MIN		0.08	14	24	11	105	45	213		51
MAX		0.48	32	53	91	188	94	283	ND	54.5
AVG		0.30	21.6	37.2	25.6	148..4	71.8	252.0		52.80
SEQS		05	40	80	120	150	75	500	1.5	55
LDL-Limits		0ppm	0ppm	0ppm	0ppm	10µg/m3	2.5µg/m3	1µg/m3	-	25dB(A)

Ambient Air Quality and Noise
Test Report

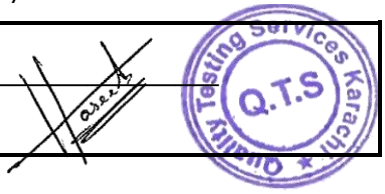
Project Name:	**60 MW Power Supply Component of K-IV Project (Transmission Line & Grid Station)**	**Test Report No**	**QTS/K4/24/1442-B**
Client:	**Sindh Transmission & Dispatch Company (STDC)**	**Sampling Duration**	**24hrs.**
Sampling Description:	**Ambient Air Monitoring-AQ/N2**	**Site Coordinates:**	**24°53'37.4"N 67°57'34.6"E**
Location:	**Near Proposed Tower No:93**		

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m3	24 Hours	0.30	5.0	0.01	Non-Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m3	24 Hours	21.6	40.0	1.00	Chemiluminescence
Nitrogen Dioxide (NO2)	µg/m3	24 Hours	37.2	80.0	1.00	
Sulphur Dioxide (SO2)	µg/m3	24 Hours	25.6	120.0	1.00	Ultraviolet Fluorescence Method
Ozone (O3)	µg/m3	01 Hour	25.7	130.0	0 ppm	Non-Dispersive UV Absorption Method
Particulate Matter (PM10)	µg/m3	24 Hours	148.4	150.0	1.00	β Ray Absorption Method
Particular Matter (PM2.5)	µg/m3	24 Hours	71.8	75.0	1.0	
Total Suspended Particles (TSP)	µg/m3	24 Hours	252.0	500.0	1.0	
Lead	µg/m3	24 Hours	ND	1.5	-	ASS Method
Noise	dB(A)	24 Hours	52.80	55	25	Sound Level Meter/SLM

*SEQS= Sindh Environmental Quality Standards.
(24 Hours Standard for all the parameters Except O3 and CO),
µg/m3= Micrograms per Cubic Meter
mg/m3= Milligrams per Cubic Meter
ppm = Parts per million
ND= Not Detected

Remarks:

The average concentration calculated for the 24 hours are well within guideline values set by SEQS

Sample Analyzed By: Hassan Ali	**Signature of Laboratory In charge:** _____  **Name: Haseeb Arshad**

Ambient Air Quality and Noise
Test Report

Project Name:	**60 MW Power Supply Component of K-IV Project (Transmission Line & Grid Station)**	**Test Report No**	**QTS/K4/24/1442-C**
Client:	**Sindh Transmission & Dispatch Company (STDC)**	**Sampling Duration**	**24hrs.**
Sampling Description:	**Ambient Air Monitoring-AQ/N3**	**Site Coordinates:**	**24°55'19.8"N 67°56'20.0"E**
Location:	**Near Proposed Tower No:77**		

PARAMETERS										
Date	**Time**	**CO (mg/m^3)**	**NO ($\mu g/m^3$)**	**NO_2 ($\mu g/m^3$)**	**SO_2 ($\mu g/m^3$)**	**PM 10 ($\mu g/m^3$)**	**PM 2.5 ($\mu g/m^3$)**	**SPM ($\mu g/m^3$)**	**Lead ($\mu g/m^3$)**	**Noise dB(A)**
20.11.2024	11:00	0.02	10	21	08	87	43	176		54.6
	12:00	0.07	13	23	09	90	44	181		54.9
	1:00	0.04	14	24	11	93	45	183		53.0
	2:00	0.09	16	26	13	97	47	185		54.1
	3:00	0.13	18	27	14	99	49	188		52.6
	4:00	0.16	19	29	15	102	50	196		52.8
	5:00	0.18	21	31	16	105	52	202		51.9
	6:00	0.19	20	33	14	108	53	206		53.2
	7:00	0.20	23	34	12	112	55	211		54.4
	8:00	0.27	24	35	10	115	56	217		52.6
	9:00	0.29	26	38	14	118	58	219		52.8
	10:00	0.30	25	39	13	119	59	223		51.9
	11:00	0.33	22	43	16	121	62	225	ND	53.0
	00:00	0.36	19	45	17	123	64	229		52.3
21.11.2024	1:00	0.38	18	46	19	125	65	234		54.1
	2:00	0.30	17	48	18	131	67	237		52.0
	3:00	0.33	15	43	16	134	69	245		53.9
	4:00	0.36	14	40	14	139	73	256		52.8
	5:00	0.34	11	39	10	143	75	263		51.7
	6:00	0.29	13	37	12	147	78	266		53.5
	7:00	0.22	14	35	09	151	79	260		53.3
	8:00	0.20	16	33	07	155	82	258		52.0
	9:00	0.18	17	31	10	162	78	251		51.9
	10:00	0.16	19	30	13	160	73	249		53.2
	11:00	0.14	21	28	14	152	70	244		53.4
MIN		0.02	10	21	7	87	43	176		51.7
MAX		0.38	26	48	19	162	82	266	ND	54.9
AVG		0.21	17.8	34.3	12.9	123.5	61.8	223.9		53.03
SEQS		05	40	80	120	150	75	500	1.5	55
LDL-Limits		0ppm	0ppm	0ppm	0ppm	10µg/m3	2.5µg/m3	1µg/m3	-	25dB(A)

Ambient Air Quality and Noise
Test Report

Project Name:	**60 MW Power Supply Component of K-IV Project (Transmission Line & Grid Station)**	**Test Report No**	**QTS/K4/24/1443-C**
Client:	**Sindh Transmission & Dispatch Company (STDC)**	**Sampling Duration**	**24hrs.**
Sampling Description:	**Ambient Air Monitoring-AQ/N3**	**Site Coordinates:**	**24°55'19.8"N 67°56'20.0"E**
Location:	**Near Proposed Tower No:77**		

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m3	24 Hours	0.21	5.0	0.01	Non-Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m3	24 Hours	17.8	40.0	1.00	Chemiluminescence
Nitrogen Dioxide (NO2)	µg/m3	24 Hours	34.3	80.0	1.00	
Sulphur Dioxide (SO2)	µg/m3	24 Hours	12.9	120.0	1.00	Ultraviolet Fluorescence Method
Ozone (O3)	µg/m3	01 Hour	21.8	130.0	0 ppm	Non-Dispersive UV Absorption Method
Particulate Matter (PM10)	µg/m3	24 Hours	123.5	150.0	1.00	β Ray Absorption Method
Particular Matter (PM2.5)	µg/m3	24 Hours	61.8	75.0	1.0	
Total Suspended Particles (TSP)	µg/m3	24 Hours	223.9	500.0	1.0	
Lead	µg/m3	24 Hours	ND	1.5	-	ASS Method
Noise	dB(A)	24 Hours	53.03	55	25	Sound Level Meter/SLM

*SEQS= Sindh Environmental Quality Standards.
(24 Hours Standard for all the parameters Except O3 and CO),
µg/m3= Micrograms per Cubic Meter
mg/m3= Milligrams per Cubic Meter
ppm = Parts per million
ND= Not Detected

Remarks:

The average concentration calculated for the 24 hours are well within guideline values set by SEQS

Sample Analyzed By: Ather Adil	**Signature of Laboratory In charge:** _____ **Name: Haseeb Arshad**

Ambient Air Quality and Noise
Test Report

Project Name:	60 MW Power Supply Component of K-IV Project (Transmission Line & Grid Station)	**Test Report No**	QTS/K4/24/1442-D
Client:	Sindh Transmission & Dispatch Company (STDC)	**Sampling Duration**	24hrs.
Sampling Description:	Ambient Air Monitoring-AQ/N4	**Site Coordinates:**	24°55'58.6"N 67°55'50.8"E
Location:	Near Proposed Tower No:70		

PARAMETERS										
Date	**Time**	**CO (mg/m^3)**	**NO ($\mu g/m^3$)**	**NO_2 ($\mu g/m^3$)**	**SO_2 ($\mu g/m^3$)**	**PM 10 ($\mu g/m^3$)**	**PM 2.5 ($\mu g/m^3$)**	**SPM ($\mu g/m^3$)**	**Lead ($\mu g/m^3$)**	**Noise dB(A)**
21.11.2024	11:30	0.16	15.5	21.1	8.8	93	45	177		53.3
	12:30	0.18	15.8	21.4	9.1	96	46	179		53.6
	1:30	0.19	15.9	21.6	9.2	99	47	184		53.5
	2:30	0.22	16.0	21.6	9.4	101	48	193		53.7
	3:30	0.24	16.3	21.8	9.45	106	49	199		53.9
	4:30	0.26	16.6	22.0	9.7	109	52	202		53.8
	5:30	0.27	16.8	22.4	9.9	112	55	208		54.0
	6:30	0.29	16.9	22.6	10.0	114	56	213		54.1
	7:30	0.31	17.0	22.8	10.2	116	57	215		54.2
	8:30	0.33	17.2	22.9	10.3	117	58	218		54.4
	9:30	0.35	17.4	23.4	10.5	118	59	223		54.5
	10:30	0.36	17.7	23.6	10.7	119	65	228		52.7
	11:30	0.37	17.9	23.7	10.9	123	67	229	ND	53.9
	00:30	0.39	18.0	23.9	11.0	120	68	234		52.0
22.11.2024	1:30	0.40	18.2	24.0	11.3	122	69	237		54.3
	2:30	0.42	18.4	24.4	11.5	125	76	243		52.6
	3:30	0.44	18.5	25.0	11.8	131	78	248		53.7
	4:30	0.45	18.8	25.3	11.6	129	79	256		52.8
	5:30	0.47	18.6	25.8	11.2	124	83	260		52.6
	6:30	0.49	18.1	26.4	10.9	118	80	262		51.1
	7:30	0.46	17.7	26.2	10.6	117	75	266		53.8
	8:30	0.41	17.1	26.0	10.5	110	73	271		53.4
	9:30	0.38	16.9	25.9	10.0	114	71	266		52.9
	10:30	0.36	16.4	25.5	9.9	109	67	260		52.7
	11:30	0.34	16.1	24.9	9.8	111	64	256		53.0
MIN		0.16	15.5	21.1	8.8	93	45	177		51.1
MAX		0.49	18.8	26.4	11.8	131	83	271	ND	54.5
AVG		0.34	17.1	23.7	10.3	113.9	63.5	228.7		53.38
SEQS		05	40	80	120	150	75	500	1.5	55
LDL-Limits		0ppm	0ppm	0ppm	0ppm	10µg/m3	2.5µg/m3	1µg/m3	-	25dB(A)

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Ambient Air Quality and Noise
Test Report

Project Name:	**60 MW Power Supply Component of K-IV Project (Transmission Line & Grid Station)**	**Test Report No**	**QTS/K4/24/1442-D**
Client:	**Sindh Transmission & Dispatch Company (STDC)**	**Sampling Duration**	**24hrs.**
Sampling Description:	**Ambient Air Monitoring-AQ/N4**	**Site Coordinates:**	**24°55'58.6"N 67°55'50.8"E**
Location:	**Near Proposed Tower No:70**		

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m3	24 Hours	0.34	5.0	0.01	Non-Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m3	24 Hours	17.1	40.0	1.00	Chemiluminescence
Nitrogen Dioxide (NO2)	µg/m3	24 Hours	23.7	80.0	1.00	
Sulphur Dioxide (SO2)	µg/m3	24 Hours	10.3	120.0	1.00	Ultraviolet Fluorescence Method
Ozone (O3)	µg/m3	01 Hour	21.5	130.0	0 ppm	Non-Dispersive UV Absorption Method
Particulate Matter (PM10)	µg/m3	24 Hours	113.9	150.0	1.00	β Ray Absorption Method
Particular Matter (PM2.5)	µg/m3	24 Hours	63.5	75.0	1.0	
Total Suspended Particles (TSP)	µg/m3	24 Hours	228.7	500.0	1.0	
Lead	µg/m3	24 Hours	ND	1.5	-	ASS Method
Noise	dB(A)	24 Hours	53.38	55	25	Sound Level Meter/SLM

*SEQS= Sindh Environmental Quality Standards.
(24 Hours Standard for all the parameters Except O3 and CO),
µg/m3= Micrograms per Cubic Meter
mg/m3= Milligrams per Cubic Meter
ppm = Parts per million
ND= Not Detected

Remarks:
The average concentration calculated for the 24 hours are well within guideline values set by SEQS

Sample Analyzed By: Hassan Ali	**Signature of Laboratory Incharge:** _____ **Name: Haseeb Arshad**

Ambient Air Quality and Noise
Test Report

Project Name:	60 MW Power Supply Component of K-IV Project (Transmission Line & Grid Station)	**Test Report No**	QTS/K4/24/1442-E
Client:	Sindh Transmission & Dispatch Company (STDC)	**Sampling Duration**	24hrs.
Sampling Description:	Ambient Air Monitoring-AQ/N5	**Site Coordinates:**	24°58'08.2"N 67°54'34.1"E
Location:	Near Proposed Tower No:47		

PARAMETERS										
Date	**Time**	**CO (mg/m³)**	**NO (µg/m³)**	**NO_2 (µg/m³)**	**SO_2 (µg/m³)**	**PM 10 (µg/m³)**	**PM 2.5 (µg/m³)**	**SPM (µg/m³)**	**Lead (µg/m³)**	**Noise dB(A)**
22.11.2024	12:00	0.16	9	15	7	91	23	188		53.3
	1:00	0.17	10	16	8	93	25	191		53.6
	2:00	0.18	11	18	9	96	27	194		53.8
	3:00	0.19	13	19	11	97	29	197		53.9
	4:00	0.22	14	22	12	99	31	199		54.0
	5:00	0.23	15	23	13	101	34	205		54.1
	6:00	0.25	16	24	14	103	36	205		54.2
	7:00	0.26	18	25	15	105	38	209		54.5
	8:00	0.28	19	26	16	108	39	213		54.6
	9:00	0.29	20	27	14	109	43	217		54.7
	10:00	0.30	22	29	13	113	46	218		54.8
	11:00	0.33	23	33	12	112	47	223		54.9
	00:00	0.34	24	34	10	110	49	226	ND	53.6
	1:00	0.35	25	35	9	114	53	227		53.8
23.11.2024	2:00	0.32	26	37	8	116	55	229		52.9
	3:00	0.30	28	38	7	118	56	234		53.2
	4:00	0.29	29	36	6	119	58	236		53.1
	5:00	0.27	31	35	8	113	61	238		52.0
	6:00	0.26	28	32	9	116	60	242		51.9
	7:00	0.25	27	30	11	112	56	247		54.8
	8:00	0.24	25	29	12	110	53	251		52.7
	9:00	0.22	22	37	14	108	50	255		53.8
	10:00	0.19	19	28	13	104	49	251		54.4
	11:00	0.17	18	30	15	102	51	249		52.3
	12:00	0.18	16	31	16	106	53	246		51.1
MIN		0.16	9	15	6	91	23	188		51.1
MAX		0.35	31	38	16	119	61	255	ND	54.9
AVG		0.25	20.2	28.2	11.2	106.8	44.6	223.4		53.6
SEQS		05	40	80	120	150	75	500	1.5	55
LDL-Limits		0ppm	0ppm	0ppm	0ppm	10µg/m3	2.5µg/m3	1µg/m3	-	25dB(A)

Ambient Air Quality and Noise
Test Report

Project Name:	**60 MW Power Supply Component of K-IV Project (Transmission Line & Grid Station)**	**Test Report No**	**QTS/K4/24/1442-E**
Client:	**Sindh Transmission & Dispatch Company (STDC)**	**Sampling Duration**	**24hrs.**
Sampling Description:	**Ambient Air Monitoring-AQ/N1**	**Site Coordinates:**	**24°58'08.2"N 67°54'34.1"E**
Location:	**Near Proposed Tower No:47**		

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m3	24 Hours	0.25	5.0	0.01	Non-Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m3	24 Hours	20.2	40.0	1.00	Chemiluminescence
Nitrogen Dioxide (NO2)	µg/m3	24 Hours	28.2	80.0	1.00	
Sulphur Dioxide (SO2)	µg/m3	24 Hours	11.2	120.0	1.00	Ultraviolet Fluorescence Method
Ozone (O3)	µg/m3	01 Hour	23.4	130.0	0 ppm	Non-Dispersive UV Absorption Method
Particulate Matter (PM10)	µg/m3	24 Hours	106.8	150.0	1.00	β Ray Absorption Method
Particular Matter (PM2.5)	µg/m3	24 Hours	44.6	75.0	1.0	
Total Suspended Particles (TSP)	µg/m3	24 Hours	223.4	500.0	1.0	
Lead	µg/m3	24 Hours	ND	1.5	-	ASS Method
Noise	dB(A)	24 Hours	53.6	55	25	Sound Level Meter/SLM

*SEQS= Sindh Environmental Quality Standards.
(24 Hours Standard for all the parameters Except O3 and CO),
µg/m3= Micrograms per Cubic Meter
mg/m3= Milligrams per Cubic Meter
ppm = Parts per million
ND= Not Detected

Remarks:

* The average concentration calculated for the 24 hours are well within guideline values set by SEQS

Sample Analyzed By: Ather Adil	**Signature of Laboratory In charge:** **Name: Haseeb Arshad**

Ambient Air Quality and Noise
Test Report

Project Name:	60 MW Power Supply Component of K-IV Project (Transmission Line & Grid Station)	**Test Report No**	QTS/K4/24/1442-F
Client:	Sindh Transmission & Dispatch Company (STDC)	**Sampling Duration**	24hrs.
Sampling Description:	Ambient Air Monitoring-AQ/N6	**Site Coordinates:**	25°02'06.8"N 67°52'56.3"E
Location:	Near Proposed Tower No:34		

PARAMETERS										
Date	**Time**	**CO (mg/m^3)**	**NO ($\mu g/m^3$)**	**NO_2 ($\mu g/m^3$)**	**SO_2 ($\mu g/m^3$)**	**PM 10 ($\mu g/m^3$)**	**PM 2.5 ($\mu g/m^3$)**	**SPM ($\mu g/m^3$)**	**Lead ($\mu g/m^3$)**	**Noise dB(A)**
23.11.2024	1:00	0.04	14	19	5	78	23	166		50.2
	2:00	0.07	15	22	7	83	24	171		50.5
	3:00	0.08	17	23	8	85	25	178		50.6
	4:00	0.09	19	24	9	87	26	180		50.8
	5:00	0.13	20	25	10	89	28	183		50.9
	6:00	0.14	18	26	11	91	29	185		51.2
	7:00	0.14	16	27	12	93	31	188		51.3
	8:00	0.15	14	28	13	95	34	191		51.6
	9:00	0.16	13	29	14	97	35	193		51.7
	10:00	0.18	15	32	12	99	37	199		51.8
	11:00	0.19	16	34	10	101	38	202		52.0
24.11.2024	00:00	0.22	17	30	9	105	45	205		52.2
	1:00	0.24	19	34	8	108	56	208	ND	52.6
	2:00	0.26	20	36	7	109	59	209		52.8
	3:00	0.28	22	37	5	111	61	213		52.9
	4:00	0.29	21	38	67	113	60	217		53.0
	5:00	0.31	19	39	9	115	58	219		53.3
	6:00	0.33	18	41	10	117	54	223		53.2
	7:00	0.32	17	40	11	118	52	220		53.0
	8:00	0.30	16	49	12	123	49	214		53.1
	9:00	0.28	14	48	13	124	47	210		52.9
	10:00	0.27	13	47	14	127	46	209		52.7
	11:00	0.26	11	45	12	131	43	203		52.6
	12;00	0.24	10	43	10	134	49	205		53.1
	1:00	0.22	09	40	9	130	39	208		53.7
MIN		0.04	9	19	5	78	23	166		50.2
MAX		0.33	22	49	67	134	61	223	ND	53.7
AVG		0.20	16.0	34.2	14.0	106.4	41.9	199.5		52.1
SEQS		05	40	80	120	150	75	500	1.5	55
LDL-Limits		0ppm	0ppm	0ppm	0ppm	10µg/m3	2.5µg/m3	1µg/m3	-	25dB(A)

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Ambient Air Quality and Noise
Test Report

Project Name:	**60 MW Power Supply Component of K-IV Project (Transmission Line & Grid Station)**	**Test Report No**	**QTS/K4/24/1442-F**
Client:	**Sindh Transmission & Dispatch Company (STDC)**	**Sampling Duration**	**24hrs.**
Sampling Description:	**Ambient Air Monitoring-AQ/N6**	**Site Coordinates:**	**25°02'06.8"N 67°52'56.3"E**
Location:	**Near Proposed Tower No:34**		

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m3	24 Hours	0.20	5.0	0.01	Non-Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m3	24 Hours	16.0	40.0	1.00	Chemiluminescence
Nitrogen Dioxide (NO2)	µg/m3	24 Hours	34.2	80.0	1.00	
Sulphur Dioxide (SO2)	µg/m3	24 Hours	14.0	120.0	1.00	Ultraviolet Fluorescence Method
Ozone (O3)	µg/m3	01 Hour	22.5	130.0	0 ppm	Non-Dispersive UV Absorption Method
Particulate Matter (PM10)	µg/m3	24 Hours	106.4	150.0	1.00	β Ray Absorption Method
Particular Matter (PM2.5)	µg/m3	24 Hours	41.9	75.0	1.0	
Total Suspended Particles (TSP)	µg/m3	24 Hours	199.5	500.0	1.0	
Lead	µg/m3	24 Hours	ND	1.5	-	ASS Method
Noise	dB(A)	24 Hours	52.1	55	25	Sound Level Meter/SLM

*SEQS= Sindh Environmental Quality Standards.
(24 Hours Standard for all the parameters Except O3 and CO),
µg/m3= Micrograms per Cubic Meter
mg/m3= Milligrams per Cubic Meter
ppm = Parts per million
ND= Not Detected

Remarks:

* The average concentration calculated for the 24 hours are well within guideline values set by SEQS.

Sample Analyzed By: Hassan Ali	**Signature of Laboratory Incharge:** _____ **Name: Haseeb Arshad**

Ambient Air Quality and Noise
Test Report

Project Name:	60 MW Power Supply Component of K-IV Project (Transmission Line & Grid Station)	**Test Report No**	QTS/K4/24/1442-G
Client:	Sindh Transmission & Dispatch Company (STDC)	**Sampling Duration**	24hrs.
Sampling Description:	Ambient Air Monitoring-AQ/N7	**Site Coordinates:**	25°02'57.5"N 67°52'04.3"E
Location:	Near NTDC Jhimpir II Grid Station		

PARAMETERS										
Date	**Time**	**CO (mg/m³)**	**NO (µg/m³)**	**NO_2 (µg/m³)**	**SO_2 (µg/m³)**	**PM 10 (µg/m³)**	**PM 2.5 (µg/m³)**	**SPM (µg/m³)**	**Lead (µg/m³)**	**Noise dB(A)**
24.11.2024	1:30	0.16	18	25	11	112	31	219		53.4
	2:30	0.17	19	27	13	115	34	223		53.7
	3:30	0.18	22	28	14	116	35	227		53.9
	4:30	0.20	23	29	15	119	37	229		54.0
	5:30	0.22	24	32	17	120	38	234		54.4
	6:30	0.24	26	34	18	123	39	236		52.6
	7:30	0.24	27	35	19	125	43	239		53.8
	8:30	.26	28	36	21	127	45	242		53.9
	9:30	0.29	29	38	23	131	46	245		53.0
	10:30	0.30	31	39	24	134	47	248		54.1
	11:30	0.33	33	42	25	136	49	253		52.3
25.11.2024	12:30	0.34	34	45	27	137	53	255		53.5
	1:30	0.35	35	46	28	141	54	258	ND	53.8
	2:30	0.37	36	48	29	144	57	261		52.1
	3:30	0.39	34	44	32	148	59	266		53.3
	4:30	0.41	32	43	30	146	62	269		53.3
	5:30	0.44	30	45	31	143	64	271		53.4
	6:30	0.46	29	42	29	141	66	277		53.5
	7:30	0.47	27	40	27	139	68	279		54.1
	8:30	0.48	26	39	25	137	65	280		54.2
	9:30	0.49	24	38	24	134	61	282		54.0
	10:30	0.46	23	37	22	130	60	280		53.4
	11:30	0.44	21	35	21	128	59	277		53.6
	12:30	0.41	24	33	20	121	54	271		54.3
	1:30	0.39	26	32	18	119	53	267		53.9
MIN		0.16	18	25	11	112	31	219		52.1
MAX		0.49	36	48	32	148	68	282	ND	54.4
AVG		0.33	27.2	37.2	22.4	130.5	51.0	255.1		53.58
SEQS		05	40	80	120	150	75	500	1.5	55
LDL-Limits		0ppm	0ppm	0ppm	0ppm	10µg/m3	2.5µg/m3	1µg/m3	-	25dB(A)

Ambient Air Quality and Noise
Test Report

Project Name:	**60 MW Power Supply Component of K-IV Project (Transmission Line & Grid Station)**	**Test Report No**	**QTS/K4/24/1442-G**
Client:	**Sindh Transmission & Dispatch Company (STDC)**	**Sampling Duration**	**24hrs.**
Sampling Description:	**Ambient Air Monitoring-AQ/N7**	**Site Coordinates:**	**25°02'57.5"N 67°52'04.3"E**
Location:	**Near NTDC Jhimpir II Grid Station**		

Parameter	Unit	Monitoring Duration	Average Obtained Concentration	SEQS	LDL-Limits	Methodology
Carbon Monoxide (CO)	mg/m3	24 Hours	0.33	5.0	0.01	Non-Dispersive Intra Red (NDIR)
Nitrogen oxide (NO)	µg/m3	24 Hours	27.2	40.0	1.00	Chemiluminescence
Nitrogen Dioxide (NO2)	µg/m3	24 Hours	37.2	80.0	1.00	
Sulphur Dioxide (SO2)	µg/m3	24 Hours	22.4	120.0	1.00	Ultraviolet Fluorescence Method
Ozone (O3)	µg/m3	01 Hour	24.4	130.0	0 ppm	Non-Dispersive UV Absorption Method
Particulate Matter (PM10)	µg/m3	24 Hours	130.5	150.0	1.00	β Ray Absorption Method
Particular Matter (PM2.5)	µg/m3	24 Hours	51.0	75.0	1.0	
Total Suspended Particles (TSP)	µg/m3	24 Hours	255.1	500.0	1.0	
Lead	µg/m3	24 Hours	ND	1.5	-	ASS Method
Noise	dB(A)	24 Hours	53.58	55	25	Sound Level Meter/SLM

*SEQS= Sindh Environmental Quality Standards.
(24 Hours Standard for all the parameters Except O3 and CO),
µg/m3= Micrograms per Cubic Meter
mg/m3= Milligrams per Cubic Meter
ppm = Parts per million
ND= Not Detected

Remarks:

* The average concentration calculated for the 24 hours are well within guideline values set by SEQS.

Sample Analyzed By: Ather Adil	**Signature of Laboratory In charge:** _____ **Name: Haseeb Arshad**

Annex III - Disaster Management Plan

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Disaster Management Plan

1. Introduction

The geographical location of many urban centers places them at risk of natural disasters, including earthquakes due to active geological fault lines, cyclones, hurricanes, and urban flooding, especially in densely populated areas.

In the event of such disasters, the organization will have a crucial role to play—firstly, to manage internal recovery, and secondly, to resume its services as swiftly as possible. This challenging task requires meticulous planning, regular drills, and coordinated execution under a comprehensive Disaster Management Program.

2. Policy Statement

The organization's Disaster Management Procedure will address major disruptions caused by natural disasters that affect its operations and infrastructure, ensuring a swift and effective response in line with relevant laws and regulations.

This Disaster Management Plan will provide guidelines for all departments and individuals with defined roles to handle emergencies in a systematic and organized manner. Such emergencies may include tornadoes, fire incidents, earthquakes, hurricanes, or any situation that, in the judgment of senior management, requires activation of the "Emergency/Disaster Response Plan."
All business units will maintain and enhance personnel, equipment, and infrastructure resources necessary to conduct emergency responses effectively. The plan will demonstrate the organization's readiness to respond to any emergency at short notice, with all departments mobilizing their resources as required.
The specific roles and resources necessary for disaster management are detailed in the Disaster Management Plan. Departments are responsible for promptly notifying all relevant parties of any changes in roles or equipment. The plan will require ongoing updates and rehearsals to ensure its effectiveness, which can only occur if all departments are fully involved and actively engaged in keeping records current.

3. Purpose

To establish efficient coordination and communication systems required to respond to any accident or crisis in a systematic and organized manner with the following objectives:

- Protecting employees and visitors
- Safeguarding property and assets
- Resuming normal operations quickly
- Ensuring as much self-sufficiency as possible during disaster response
- Prioritizing personnel and resources, and clearly defining tasks

4. Scope

This procedure applies to all personnel and locations within the organization. It is mandatory for all personnel involved in these activities to adhere to these procedures.

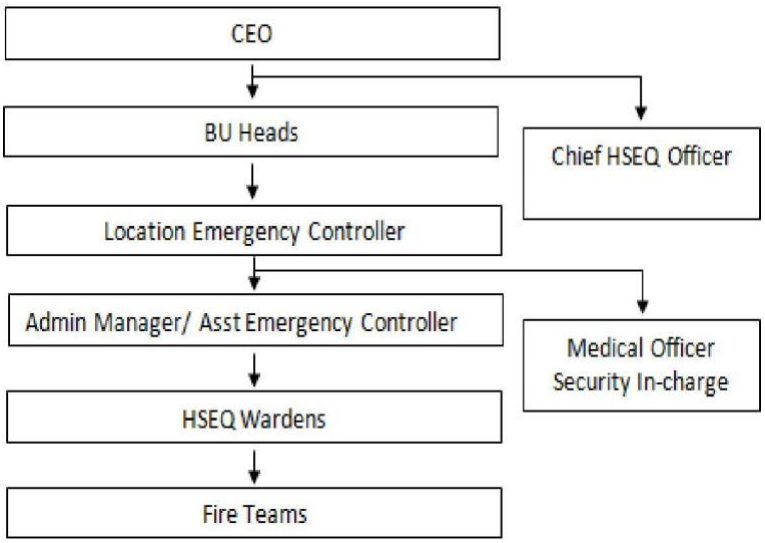
5. Principles

The principles of this disaster management plan are rooted in preparedness, coordination, and resilience. All personnel and departments must be proactive in planning for emergencies, ensuring that roles, resources, and communication channels are well-defined. Regular training and drills are essential to maintain readiness and adaptability during crisis situations. The plan emphasizes a structured response, prioritizing the safety of individuals, protection of assets, and swift recovery of operations. Continuous improvement through feedback and preventive actions is vital to maintaining an effective disaster management system.

6. Definitions

NDMA	:	National Disaster Management Authority
PDMA	:	Provincial Disaster Management Authority
DCC	:	Disaster Control Center
DMP	:	Disaster Management Plan
BU	:	Business Unit

7. ORGANIZATION CHART OF DISASTER



MANAGEMENT

8. Responsibilities

8.1 Chief Executive Officer

- Liaison with major government functionaries.
- Approve disaster management policies and procedures.

- Ensure that finance department makes available sufficient funds.
- Issue or clear press release after accident if required.
- Advice all concerned for ensuring the conformity of all actions to establish co-ordination function.
- Where appropriate, visit disaster site and or injured employees.
- Head Disaster Control Center

8.2 BU Heads

- Coordinate with DCC or the other disaster Management agencies on required basis.
- Each plant or location may require a different type of disaster response organization to meet its particular needs so prepare customize DMP accordingly.
- Identify the human and material resource and devise a call out procedure for off duty key personnel.
- Prepare procedures to be followed at the start of emergency / recovery plan.
- Training of personnel.

8.3 Chief HSEQ Officer

- Liaise with national and provincial disaster agencies.
- Assist BU's in preparation/implementation of DMP.
- Advice CEO about nature of emergency, immediate remedial action and on relevant safety and investigation issues / process.
- Be available at DCC.
- Declare disaster emergency condition as per situation.
- Periodic audit of DMP.

8.4 Location Emergency Controller

Throughout the duration of an emergency, concerned emergency controller will be responsible for making command decisions and/or coordinating decisions with administration to respond appropriately to the emergency.

- Liaise with Chief HSEQ Officer for notification of emergency
- Suspend, resume and continue operational activities.
- Coordinate with the outside agencies.
- Authorize evacuation.
- Start firefighting activities after notifying the fire brigade.
- Give technical advice to the fire department officer.
- Coordinate and/or approve activities and decisions of the field staff.
- Select and/or approve appropriate strategies to meet the emergency.
- Coordinate the joint planning and implementation of tactical operations.
- Initiate rescue activities needed and see that first aid is rendered to injured persons pending arrival of the ambulance.
- Notify neighboring areas that may endangered.

- Get word promptly to off-duty key supervision in night shifts, weekends, and holidays.
- Organize area messenger service to function in case of failure of telephone service.
- Determine overall objectives to meet emergency.
- Liaise with Disaster Control Center

8.5 Administration Manager / Assistant emergency controller

- Assist the emergency controller during emergency
- Develop and maintain an intra-departmental plan to meet emergencies, as well as a call-out list of vital personnel.
- Develop and maintain a list of equipment, supplies, tools and machinery on hand, as well as those needed to meet particular emergencies.
- Mobilize teams to assist in coping with preparation, response and securing from an emergency.
- Coordinate requests for gathering and delivery of personnel and supplies.
- Ensure isolation of emergency area via control of gas, water, power and sanitation.
- Clear and maintain access routes as required.
- Have access to building floor plans, schematics and mechanical drawings of buildings.
- Provide for emergency power to areas requiring such to maintain operations during an emergency.
- Determine extent of damages.
- Provide cost estimate of damage.
- Assist in preparing and securing buildings.
- Assist with rescue efforts.
- Provide for cleanup effort after emergency.
- Care for utility emergencies (e.g., down power lines).
- Provide custodial services to shelters and buildings maintaining operations during emergency event.
- Assist in barricading and physically isolating designated areas.
- Provide additional vehicles and vehicle maintenance as required.

8.6 Security in-charge

- Determine initial condition and extent of emergency situation, response criteria and potential for escalation.
- Collect and disseminate intelligence information.
- Control affected areas until relieved by proper authority.
- Provide radio and telephone communications to field teams.
- Conduct any necessary searches of area.
- Preserve law and order.
- Maintain public safety.
- Provide for crowd control and movement of personnel.
- Control vehicular traffic at evacuation routes, as well as ingress/egress to emergency location.
- Secure and maintain continuous security of buildings/installations.

- Preservation of emergency scene and evidentiary materials.
- Maintain up-to-date lists of emergency response agencies and personnel.
- Monitor weather conditions.
- Provide continuous updates of emergency conditions as situations escalate or deescalate.
- Report localized hazardous conditions as they develop in order to limit further damage/injury.
- Provide initial first aid to injury victims.
- Provide or assist with rescue efforts.
- Develop and maintain list of equipment and supplies on hand and those needed for particular emergencies.

8.7 Medical officer

- Prepare plans for use of alternate and/or additional medical centers.
- Assign doctors, paramedics and ambulance drivers to specific jobs.
- Prepare procedure for accounting for injured personnel.
- Prepare procedure for identification of fatalities and notification of the coroner.
- Establish hospital liaison and contact with medical supply houses for procurement of supplies (nights, Saturdays/holidays)
- Co-ordinate drills with other groups in the disaster organization.

8.8 Employee / Department Responsibilities

- Print and have available two copies of the Disaster Management Procedure: one for the office and one for home.
- Print contact pages to have readily available in the event of emergency.
- Assess the urgency of the situation and make the appropriate call.
- Secure office equipment, files and furniture.
- Make a backup of essential electronic data and keep in a secondary location.
- Unplug electrical outlets.
- Cover equipment (desktop computers, printers, monitors, copiers, fax machines).
- Secure hazardous chemicals.
- Secure materials according to standard industry practices and policies. Each department is responsible for its own materials.
- Prepare emergency kit, which should contain items necessary to carry on business in event of an emergency.

9. Activation Of Disaster Control Center:

The Disaster Control Centre will serve as the central command post for coordinating both external and internal information, communication, response, and all relevant decision-making. The center will be located at the Head Office and will be headed by the CEO.

Upon arrival, members are responsible for organizing and setting up the center according to the Disaster Control Plan. Once the setup is complete, all phones, faxes, computers, televisions, and other essential equipment must be operational and ready for use.

- Once the Emergency Control Center is established, proceed with the Quick Start-Up Checklist. If completed, members should continue with tasks specific to their department under their assigned disaster management responsibilities.
- The Emergency Response Quick Start-Up Checklist includes tasks that must be performed immediately upon notification. It is the responsibility of all members to ensure these tasks are completed when they arrive at the Control Center. The Administration Department will be responsible for the activation and management of the Control Center.
- Upon declaration of a disaster or emergency alert, the organization's leadership will be notified and, if accessible, will report immediately to the Control Center.
- In the event of a localized emergency caused by industrial factors, a field control center may be set up closer to the source of the issue.
- The Control Center will be staffed by department heads and their aides. The Administration Department will ensure that the Control Center is adequately equipped with communication facilities, auxiliary lighting, and emergency equipment.

10. Rules And Regulations:

- National Disaster Management Act 2010

11. General Considerations When Emergency Strikes:

11.1 Be prepared

The time to read these instructions is before an emergency strikes, so that, forewarned, you know what to do as soon as danger threatens. Just as the middle of a darkening moor is no place to begin learning how to use a map and compass, the middle of a crisis is no time to begin discovering how to deal with it. Emergency experts also stress that, in any crisis, thinking is as crucial as doing. First assess the situation quickly, they say – then act. The experts identify their major rules to bear in mind: do not panic; improvise; and weigh the risks.

11.2 Do not panic

In any crisis, staying calm is the most important rule of all. Panic can turn a problem into a tragedy; and staying calm can do more than any other single factor to save a life – yours or someone else's.

Knowledge is one antidote to it. The best cure, though, is an unshakable determination not to give way to it. Keep telling yourself that panic will only make things worse.

11.3 Improvise

No emergency is quite like any other. Treating a bad cut at home when you have a first aid kit to hand and an ambulance only a telephone call away is very different from trying to cope with the same problem when you are out camping far from help.

In any situation, if you do not have exactly what you need, be prepared to make do with whatever is to hand. Look around for possible substitutes. Keep looking until you find one.

12. EARTHQUAKE:

During the shock following are the hazards

- Falling objects
- Weakened Building Parts
- After-shocks

Earthquakes normally last for less than a minute on feeling the shock we can just get out of a small building or house but it will not be possible for us to get out of a large or multistoried building complex in a few seconds. Under such a condition it is better to:

12.1 Immediate actions

- ➢ Stay in-side;
- Take cover under some piece of Heavy Furniture or a Table
- Go in a corner and sit down away from cabinets, shelves window panes and other hanging objects
- Hold some heavy object
- Keep a pillow or a similar thing over your head
- ➢ If you are out;
- Stay away from the buildings and other structures
- Stay away from the poles and overhead wires
- Stay away from the trees
- ➢ If you are in a car
- Stop the car, remain in-side and park it away from the:
- Buildings and other structures
- Poles trees and overhead wires
- ➢ Remedial actions
- Evacuation/shelter
- First aid
- Utilities (gas, water, electricity, sanitation)
- Clearing and maintaining access routes
- Communications
- Preserving law and order
- Security of buildings
- Damage evaluation and reporting
- Downed power lines
- Rescue efforts

13. URBAN FLOOD:

As undeveloped land is paved for construction, it loses its ability to absorb rainfall. Rainwater cannot be absorbed into the ground and becomes runoff, filling parking lots, making roads into rivers, and flooding basements and businesses. An urban area

can be flooded by an amount of rainfall that would have had no impact in a rural area. But in crowded towns and cities, rainwater flows into storm sewers and drainage thus flooding them.

13.1 Immediate actions

- Avoid crossing at a bend, although the current may be slow and the rain-water shallow on the inside of the bend, the water will be deeper and more powerful towards the outside bank.
- Avoid crossing near submerged trees, high or slippery banks, and above rapids or weirs.
- Be watchful as rain water may flood suddenly without much warning

13.2 Remedial actions

- Drainage of stagnant water

14. GAS RUPTURE / EXPLOSION:

14.1 Immediate Consideration

- Call Gas Company and fire brigade.
- Identify location.
- Identify threat to personnel/structures.
- Take evacuation measures.
- Establish perimeter and secure area.
- Secure ignition sources.

15. Hazardous Material Incidents (Nuclear, Biological, Chemical):

15.1 Immediate Considerations

- Identify nature of incident/material from distance.
- Evacuate.
- Establish perimeter and secure area.
- Secure ignition sources.

15.2 Tactical Command Considerations

- Identify specific material.
- Identify wind and weather conditions.
- Have evacuation routes ready.
- Keep personnel upwind and out of immediate area.
- Decontaminate area.
- Allow no open flames or ignition sources.
- Provide shelter area

16.PUBLIC HEALTH EMERGENCIES:

16.1 Introduction

Communicable diseases, particularly those with the potential of becoming global pandemics, have important implications.
This document has two primary objectives;

- Identify in broad terms how to prepare for a public health emergency.
- Provide checklists of actions that should be built into a public health
- Emergency plan

This is purposely generic in order that it could be of use in different types of public health emergencies and in order to avoid having to produce new templates specific to each emergency that might occur.

Once the Public Health Emergency Executive Members determine that some specific emergency is there and now the concerted and coordinated actions have been necessitated, it will activate the Public Health Emergency Response Team (PHERT) and will call the Core and Support Members as per the requirements of the time.

16.2 PHERT Executive Members

Public Health Emergency Executive Team Executive members will have the primary responsibility for advising senior management of developments relating to a public health emergency and actions to be taken in response. CMO to form a committee of Core Members.

16.3 Triggers of Public Health Emergency Response

The information triggering an emergency response could come from any number of different areas. The most likely scenario would probably be a notification from the World Health Organization (WHO) that there has been a progression into a more critical phase of the emergency in question. However, the information could also come from Federal Public Health Authorities / Airport Health Officers, as it did for some countries during the SARS crisis. Depending on the origin and the nature of the information received, the level of response will vary; it could be limited to action required by medical and public relations and communication sections or could extend to a full response.

17. Training for Disasters

Response Plan (ERP) should be conducted either externally or in-house by the organization's own qualified staff. This training typically includes drills, desktop exercises, and/or simulations to familiarize team members with their roles during actual emergencies. Attendees should include both management and operational personnel from the head office and other locations. The relevant department will be responsible for arranging training courses and refreshers.

To ensure that all aspects of the Disaster Management Procedure are rehearsed or practiced regularly, exercises and rehearsals should be conducted periodically. This ensures the involvement of personnel who would be called upon during an actual emergency or crisis and checks the readiness and functionality of required equipment. A full-scale exercise should be

conducted every two years, along with more frequent exercises for different units. After each exercise, debriefing sessions should be held to discuss strengths and areas for improvement. Preventive actions identified during these sessions should be communicated to the relevant activity heads, and implementation will be monitored by each department.

All location managers should arrange one disaster management training session per year, such as an earthquake emergency drill. Locations covered under Fire Safety and Housekeeping procedures will be graded for a Fire Safety Trophy.

18. Earthquake Advisory

Though today's earthquake has passed, slight tremors may be felt in days to come. Although going out is a natural instinct but wait and let the worst pass. Unlike popular belief, where people exit the building during a fire emergency, exiting in this case can do more harm than good, as falling debris from a potentially falling building could result in serious injuries. Here are actions required to be taken during an earthquake.

18.1 During the Earthquake:

If you are indoors, stay there. Quickly move to a safe location in the room such as under a strong desk, a strong table, or along an interior wall. The goal is to protect yourself from falling objects and be located near the structural strong points of the room. Avoid taking cover near windows, large mirrors, hanging objects, heavy furniture, heavy appliances or fireplaces.
If you are cooking, turn off the stove and take cover.
If you are outdoors, move to an open area where falling objects are unlikely to strike you. Move away from buildings, powerlines and trees.
If you are driving, slow down smoothly and stop on the side of the road. Avoid stopping on or under bridges and overpasses, or under power lines, trees and large signs. Stay in your car.

18.2 After the Earthquake:

Check for injuries; attend to injuries if needed, help ensure the safety of people around you.
Check for damage. If your building is badly damaged you should leave it until it has been inspected by a qualified professional.
If you smell or hear a gas leak, get everyone outside and open windows and doors. If you can do it safely, turn off the gas at the meter. Report the leak to the Gas Company and fire department. Do not use any electrical appliances because a tiny spark could ignite the gas.
If the power is out, unplug major appliances to prevent possible damage when the power is turned back on. If you see sparks, frayed wires, or smell hot insulation turn off electricity at the main fuse box or breaker. If you will have to step in water to turn off the electricity you should call a professional to turn it off for you.

19. Review and Update

- This Document will be reviewed annually or following any significant spill incident to ensure its effectiveness.
- Update the Document as necessary based on changes in operational practices, company policies, or legal requirements.

Annex IV - Electrocution Prevention PLan

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Details of Electrocution prevention measures, particularly during wet season

1. Purpose

This SOP outlines the necessary precautions and preventive measures to minimize the risk of electrocution, especially during the wet season when moisture significantly increases electrical hazards.

2. Scope

This SOP applies to all employees, contractors, and personnel working with or near electrical installations, equipment, or power lines. It covers work sites, homes, and public spaces where there is an increased risk of electrocution due to moisture.

3. Responsibilities

The respective Section Manager is responsible to distribute this procedure to all involved parties and monitor the implementation. Added responsibilities:

Role	Responsibility	Additional Notes
Safety Officer	• Ensuring that all personnel are trained in electrocution prevention measures. • Conducts regular safety briefings and refreshers, especially during wet seasons. • Ensures availability and proper use of Personal Protective Equipment (PPE).	• Develops safety protocols and conducts regular safety audits. • Reports on compliance to management. • Organizes drills for emergency response. • Supervises the distribution and usage of insulated gloves, boots, and rainproof clothing.
Electrical Maintenance Team	• Performs regular inspections of electrical installations, equipment, and infrastructure. • Ensures all electrical installations are properly grounded and weather-proofed. • Conducts emergency repairs and de-energizes circuits in hazardous conditions.	• Uses appropriate tools (e.g., moisture meters) to identify risks during wet conditions. • Coordinates with the safety officer to establish clear shutdown protocols during wet weather.

Employees/Workers	• Complies with all safety procedures and protocols. • Follows wet weather protocols, including de-energizing equipment and using PPE. • Participates in training sessions and safety briefings.	• Reports potential hazards (e.g., exposed wires, wet areas near electrical equipment) immediately. • Avoids unsafe practices, such as handling electrical devices with wet hands. • Must attend mandatory electrical safety training and pass assessments on safety awareness.
Contractor	• Adheres to the same safety measures and protocols as employees. • Conducts inspections of their own equipment before use on-site.	• Must attend safety orientations specific to the wet season electrical hazards. • Responsible for reporting faulty equipment and adhering to safety rules
Warehouse/Inventory Personnel	• Ensures PPE and safety equipment are stocked, inspected, and replaced as needed. • Collaborates with the electrical team to provide required tools and equipment for weather-proofing electrical installations.	• Manages inventory of insulated gloves, boots, waterproof covers, and rainproof clothing, especially during the wet season. • Inspects all safety gear for wear and tear before distribution.

4. Procedure

4.1 Inspection and Maintenance

4.1.1 Daily Inspection

- Inspect all electrical installations and equipment at the start of each day for signs of wear, exposure, or moisture intrusion.
- Use moisture meters to test areas prone to water accumulation near electrical equipment.

4.1.2 Routine Maintenance:

- Ensure all cables, power lines, and electrical equipment are properly insulated.
- Replace any damaged insulation, frayed wires, or broken equipment immediately.

4.1.3 Grounding:

- Ensure that all electrical installations are properly grounded, with ground fault circuit interrupters (GFCIs) installed in high-risk areas.

4.2 Protective Measures

4.2.1 Waterproofing:

- Cover outdoor electrical equipment with waterproof or water-resistant covers during the rainy season.
- Elevate electrical installations and ensure that water does not pool around them.

4.2.2 Barriers and Signage:

- Install physical barriers around high-voltage equipment in outdoor areas.
- Place clear warning signs around wet areas with a risk of electrical exposure.

4.2.3 Power Shut-off Protocol:

- Establish a protocol to shut off power in areas prone to flooding or heavy rain.
- Mark emergency shut-off switches clearly, ensuring easy access for all personnel.

4.3 Personal Protective Equipment (PPE)

4.3.1 Insulated Gloves and Boots:

- Workers handling electrical equipment must wear rubber insulated gloves and boots at all times during wet conditions.

4.3.2 Rainproof Clothing:

- Ensure all personnel working outdoors in wet conditions wear rainproof clothing that covers all exposed skin.

4.4 Wet Weather Protocol

4.4.1 Work Restrictions

- Suspend any outdoor electrical work during storms, heavy rain, or when water accumulation reaches hazardous levels. Clothing CAT – II

4.4.2 De-energizing Equipment:

- When possible, de-energize electrical circuits and equipment before working in wet areas.

4.4.3 Evacuation in Emergencies

- In case of water-logged areas near electrical installations, evacuate the area and turn off the power immediately.

5. Training

All employees must undergo mandatory electrical safety training, which will include:

- Recognizing electrical hazards.
- Emergency procedures for electrocution.
- Safe handling of electrical equipment in wet conditions.
- The use of GFCI outlets and other protective devices.

6. Documentation and Record-Keeping

All inspection, maintenance, and training records must be documented and stored by the Safety Department. Incident reports should be filed and reviewed during safety audits.

6.1 Review and Update

This SOP should be reviewed annually or after any major incident to ensure its effectiveness and compliance with updated safety standards.

Annex V - Fire Prevention Plan

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Fire prevention measures

1. Purpose

The purpose of this management system procedure is to establish a comprehensive and standardized fire prevention and management system across all GRID operations. This procedure aims to ensure:

Clearly Defined Functions: The specific roles and responsibilities of the Fire Department within the organization.

Comprehensive Understanding: A thorough explanation of the responsibilities of various business units (BUs) regarding fire prevention, emergency response, and extinguishing procedures.

Explicit Definition of Roles: Clear identification of roles and responsibilities for personnel involved in fire safety, ensuring accountability and prompt action during emergencies.

2. Scope

This procedure applies to all employees, contractors, and any personnel engaged in GRID operations. It covers all activities related to fire prevention and management, ensuring that safety practices are consistent and effective across all locations.

3. Principles

The core principle of this procedure is straightforward: Safety First. The objective is to prevent fires before they occur, but in the event of a fire, the focus is on prompt, safe, and effective action. It is essential for all personnel to be aware, prepared, and capable of responding in a manner that minimizes damage and ensures safety. Ultimately, this procedure aims to protect lives and equipment while ensuring the uninterrupted operation of the GRID. Safety is not merely a rule; it is a critical mindset that must be embraced by all.

4. Responsibilities

4.1 Manager – Fire Section

- Overall responsibility for the fire section's operations and management.
- Regular reporting to upper management on fire safety initiatives and incidents.
- Coordination of external training and equipment contracts.

4.2 Safety/ Fire Wardens

- Responsible for maintaining fire safety equipment and ensuring compliance with procedures.
- Conducting regular inspections and reporting deficiencies.
- Leading evacuation efforts during emergencies.

4.3 GRID Personnel

- All employees are responsible for familiarizing themselves with fire safety procedures.
- Participation in training and drills is mandatory.

5. Emergency Response Organization

The Emergency Response Organization is tasked with managing accidents and emergencies within the GRID section. Key components include:

- **Emergency Controllers**: Designated senior managers responsible for leading the response to emergencies.
- **Safety Personnel and Fire Wardens**: Trained individuals at each site who assist in managing fire safety protocols and emergency procedures.

5.1 Training and Preparedness

Regular training sessions will be conducted to ensure all employees understand their roles in fire prevention and response. Training will cover:

- Use of firefighting equipment.
- Evacuation procedures.
- Identification of potential fire hazards.

5.2 Communication with Local Emergency Services

Each site will establish relationships with local fire departments, ensuring quick response times during emergencies. Contact information for local fire services will be displayed prominently throughout facilities.

6. Functions

The fire prevention and management system will adopt a decentralized approach, enabling timely and effective responses. Key functions include:

- **Firefighting Teams**: Independent teams at each GRID site, trained to respond quickly to fire incidents.
- **Regular Equipment Checks**: Scheduled inspections and maintenance of firefighting equipment to ensure readiness.

6.1 Reporting and Documentation

All fire incidents must be reported and documented. This includes:

- Date and time of the incident.
- Description of the event and response actions taken.
- Personnel involved and any injuries sustained.

7. Fire Management System

7.1 Classification Of Fire

Understanding fire classifications is essential for appropriate response. Categories include:

- **Class A**: Solid materials like paper and wood.
- **Class B**: Flammable liquids such as gasoline and oils.
- **Class C**: Flammable gases, including propane and butane.
- **Class D**: Metals that burn, such as magnesium and potassium.

7.2 Use Of Fire Extinguishers

- **Water**: Best for Class A fires; should not be used on electrical fires.
- **Foam**: Suitable for flammable liquids; requires isolation of electrical sources.
- **Dry Powder**: Effective for Classes A, B, and C; suitable for electrical fires but may require cleanup.
- **Carbon Dioxide (CO2)**: Effective for Classes B and C, particularly for electrical fires.

7.3 Fixed Installations

- **Fire/Smoke Detection Systems**: Must be regularly maintained and tested.
- **Fire Alarms**: Clear protocols for both manual and automatic systems.

8. Response To Fire

8.1 Person Detecting Fire

Immediate actions include:

- Activating the fire alarm.
- Notifying the safety/fire warden.
- Shutting down nearby electrical equipment if safe.

8.2 Actions By Safety / Fire Wardens

Upon notification of a fire, fire wardens must:

- Confirm the fire's location.
- Communicate with the Emergency Controller.
- Evaluate the situation and decide whether to engage firefighting efforts.

8.3 Evacuation Procedures

Establish clear evacuation routes and assembly points, ensuring all personnel are familiar with these locations.

9. Training And Drills

Regular training sessions will include:

- Use of fire extinguishers.
- Conducting evacuation drills.
- Familiarization with fire alarms and emergency equipment.

9.1 Record Keeping

Maintain records of all training, drills, and inspections to ensure compliance and continual improvement in fire safety practices.

10. Audits And Reviews

Conduct regular audits to evaluate compliance and identify areas for improvement. The audit process will include:

- Reviewing incident reports.
- Assessing equipment readiness.
- Evaluating training effectiveness.

11. Record Keeping

Maintain accurate records of:

- Training and drill participation.
- Equipment maintenance and inspections.
- Incident reports and corrective actions taken.

12. Continuous Improvement

Encourage feedback from personnel regarding fire safety practices and use this information to enhance procedures and training programs.

13. Applicability

This procedure applies to all staff within the GRID section, including management and third-party contractors involved in relevant activities.

Annex VI - SF6 Use & Uncontrolled Release Plan

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SOPs for SF6 use and uncontrolled release.

1. Purpose

This Standard Operating Procedure (SOP) outlines the necessary guidelines for the safe handling, maintenance, and emergency response related to switchgear containing Sulphur Hexafluoride (SF6) gas. It aims to align with the Company System Safety Rules to ensure both personnel safety and compliance with environmental standards.

2. Scope

This Safety Instruction outlines the procedures to ensure the safety of personnel working on switchgear that contains or has contained Sulphur Hexafluoride (SF6) gas. It includes general safety guidance for maintenance work on this type of switchgear, following the principles set out in the Company System Safety Rules.

3. Principles

Arced SF6 gas can result in the destruction of deep tissue layers and bones, and cause bronchoconstriction and increased asthma symptoms.
Only trained and Competent Person (CP) shall be allowed to perform inspection and maintenance of SF6 switchgear and enclosures.
Before working on or near SF6 switchgear or equipment any operational restrictions, danger notices and defects shall be considered and task should not be initiated.

4. Definitions

For the purpose of this document following definition applies:

Term	Definition
AP	Authorized Person
Arced SF_6	SF_6 gas which has been subject to operations where breaking fault current occurs.
CP	Competent Person
SF_6	Sulphur Hexafluoride Gas
SO_2	Sulphur dioxide (SO_2) is a toxic breakdown product of SF_6. Sulphur dioxide can cause adverse respiratory effects including bronchoconstriction and increased asthma symptoms.

5. Responsibilities

The respective Section Manager is responsible to distribute this procedure to all involved parties and monitor the implementation. Added responsibilities:

Role	Sulphur Hexafluoride Gas
Authorized Person / Supervisor	• Conducts onsite risk assessment. • Coordinates, plans and observes the working activity on and near SF6 switchgear and enclosures. • Ensures that only CPs shall access, inspect and maintain SF6 switchgear and handle SF6 gas cylinders by following this SOP and supplier instructions. • Ensures that all required PPE and emergency equipment is available and worn / used as required.
Competent Person	• Conducts the onsite tool box talk / safety briefing. • Ensures that all inspection, maintenance SF6 switchgear shall be according to this SOP by considering AP instructions and guidance. • Storing and handling of SF6 gas cylinder shall be according to supplier's instructions. • Safety document shall be received where appropriate. • Ensures that the accompanying person is aware of the risks associated with SF6 gas.

6. Procedure

6.1 Planning and Assessment

6.1.1 All inspection and maintenance on SF6 switchgear shall be carried out by a CP, who shall be in possession of a valid competency certificate.

6.1.2 CP shall conduct an onsite tool box talk / safety briefing with the working party as described in section 6.2.1. If any high risk is identified during the safety briefing, then this shall be made known to the Authorized Person (AP).

6.1.3 When maintenance is carried on SF6 gas chamber, or when removal of withdrawable equipment is required, an AP shall directly supervise the work, and an appropriate safety document shall be issued to CP.

6.2 Tool box talk / Safety briefing

6.2.1 On-site Tool box talk / safety briefing shall be undertaken to review the risks for each location.

Tool box Topics / Safety briefing
Is safe access and egress to each location and the worksite available?
Is there adequate ventilation, space and illumination?
Are instructions understood in case of a leak of SF6 gas and effective controls in place?
Is SF storage cylinder area tested and free from SF fumes?
Is SF6 Gas pressure level indicator in the green position on switchgear?

6.3 SF_6 Switchgear

All SF6 Switchgear is fitted with a gauge, which indicates safe (Green) and unsafe (Red) gas pressure. Therefore, before inspection, operation and maintenance of the equipment the pressure indicator should be checked and recorded.

When the indicator is in the green zone then the switchgear may safely be inspected, operated and maintained. Whereas if indicator is in red zone, then no inspection, operations and maintenance shall be undertaken.

- When an SF6 low pressure is identified or alarm is received during work activity, immediately evacuate the area and inform the AP.
- If the switchgear has to remain live on the system to maintain continuity of supply, then the operational restriction shall be placed with danger notice attached / placed on the equipment, which shall only be operated in Dead condition.

6.4 Arrangements for leaked SF gas from switchgears and storage cylinders

6.4.1 Required PPE

- Clothing CAT – II
- Work Gloves
- Safety Helmet
- Safety Shoes
- Protective clothing
- Full Face Mask with Filters

6.4.2 When entering a storage area of SF cylinders, leaked SF gas may pool in low laying areas and should be checked and treated by:

- Using a SF& Gas Detector These detectors will sound an alarm when oxygen levels are outside the acceptable range (19.5% to 23.5%), and will also alarm if there is a presence of Sulphur dioxide (SO2).
- Artificial Ventilation - Ventilation should be suction-based, with the outflow directed. upwards and outwards of the storage area.

6.4.3 If leaked SF6 is found in enclosed areas such as below-ground areas (e.g., cable trenches), adequately ventilate the area from by using suction-based ventilation.

SF6 Gas Handling

1. When retrieving SF gas from switch gear or filling SF gas should preferable be done outdoors, if it is to be performed indoors, then suction-based ventilating equipment shall be in operation.

2. No smoking or naked flames are allowed in the workplace

3. During handling if leakage is detected, personnel should evacuate the area unless equipped with face mask and filters.

6.5 Arrangements for Arced SFs leaked gas and decomposed Powder

6.5.1 Required PPE

- Clothing Cat -II
- Chemical Gloves
- Gauntlet Gloves
- Eye Protection (Chemical & Industrial)
- Safety Shoes
- Protective Clothing
- Full face mask with air supply

6.5.2 Required Tools and Instrument

- SF6 Gas detector
- Artificial Ventilation should be suction-based

6.5.3 All low levels area shall be regarded as confined spaces and the SOP of Confined Space shall be followed.

6.5.4 Whenever leaks of switchgear either during fault conditions or normal operations is detected, the CP shall:

- Verify sufficient oxygen levels as described in section 5.4.2;
- If gas detectors indicate presence of SFs or Sulphur dioxide, immediately evacuate the area;
- Access shall be restricted for all workers who are not wearing special PPE (Appendix -7.1);
- Special PPE as listed in Appendix -7.1 shall be worn to complete the work.

Visible Signs of Deposit of Powder

1. If light powder deposits on HV Ring Main Units (RMU) and circuit breakers then it must be cleaned with suitable vacuum cleaner with the CP wearing full face mask with filters.

2. Gas-filled compartments in which abnormal arcing has occurred (e.g., internal fault) can be expected to have high levels of SF decomposition products. Medium to heavy powder deposits should first be removed using a suitable vacuum cleaner by wearing full face mask with air supply or Self-Contained Breathing Apparatus (SCBA).

6.5.5 Filter materials and vacuum cleaner bags should be removed and stored in sealed containers prior to neutralisation.

6.6 Neutralisation of Tools and Equipment Contaminated with Arced SF6

6.6.1 All contaminated parts, tools and clothing should be soaked in a neutralising solution for the minimum time as detailed in Table below. The alkaline will combine with the acid to form calcium sulphate (gypsum) or calcium fluoride (fluorspar). Following the soak, the parts, tools or clothing should be thoroughly rinsed with water.

Neutralisation Soak Times for Parts Contaminated with Arced SF6	
Neutralising Agent	**Soak Time (hours)**
Washing soda (sodium carbonate) solution (0.1 kg/L)	48
Lime Solution (Saturated)	24

6.7 Emergency Planning and Rescue

6.7.1 Develop an emergency response plan when required and ensure that it is available prior to commencing task including the following:

- Handling of leaked SF6
- Release of Arced SF6 and Powder.

6.7.2 CP or accompanying Person shall be trained as First Aider.

6.8 Documentation and Record-Keeping

Maintain comprehensive records of SF6 usage, maintenance activities, and any incidents involving SF6. Ensure that documentation is current, readily accessible, and updated regularly to reflect any changes or new procedures.

6.9 Review and Training

Regularly review and update this SOP to incorporate new regulations, technological advances, and lessons learned from past incidents. Provide ongoing training to all personnel to ensure they understand and adhere to the procedures outlined in this SOP.

7. Appendices

Appendix - Approved PPE list for SF 6 Switchgear

Sr. No	PPE for Electrical Safety	Standard/Specification
1	Clothing Cat -Il	IEC 61482-2, ASTM F1506, ASTM F 1959
2	Safety helmet	ANSI Z89.1, ASTM F2178-12, EN 12492
3	Safety Shoes	ASTM F2412-11, ASTM 2413-11
4	Insulating gloves	ASTM D 120, NFPA 70E, IEC EN 60903, ASTM F 696, EN 420: 2003, EN 407: 2004
5	Gauntlet Gloves	EN 388, EN 420
Special PPE for SF6		
6	Protective suit (Over the clothing)	EN 533, EN14116, EN531, EN11612
7	Chemical Gloves	EN 420: 2003, EN 374: 2003
8	Eye Protection (Chemical & Industrial)	EN166, ANSI Z87.1-2010
9	Full face mask with air supply	EN 136
10	Face Mask with Filters	EN 405
11	Vacuum Cleaner - Industrial wet or dry type with non-metallic attachments, micro filter elements (particles to 0.3 µm)	(AS/NZS 60335.2.69)

Annex VII - Transformer Oil Use & Spill Control Plan

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SOPs for Transformer oil use and spill control

1. Purpose

This SOP outlines the standardized procedures for the safe handling, storage, transportation, and spill control of transformer oil. It aims to ensure compliance with regulatory standards in Pakistan, minimize environmental impact, and protect personnel from potential hazards.

2. Scope

This Safety Instruction outlines the procedures to all operations involving transformer oil, including handling, storage, transportation, and spill response. It is mandatory for all personnel involved in these activities to adhere to these procedures.

3. Principles

Safety is paramount in all activities involving transformer oil, with strict protocols to minimize risks. Compliance with local, national, and international regulations is essential for the proper use, storage, and disposal of transformer oil.
Environmental protection requires responsible handling to minimize contamination, and preparedness is key, ensuring personnel are trained and equipped to manage spills effectively. Accountability is maintained through clear responsibilities and thorough documentation, while continuous improvement is achieved by regularly updating procedures to reflect best practices and lessons learned.

4. Responsibilities

4.1 Site Manager:

- Ensure strict compliance with this SOP.
- Conduct regular audits and risk assessments.
- Provide adequate training and resources to staff.

4.2 Maintenance Personnel:

- Safely handle and use transformer oil as per the SOP.
- Promptly report any spills or incidents.
- Execute spill control and clean-up procedures when necessary.

4.3 Environmental Health and Safety (EHS) Officer:

- Monitor environmental compliance and safety standards.
- Lead spill response efforts.
- Liaise with regulatory bodies in case of significant spills.

5. Definitions

5.1 Transformer Oil: A specialized mineral oil used in transformers for its electrical insulating and cooling properties.

5.2 Spill: An accidental release of transformer oil that could potentially harm the environment or pose safety risks.

6. Handling Procedures

6.1 Storage

6.1.1 Store transformer oil in clearly labeled, secure, and leak-proof containers.

6.1.2 Containers should be stored in well-ventilated areas, shielded from direct sunlight and heat sources.

6.1.3 Implement secondary containment systems (e.g., bund walls) to contain potential leaks.

6.2 Handling

6.2.1 Personnel must wear appropriate personal protective equipment (PPE) such as gloves, safety goggles, and aprons.

6.2.2 Inspect all containers for integrity before use.

6.2.3 Use proper tools (e.g., pumps) to transfer oil, avoiding manual handling to minimize exposure.

6.2.4 Do not overfill transformers to reduce the risk of operational spills.

6.3 Transportation

6.3.1 Use only certified containers and vehicles for the transportation of transformer oil.

6.3.2 Ensure containers are securely fastened to prevent movement and potential spills during transit.

6.3.3 Comply with national transportation regulations regarding hazardous materials.

7. Spill Control Procedure

7.1 Immediate Response

- Immediately stop the source of the spill, if it is safe to do so.
- Evacuate the area and restrict access to unauthorized personnel.
- Notify the EHS Officer and Site Manager without delay.

7.2 Containment

- Deploy absorbent materials (e.g., sand, sawdust, or specialized spill kits) to contain the spill.
- Prevent the oil from entering drains, sewers, or natural water bodies.

7.3 Clean-Up

- Collect the absorbed oil and contaminated materials using appropriate methods.
- Dispose of contaminated materials as per local hazardous waste disposal regulations.
- Thoroughly clean the affected area with suitable cleaning agents.

7.4 Training

- All personnel involved in transformer oil handling and spill response must receive initial and periodic refresher training.
- Conduct spill response drills at least once a year to ensure preparedness.

8. Documentation and Record-Keeping

- Maintain detailed records of transformer oil storage, usage, and transportation activities.
- Keep a log of all spill incidents and the corresponding response actions taken.
- Ensure that records are readily available for internal audits and regulatory inspections.

9. Regulatory Compliance

- Comply with the National Environmental Quality Standards (NEQS) and other applicable regulations in Pakistan regarding the handling, storage, and disposal of transformer oil.
- Regularly review regulatory updates to ensure ongoing compliance.

10. Review and Update

- This SOP will be reviewed annually or following any significant spill incident to ensure its effectiveness.
- Update the SOP as necessary based on changes in operational practices, company policies, or legal requirements.

Annex VIII - Waste Management PLan

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Disaster Management Plan

1. Introduction

Effective waste management is crucial for maintaining a safe and sustainable environment, especially in industries where different types of waste, such as hazardous, non-hazardous, and recyclable materials, are generated. Poor management of waste can lead to environmental pollution, health hazards, and regulatory violations. This procedure outlines the organization's approach to waste management, ensuring compliance with environmental standards and promoting sustainability through responsible waste handling, segregation, and disposal practices.

2. Policy Statement

The organization's Waste Management Procedure addresses the proper handling, segregation, storage, and disposal of all waste generated during operations. This procedure is designed to ensure that all waste is managed in a manner that minimizes its impact on the environment and public health. Compliance with local and national environmental regulations is mandatory, and all departments must follow the guidelines provided in this plan. Regular audits, training, and updates will ensure continuous improvement in waste management practices.

3. Purpose

The purpose of this procedure is to provide a systematic approach to managing waste in a safe, efficient, and environmentally friendly manner. The objectives include:

- Reducing waste generation at the source.
- Ensuring proper segregation of waste into hazardous, non-hazardous, and recyclable categories.
- Minimizing the environmental impact of waste disposal.
- Complying with all relevant legal and regulatory requirements.
- Promoting recycling and waste reduction initiatives.

4. Scope

This procedure applies to all personnel and locations within the organization. It is mandatory for all personnel involved in these activities to adhere to these procedures.

5. Principles

The waste management principles emphasize sustainability, safety, and compliance. Waste must be reduced, reused, or recycled wherever possible. The organization will prioritize waste segregation to ensure safe handling and disposal, and regular training will be conducted to enhance awareness. Waste audits will be conducted periodically to monitor and improve waste management practices. Communication between

departments is essential to maintain a clear and coordinated approach to waste reduction and disposal.

6. Definitions

Hazardous Waste: Waste that poses substantial or potential threats to public health or the environment.
Non-hazardous Waste: Waste that does not pose immediate risk but requires proper handling and disposal.
Recyclable Materials: Waste materials that can be processed and used again, such as paper, plastic, and metal.
Waste Segregation: The process of separating waste into different categories for appropriate handling and disposal.

7. Responsibilities

7.1 Chief Executive Officer

- Approve waste management policies and procedures.
- Ensure sufficient funds are available for waste management infrastructure and activities.
- Review regular reports on waste management performance and compliance.

7.2 Department Heads

- Ensure waste is segregated properly within their departments.
- Oversee the training of personnel in waste management practices.
- Ensure all equipment and resources are available for waste handling and disposal.
- Report any changes in waste management practices to the Environmental Officer.
- Training of personnel.

7.3 Environmental Officer

- Develop and update the Waste Management Plan.
- Ensure compliance with all legal and regulatory requirements.
- Conduct regular audits to assess waste management practices and identify areas for improvement.
- Coordinate with waste disposal contractors and recycling agencies.
- Provide regular training and awareness programs on waste management.

7.4 Location Emergency Controller

- Ensure waste is segregated, handled, and stored properly.
- Monitor waste collection points and ensure timely removal of waste.
- Report any discrepancies or issues related to waste disposal to the Environmental Officer.

7.5 Employee / Department Responsibilities

- Comply with waste segregation and disposal guidelines.

- Report any waste management issues or hazards.
- Participate in waste management training and awareness programs.
- Assess the urgency of the situation and make the appropriate call.

8. Waste Segregation and Disposal:

- **Waste Segregation:** All waste must be segregated at the source into hazardous, non-hazardous, and recyclable categories. Clear labeling and color-coded bins must be used.
- **Hazardous Waste:** Must be handled by trained personnel and stored in designated areas. Disposal must comply with local and national regulations.
- **Non-hazardous Waste:** General waste should be disposed of in accordance with standard disposal methods, and non-recyclable waste must be minimized.
- **Recycling:** Recyclable materials such as paper, plastic, and metal must be separated and sent for recycling. Bins for recyclables must be strategically placed across the facility.

9. Training for Disasters

All employees will undergo regular training on waste management procedures, with a focus on waste segregation, handling of hazardous materials, and recycling. Periodic refresher courses will be conducted, and awareness campaigns will promote waste reduction initiatives across the organization.

10. Monitoring and Review

The Environmental Officer will conduct regular waste audits to ensure compliance with the waste management procedure. The results will be reviewed by senior management, and corrective actions will be taken where necessary. Continuous improvement will be achieved through feedback and proactive measures aimed at reducing waste generation.

11. Compliance And Legal Obligations

All waste management activities must comply with local, national, and international environmental regulations, including proper documentation and reporting of hazardous waste disposal. Non-compliance with regulations may result in penalties or fines.

12. Review and Update

- This Document will be reviewed annually or following any significant spill incident to ensure its effectiveness.
- Update the Document as necessary based on changes in operational practices, company policies, or legal requirements.

Annex IX - Emergency Response Plan

Emergency Response Plan

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Emergency Response Plan

1. Purpose

This procedure is intended to ensure that in the event of an incident at installations such as major fires, explosions, arc flashes, release of flammable materials and hydrocarbons, bomb threats or sabotage, floods, earthquakes, building collapses, tsunamis, medical emergencies, heat waves, blackouts, civil unrest, political instability, IT service disruptions, and pandemics, all necessary actions are taken to protect personnel, contractors, visitors, the environment, affected communities, and assets. Additionally, a community awareness program regarding potential emergencies should be established to maintain public trust and confidence in operations. Community and civil authorities should be involved in emergency response plans in alignment with the requirements of the Community Awareness Program, where applicable.

2. Scope

This document outlines the requirements for compliance with the Process Safety Management (PSM) element related to Emergency Preparedness and Contingency Planning. This procedure applies across all operational locations.

3. Summary

This procedure details the protocol for emergency response and planning requirements at the site to ensure that:

- Emergency response strategies, including the organization and responsibilities for managing various emergency situations, are documented.
- The basis for the emergency response and planning program is clearly defined.
- Requirements for the site emergency response manual content are established.
- Training requirements for relevant emergency response teams, employees, and contractors are documented.
- Public Affairs and Community Awareness program requirements are in place.

4. Definitions and Abbreviations

- AFRA Arc Flash Risk Assessment
- BU Business Unit
- CAER Community Awareness & Emergency Response
- CFR Code of Federal Regulations
- CPR Cardiopulmonary Resuscitation
- D/O Drop Out
- DGM Deputy General Manager
- EHT Extra High Tension (66, 132 & 220kV)
- EPA Environmental Protection Agency
- FEHA Fire & Explosion Hazard Assessment

- GM General Manager
- H2 Hydrogen Gas
- HFO Heavy Fuel Oil
- HSD High Speed Diesel
- HSEQ Health, Safety, Environment & Quality
- HT High Tension (11kV)
- LBS Load Break Switch
- LOTO Lock Out Tag Out
- MIS Management Information System
- MOC Management of Change
- OCB Oil-filled Circuit Breaker
- OSHA Occupational Safety & Health Administration
- PMT Pole Mounted Transformer
- PPE Personal Protective Equipment
- PSI Process Safety Information
- PSM Process Safety Management
- QRA Quantitative Risk Assessment
- SCBA Self Contained Breathing Apparatus
- SDS Safety Data Sheet
- TR Temporary Repair
- VCB Vacuum Circuit Breaker

5. Definitions

5.1 Administrative Controls

Procedures for directing and/or checking human performance on plant, transmission, distribution departments, offices, or process tasks (e.g., equipment handling, operations management, isolation of networks, testing, permit processes, lockout/tagout procedures, etc.).

5.2 Engineering Controls

Systems or interlocks involving the operation of physical components (e.g., sensors, transmitters, valves, circuit breakers, switches, remote operations, protection relays, or other control elements, containment systems, etc.) that operate automatically without human intervention.

5.3 Consequence Analysis

The development of potential scenarios describing hazardous events that may occur due to a loss of engineering or administrative controls and evaluating the resulting impact on site personnel, off-site communities, and the environment, independent of the event's probability.

5.4 Explosion

A release of energy that causes a blast.

5.5 Facility

The physical structure, location, or area within which a given process segment is operated. It includes plants, equipment, pipelines, distribution points, grids, project sites, and substations.

5.6 Fire

A combustion reaction accompanied by the evolution of heat, light, flame, electrical flash, arcing, and sparking.

5.7 Hazard

An inherent property or characteristic of a material, system, or process that has the potential to cause serious injury to people, property, or environmental damage.

5.8 Hazardous Substance

Any substance that can result in death or irreversible health effects, significant property damage, or environmental harm when released, ignited, or when its energy is released. This includes toxic, reactive, flammable, or explosive materials.

5.9 Hazard Evaluation

The application of process hazard analysis methodologies to determine the significance of hazardous situations associated with a process or activity, identifying weaknesses in design, operation, and controls that could lead to hazardous events.

5.10 Hazard of Materials

The physical and chemical properties of process substances that create hazards to people, facilities, and the environment when released.

5.11 Major Release

Flammable gas releases of a size and duration capable of causing multiple serious injuries unless effective protective measures are taken.

5.12 Mitigation

The process of lessening the impact of a hazardous event by reducing its magnitude or the exposure to people, property, or the environment.

5.13 Operation Facilities

The facilities where infrastructure is installed, including but not limited to generation plants, grid stations, substations, power lines, project sites, and office buildings.

5.14 Process Hazard

A condition that has the potential to result in the release of, or exposure to, a hazardous substance, or in the release of energy that can cause serious injury to personnel, significant property damage, or environmental harm.

5.15 Qualitative Risk Assessment

The systematic development of non-quantitative estimates of the expected frequency and consequence of potential hazardous events associated with a process or operation, based on engineering evaluation.

5.16 Quantitative Risk Assessment (QRA)

The systematic development of numerical estimates of the expected frequency and consequence of potential hazardous events associated with a process or operation, utilizing appropriate mathematical techniques.

5.17 Worst Case Scenario

The release scenario that results in the greatest off-site impact regarding both distance and population.

5.18 Safety Critical Equipment

Devices, systems, or equipment whose failure could contribute to the release of or exposure to hazardous substances or their energy, resulting in serious injuries or significant property or environmental damage. This includes electrical protection devices, containment systems, and emergency response equipment.

5.19 Skill Certification Process

The process of training newly hired or cross-trained employees, culminating in skill certification after formal tests and reviews by management. This certification is mandatory for all staff handling emergencies or acting as first responders to ensure competency in emergency response.

6. Consequence Analysis

The main risk at KE sites includes:

1. Fire & Explosion
2. Hydrogen Fire
3. Electrical fires / arc flash energy
4. Hydrocarbon Release
5. Bomb Threat or Sabotage

Consequence analysis should be conducted for all potential hazardous events resulting from the loss of engineering, administrative, or operational controls. This evaluation includes estimating release amounts and conditions, assessing consequences on affected areas, and determining the resulting health, safety, and environmental effects. The intent of the consequence analysis is to understand the type, severity, and number of potential injuries, property damage, and significant environmental effects both on and off the site. A qualitative review of these hazardous impacts is acceptable if the effects are confined to the site. However, if the effects could extend offsite, such as thermal or electrical energy releases due to fire or explosion, a more quantitative analysis is required.

7. Emergency Preparedness & Contingency Planning

This section outlines the contents and requirements for the Site Emergency Response Plan applicable across all operational locations.

7.1 Emergency Handling Techniques

Guidelines for handling various types of emergencies, including fires, arc flashes, and liquid or gas releases, are vital components of the emergency response plan. The plan should cover the following:

- Firefighting actions and containment techniques.
- Spill control and decontamination procedures.
- Shutdown and isolation of plant, grid, transmission network, substation equipment, and distribution network as necessary.
- Handling of arc flash incidents.
- Handling of electrical substation or breaker fires.
- Handling of hydrogen fires.
- Emergency health information sheets for hazardous materials.
- Guidelines for handling chemicals and hydrocarbons on-site.
- Information regarding firewater networks.
- Activation of automatic fire suppression systems.
- Availability of fire tenders or substitutes in the absence of a firewater network.

7.2 EMERGENCY RESPONSE MANUAL/PLAN

The emergency response manual/plan for all operational facilities shall be developed by the location owner and should cover the following:

- Purpose and scope of the manual/plan.
- Hazards of materials.
- Types of emergencies.
- Reporting of emergencies.
- Detection, declaration, and notification of emergencies, including emergency alarm codes.
- Communication channels.
- Details of emergency organization, responsibilities, and authorities.
- Emergency squad membership and leadership.
- Activation of the emergency squad.
- Types and locations of emergency control centers based on emergency situations.
- Role statements for individuals involved in emergency response.
- Notification and coordination with civil authorities.
- Assembly locations for personnel evacuating the site.
- Personnel accounting responsibilities for checking numbers and assembly points.
- Emergency shutdown procedures for non-process emergencies.
- Firefighting and handling techniques for chemical and electrical energy releases.
- Rescue plans, including medical assistance and communication with designated hospitals.
- Layout and location of safety and emergency equipment.

- Miscellaneous information (e.g., local population, typical wind reference diagrams).
- Community Awareness and Emergency Response (CAER) initiatives.
- Responsibilities for communication with neighboring facilities.
- Training requirements.
- Stewardship and accountability.

7.2.1 Distribution & Updates

- A system for periodically updating the manual, at least every three years, should be in place.
- Updated copies of the manual should be available in all control rooms and with key members involved in emergency handling.
- A distribution list for the manual should be maintained, and updates should occur as needed, but not later than every three years.

7.3 Emergency Shutdown Procedures

A fast shutdown procedure must be adopted when an emergency occurs, typically covered through Grave Emergency Shutdown Procedures.

7.3.1 Grave Emergency Shutdown Procedures

This section outlines critical steps for safely shutting down operations, adapted from routine procedures:

- Assign and prioritize tasks to ensure vital precautions are completed first.
- Operations staff equipped with necessary personal protective equipment (PPE) should report to assembly locations after following shutdown steps.
- All grave emergency shutdown procedures should be simulated, considering the time available for operators to reach assembly locations safely.
- The exercise's objective should focus on steps directly impacting the emergency rather than merely shutting down the facility.
- Complex tasks, such as climbing, should be avoided and replaced with more efficient options (e.g., remote-operated valves).
- Each location should develop its grave emergency response plan, including shutdown procedures for plants and distribution networks.

7.4 Rescue Operations Guidelines

Rescue operations guidelines shall be developed for Emergency Response Teams and Control Centers. Sites must establish rescue protocols for personnel in emergencies, including but not limited to confined space and pole top rescues.

7.5 Stewardship Of Emergency Preparedness Program

- The emergency preparedness program should be presented to the relevant Business Units at least once every two years for objective review and evaluation.
- Status updates on recommendations from simulated exercises should be shared quarterly with relevant stakeholders, including management.
- Annual presentations should be made to respective committees regarding the status of the emergency preparedness program.

8. Mutual Aid/Liaison with Civil Authorities

- Written arrangements with neighboring facilities should be established to facilitate mutual aid during emergencies, including resource and equipment sharing.
- Coordination with civil authorities must be maintained to ensure public safety outside the facility, including traffic management and local hazard alerts.

9. Training On Emergency Preparedness

- All new or transferred employees must undergo initial training on emergency procedures and their specific roles.
- A comprehensive program for quarterly simulated exercises should be established, involving all staff and civil authorities at least once a year.
- Observers should assess compliance during exercises, followed by critique sessions for feedback and improvement.

9.1 Alarm Codes for Simulated Exercises

- Establish emergency alarm codes for simulated exercises and actual emergencies, ensuring proper maintenance of alarm systems.

9.2 Skill/Competency Requirements for Emergency Teams

9.2.1 General Requirements:

- Awareness of emergency reporting procedures.
- Understanding of assigned roles in emergencies.
- Proficiency in using personal protective equipment (PPE) and emergency response tools.

9.2.2 Leadership Requirements:

- Capability to lead the emergency team and coordinate responses.
- Knowledge of equipment hazards and emergency protocols.

10.Safety & Firefighting Equipment

Refer to relevant procedures for the maintenance and inspection of safety and firefighting equipment.

11.Public Affairs Plan

- Documented public affairs strategies must address emergency communication.
- Training for personnel involved in media and public interactions should be established.

11.1.1 Community Awareness Program

- Systems must be in place to address community concerns about health, safety, and environmental impacts.
- Regular evaluations should identify and respond to community feedback regarding operations.
- Training programs should educate employees on community safety issues.

11.1.2 Requirements:

- Open communication about safety operations.
- Regular updates on health, safety, and environmental management.
- Engagement with local community through outreach programs.

12.Review and Update

- This SOP will be reviewed annually or following any significant spill incident to ensure its effectiveness.
- Update the SOP as necessary based on changes in operational practices, company policies, or legal requirements.