HESCO

ELECTRICITY DISTRIBUTION EFFICIENCY IMPROVEMENT PROJECT (EDEIP)

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

FOR

CONVERSION OF 66KV KHIPRO GIRD STATION TO 132KV ALONG WITH TRANSMISSION LINE FROM KANDIARI TO KHIPRO









HYDERABAD ELECTRIC SUPPLY COMPANY (HESCO)

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Executive Summary

The Hyderabad Electric Supply Company (HESCO) is planning the conversion of the Khipro grid Station from 66-kilovolt (kV) to 132-kV and the construction of an associated 132-kV transmission line from Kandiari to Khipro (these works will be described as the proposed subproject in this document). All components of the proposed subproject are located within the District Sanghar, Sindh Province.

HESCO is undertaking the proposed subproject under the Electricity Distribution Efficiency Improvement Project (EDEIP), with financial assistance from the World Bank (WB). The EDEIP also includes the Peshawar Electric Supply Company (PESCO) and the Multan Electric Power Company (MEPCO), in addition to the Power Division of the federal Ministry of Energy.

This Environmental and Social Impact Assessment (ESIA) has been prepared to address the potential environmental and social (E&S) risks and impacts of the proposed subproject, in compliance with the national/provincial regulatory requirements as well as the WB Environmental and Social Framework (ESF).

EDEIP Overview

EDEIP aims to improve the operational efficiency, reliability, and quality of electricity distribution companies (DISCOs). The EDEIP has four components: Improving Grid Reliability, Modernizing Operations and Management; Building Capacity and Technical Assistance; and Reform Support. The first component covers the investments for the Secondary Transmission and Grid (STG) and Energy Loss Reduction (ELR) programs. The second component includes modernization of the operations and management functions using the latest equipment, technology, and information systems. The third component includes improving operations and maintenance, capacity building and training, and EDEIP implementation support. The fourth component aims to support the implementation of power sector reforms and improve sector governance.

Subproject Overview

The proposed subproject is a part of the first component of EDEIP and comprises the conversion of the existing 66 kV Khipro Grid Station into a 132 kV Grid Station and the construction of a new 34.54-kilometer (km) long double-circuit 132-kV transmission line from Kandiari Grid Station to Khipro Grid Station in the district Sanghar. The proposed subproject is a critical infrastructure initiative implemented by HESCO to alleviate power overloading, enhance grid capacity, and improve system efficiency in Khipro, Sindh.

The proposed 132-kV grid station equipment will be installed within the boundaries of the existing Khipro grid station. The key equipment and components to be installed in the grid station will include power transformers, circuit breakers, disconnectors, earthing switches, current transformers, voltage transformers, busbars, control panels and other accessories. The proposed 132-kV grid station will be an Air Insulated Switchgear (AIS). The key construction activities will include land clearing and levelling, excavations for foundations, concreting for

foundations, erection of steel works and gantries, equipment installation, cabling and connections, construction of control building and office block, and finally, testing and commissioning. For the transmission lines, the key equipment includes lattice steel towers, conductors, insulators and other accessories. The key construction activities for the transmission lines will include excavation for tower foundations, concreting for foundations, tower erection, stringing of conductors, installation of insulators and other accessories, and finally, testing and commissioning. The operation and maintenance of the 132-kV Khipro grid station and its associated 132-kV transmission line is also included in the scope of the proposed subproject.

Institutional and Legislative Framework for Environmental and Social Management

The key regulatory institution for the management of E&S aspects of the proposed subproject is the Sindh Environmental Protection Agency (Sindh EPA). The key provincial legislation to manage the E&S aspects of the proposed subproject is the Sindh Environmental Protection Act, 2014, which provides the legislative framework for protection, conservation, rehabilitation, and improvement of the environment in Sindh province. Under this Act, HESCO will seek environmental approval for the proposed subproject from the Sindh EPA.

In addition to the national/provincial legal requirements, the subproject will also comply with the World Bank's ESF as well as the Environmental and Social Standards (ESSs).

Environmental and Social Management Framework (ESMF)

To address the generic environmental and social impacts associated with the EDEIP and to define principles, assessment criteria, and procedures to prepare various E&S documents for the various EDEIP subprojects, an Environmental and Social Management Framework (ESMF) has been prepared in accordance with the WB ESF. The present ESIA has been prepared based on the principles and criteria described in the ESMF.

Overview of Baseline Conditions

The grid station conversion works will be carried out within the boundaries of the existing 66-kV Khipro Grid Station, situated within Khipro town, approximately 2 km from the city center along Khipro-Mirpurkhas Road. The site is surrounded by a mix of residential and agricultural areas. The associated 132-kV double-circuit transmission line (TL) route passes through rural and agricultural settings.

There are no major existing sources of environmental pollution in the subproject area. Because the site is characterized by existing settlements and active cultivation, it is not considered ecologically sensitive, and there are no protected areas in its vicinity. Ambient air quality, water quality, and noise levels, measured as part of this ESIA,were found to be within acceptable limits.

The socioeconomic profile of the subproject area reflects a predominantly rural and low-income population with limited access to social services and modest human development conditions. A total of96 respondents were surveyed through a statistically derived sample. The age structure shows that the majority of respondents fall within the economically active groups, particularly 36–45 years (31.3%) and26–35 years (26.0%)**,** indicating that most households depend on working-age members for their livelihoods. However, the education profile remains weak, with 44.8% of respondents being illiterate, while only a small proportion attained education beyond matric and intermediate levels. Occupationally, the local economy is dominated by daily wage labor (51.0%)and farming (21.9%)**,** confirming strong dependence on agriculture and informal labor opportunities, with very limited participation in business, private employment, or government service. This livelihood pattern points to moderate economic vulnerability, low diversification of income sources, and heightened sensitivity to temporary disruptions in land use, mobility, and access during project implementation.

The broader social infrastructure of Sanghar District provides a basic institutional framework, but service availability within the immediate subproject area remains limited. In the education sector, the district has approximately 3,022 educational institutions, including 2,837 primary schools, 105 middle schools, 61 secondary schools, and 19 higher secondary schools, along with degree colleges and technical institutes concentrated in urban centers such as Sanghar, Shahdadpur, Tando Adam, Khipro, and Kandiari. Despite this overall network, villages within the subproject area generally have access only to primary education, while middle, secondary, and higher education require travel to nearby towns, contributing to dropout rates, especially among girls.

The health sector shows similar disparities: Sanghar District has five government hospitals, six Rural Health Centers, nearly 60 Basic Health Units (BHUs), and 90 government dispensaries, but rural communities in and around the subproject corridor continue to face shortages of qualified staff, medicines, and specialized healthcare. As a result, local residents often rely on BHUs, small private clinics, and referral services in larger urban centers such as Hyderabad and Karachi. Overall, the survey findings and district-level service profile indicate that the subproject area is characterized by limited educational attainment, dependence on labor-intensive livelihoods, and constrained access to quality health and education services.

E&S Scoping

The E&S scoping was carried out during the preparation of this ESIA. The scoping considered all E&S impacts and risks that could be caused by the proposed subproject and then evaluated their relevance to its nature, activities, and settings. Scoped-in aspects include resettlement impacts, soil erosion and contamination, air quality deterioration, water contamination, noise generation, occupational health and safety (OHS) risks, community health and safety (CHS) risks, blocked roads and routes, waste generation, labor influx, sexual exploitation and abuse (SEA) and sexual harassment (SH), child labor, and damage to existing infrastructure such as roads and public utilities. Key aspects that were scoped out include damage to cultural heritage.

The aspects that have been scoped in have been further assessed and their mitigation and control measures have been identified in this ESIA. The aspects that have been scoped out have not been further discussed in this ESIA.

Potential Impacts

Most of the grid station construction works will be carried out within the existing grid station site; hence, their potential E&S impacts will mostly be confined to the site boundaries and their immediate vicinities. During the construction phase, these impacts will include: dust and noise generation as well as air quality deterioration caused by the excavation activities and operation of construction machinery and movement of vehicles; soil erosion and generation of spoil caused by foundation excavation; waste water releases from the construction sites and workers' camps causing soil and water contamination; soil erosion caused by excavation for foundations; OHS risks for construction workers caused by working near moving machinery/vehicles, lifting and hoisting, working at heights, working in confined spaces, fall and trips, and working at/near energized systems/equipment; CHS risks for nearby population associated with the vehicle movement, construction activities and electrocution; generation of solid waste including hazardous waste; disposal of spoil/excavated material; issues related to labor influx (such as SEA/SH); living conditions within workers' camps; and child labor. No resettlement impacts are anticipated since the grid station works will be carried out on the site already owned and occupied by HESCO. During the operation and maintenance (O&M) phase, the potential E&S risks associated with the grid stations will include OHS risks particularly working at heights and electrocution, safety risks for the communities particularly the residents of staff colony, soil and water contamination in case of transformer oil leakage, release of effluents (particularly, toilet waste) from office/control building and staff colony; and solid waste generation from office, workshop and staff colony. Most of these impacts and risks are moderate in nature and can be mitigated and controlled with the help of standard and easy to implement mitigation and monitoring measures.

The potential impacts and risks associated with the TL construction activities include livelihood impacts, diminution of land value under the towers and transmission line conductors, damage to crops and built structures caused by construction of tower foundations and stringing of conductors, dust and noise generation as well as air quality deterioration caused by the excavation activities and operation of construction machinery and movement of vehicles; generation of spoil caused by foundation excavation; soil erosion caused by excavation and operating vehicles on unpaved roads, waste water releases from the construction sites causing soil and water contamination; soil erosion caused by excavation for tower foundations; OHS risks for construction workers caused by working near moving machinery/vehicles, lifting and hoisting, working at heights, fall and trips, and working at/near energized systems/equipment; CHS risks for nearby population associated with the vehicle movement, construction activities and electrocution; generation of solid waste including hazardous waste; disposal of spoil/excavated material; damage to crops; blocked local roads and routes; issues related to labor influx (such as SEA/SH); privacy of women, and child labor.

The E&S risks associated with the O&M phase of the TL include OHS risks, particularly working at heights and electrocution, SEA/SH risks, and CHS risks, particularly electrocution for communities within the right-of-way (RoW) of TL.

Mitigation Measures

The risks and impacts described above will be mitigated and controlled mostly with the help of standard mitigation measures. For the construction phase, the mitigation measures to address environmental risks and impacts would include balancing cut and fill operations, to the extent possible, to minimize spoil production and also need of fill material; disposing spoil material appropriately without causing impacts on cultivation fields, crops and public routs/roads, water sprinkling to control dust emissions; scheduling construction activities during the daytime to minimize the impact of noise generation; apprising the local communities about noise generation and safety risks associated with the construction activities; treating the waste effluents released from the site; treating the toilet waste from the workers' camps and offices appropriately (such as through septic tanks); avoiding soil erosion by appropriate techniques such as building dykes and covering the loose soil; disposing non-hazardous waste through the municipality waste handling and disposal system (if available) otherwise disposing it in a manner not to affect irrigation channels, cultivated areas, communities, or local routs/roads; disposing hazardous waste in accordance with the associated material safety data sheet (MSDS); addressing OHS risks through adopting a stringent OHS management regime that would include employing properly qualified and trained OHS staff at the construction sites, hazard risk assessment and implementing standard operating procedure (SOP) for each construction activity.

The construction phase mitigation measures for social risks and impacts would include: preparing and implementing a Resettlement Plan to address resettlement impacts including land value diminution, damage to crops and structures, and any livelihood impacts; barricading the construction sites to avoid entry of community members particularly children; awareness raising and training of subproject staff and workers about gender issues particularly SEA/SH; adopting a code of conduct (CoC) covering gender, cultural and SEA/SH issues, to be followed by all site personnel; ensuring proper living conditions within the worker's camps in accordance with the labor laws and the Labor Management Procedures (LMP) that has been prepared for EDEIP; identifying alternate routes in consultation with the communities, in case of blockage of routes and tracks; ensuring that no child labor is employed at the site and workers' camps; repairing any damaged infrastructure or public utilities; and maintaining a fully operationalized grievance redress mechanism (GRM) for communities and workers.

During the O&M phase, HESCO's existing OHS management system will be strictly followed to address the OHS risks. The mitigation and control measures for the remaining O&M-related risks will mostly be the same as described above for the construction phase.

With the help of the above-described mitigation measures, the E&S performance of the proposed subproject is expected to be environmentally and socially sound and sustainable.

Environmental and Social Management Plan (ESMP)

Institutional Setup. For its subprojects under EDEIP, HESCO has established a dedicated Project Management Unit (PMU) comprising qualified E&S personnel responsible for overall supervision and compliance. In addition, the Project Implementation and Management Support Consultants (PIMSC), engaged under EDEIP, include E&S specialists responsible for conducting environmental and social assessments, preparing safeguard instruments (including this ESIA), and ensuring effective implementation of E&S requirements during construction.

The construction contractor to be engaged for the proposed subproject will also be required to appoint full-time, site-based E&S staff to ensure day-to-day compliance with the ESIA, ESMP, and other applicable E&S documents and regulatory requirements.

E&S Mitigation and Monitoring. The contractor will implement all mitigation measures identified in this ESIA. The PIMSC will conduct regular compliance monitoring to verify implementation of mitigation measures. In addition, effects monitoring will be carried out for key environmental and social indicators, including air quality (including dust), noise levels, OHS and CHS incidents, community grievances, and waste management performance.

Contractor's Environmental and Social Management Plan (C-ESMP). The construction contractor will prepare and implement a site-specific Contractor's Environmental and Social Management Plan (C-ESMP) for the subproject. The C-ESMP will include detailed, subproject-specific management plans such as a Camp Management Plan, Waste Management Plan, Traffic Management Plan, OHS Management Plan, CHS Management Plan, and Site Restoration Plan.

Capacity Building. The PMU, PIMSC, and the construction contractor will ensure the delivery of regular training and awareness sessions for all subproject personnel, including site supervisors and construction workers. These trainings will cover key E&S aspects such as waste management, OHS, camp management, GRM, traffic management, and CHS, CoC, and SEA/SH.

GRM. For all of its subprojects under EDEIP, HESCO has established a structured three-tier Grievance Redress Mechanism (GRM) to receive, assess, and resolve concerns and complaints from affected communities and other stakeholders regarding environmental and social (E&S) aspects of project implementation.

The GRM is designed to ensure timely, transparent, and fair resolution of grievances, providing affected persons with an accessible and responsive platform to raise concerns related to the proposed subproject and other EDEIP interventions. The mechanism emphasizes early resolution at the lowest appropriate level, with clear procedures and defined timelines for complaint handling.

In addition, a dedicated mechanism will be maintained to address labor-related grievances in accordance with applicable labor and OHS requirements. A separate, confidential, and survivor-centered mechanism will also be established to handle complaints related to SEA/SH, ensuring privacy, sensitivity, and appropriate referral pathways.

Stakeholder Consultations

A comprehensive Stakeholder Engagement Plan (SEP) has been prepared for the entire EDEIP to define the objectives, principles, and procedures for stakeholder engagement throughout project implementation. The stakeholder consultations for this ESIA have been conducted in accordance with the framework and guidance provided in the SEP.

For the proposed subproject, consultations have been carried out with local communities, including males and females, and other relevant stakeholders to disclose subproject information and discuss potential E&S impacts. During these sessions, details of the proposed works, anticipated E&S impacts, and planned mitigation measures were explained, and stakeholders were invited to share their views, concerns, and suggestions. Separate consultations have also been undertaken with relevant government departments to seek their input regarding regulatory compliance and potential E&S implications.

Community participants generally welcomed the subproject, acknowledging its potential to improve electricity reliability and availability in the area. However, concerns were raised regarding power outage during shifting the 11-kV feeders from the existing 66-kV grid station to the proposed 132-kV grid station, safety risks, potential crop damage, possible reduction in land value under the TL and its towers, conduct of contractor personnel, adherence to local norms, labor influx, communication gaps, noise and dust emissions, community health and safety risks, temporary access restrictions, land acquisition matters, and timely compensation payments. Community members also expressed expectations for employment opportunities for residents during the construction phase.

HESCO assured stakeholders that appropriate, precautionary and mitigation measures would be implemented to minimize adverse impacts and ensure community safety. It was clarified that the ESIA documents all identified impacts along with corresponding mitigation and monitoring measures, and that contractors will be contractually bound to implement these measures. Local employment opportunities will be considered, where feasible, during construction.

Relevant government departments expressed overall support for the subproject while highlighting specific concerns, including compliance with Sindh Environmental Quality Standards (SEQS), protection of agricultural land and irrigation infrastructure, avoidance of unnecessary tree cutting, and provision of local employment. These inputs have been incorporated into the impact assessment and reflected in the mitigation measures outlined in this ESIA.

Cost of ESIA Implementation. The total estimated cost for the implementation of the ESIA is approximately Pakistani Rupees (PKR) 15.7 million. It includes the cost of laboratory analysis for key environmental parameters, E&S training, and contingencies.

List of Abbreviations

AIS	Air insulated Switchgear
AMI	Advanced Metering Infrastructure
ABC	Aerial Bundled Cables
A/C	Alternative Current
ANSI	American National Standards Institute
AP	Affected Person
APHA	American Public Health Association
AOI	Area Of Influence
As	Arsenic
BHU	Basic Health Unit
BDL	Below detection limit
Capex	Capital Expenditure
Cd	Cadmium
CO	Carbon Monoxide
CoC	Code of Conduct
CEO	Chief Executive Officer
Cl^-	Chloride
Cr	Chromium
CHS	Community Health and Safety
CBO	Community-Based Organization
C-ESMP	Contractor's Environmental and Social Management Plan
CBD	Convention on Biological Diversity
CITES	Convention on the International Trade of Endangered Species
CHA	Critical Habitat Assessment
CR	Critically Endangered
°F	Degree Fahrenheit
DC	Deputy Commissioner
DISCO	Distribution Company
DCR	District Census Report
EC	Electrical Conductivity
EDEIP	Electricity Distribution Efficiency Improvement Project
EMF	Electro Magnetic Field
EN	Endangered
ELR	Energy Loss Reduction
E&S	Environmental and Social
ESF	Environmental and Social Framework
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Standard
ESU	Environmental and Social Unit
EIA	Environmental Impact Assessment
EHS	Environmental, Health, and Safety
FGD	Focus Group Discussion
GAP	Gender Action Plan
GoP	Government Of Pakistan
GHG	Green House Gases
GS	Grid Station

GRC	Grievance Redress Committee
GRM	Grievance Redress Mechanism
HSE	Health, Safety, and Environment
HIV/AIDS	Human immunodeficiency virus/ acquired immunodeficiency syndrome
HVAC	Heating, Ventilation, and Air Conditioning
HESCO	Hyderabad Electric Supply Company
IA	Implementing Agency
IBA	Important Bird and Biodiversity Area
IEE	Initial Environmental Examination
IFC	International Finance Corporation
ILO	International Labor Organization
ISO	International Organization for Standardization
IUCN	International Union for Conservation of Nature
JHA	Job Hazard Analysis
kWh	Kilowatt-Hour
KBA	Key Biodiversity Area
Km	Kilometer
Km/h	Kilometers per hour
KPI	Key Performance Indicator
kV	Kilo Volt
LV	Low Voltage
LMP	Labor Management Procedures
LAA	Land Acquisition Act
Pb	Lead
LOTO	Lock-Out Tag-Out
MSDS	Material Safety Data Sheet
MWh	Mega Watt Hour
MVA	Mega Volt Ampere
MV	Medium Voltage
Hg	Mercury
mg/l	Milligrams Per Liter
NCS	National Conservation Strategy
NEPRA	National Electric Power Regulatory Authority
NHA	National Highway Authority
Ni	Nickel
Nox	Nitrogen Oxides
NOC	No Objection Certificate
NGO	Non-Governmental Organization
OCHS	Occupational and Community Health and Safety
OHSMP	Occupational Health and Safety Management Plan
O&M	Operation and Maintenance
O_3	Ozone
PKR	Pakistani Rupee
PCB	Polychlorinated Biphenyls
PCCA	Pakistan Climate Change Authority
PCCC	Pakistan Climate Change Council
PEPA	Pakistan Environmental Protection Act
Pak-EPA	Pakistan Environmental Protection Agency
PM	Particulate Matter

PGA	Peak Ground Acceleration
POPs	Persistent Organic Pollutants
PPE	Personal Protective Equipment
PCR	Physical Cultural Resource
PAP	Project Affected Person
PDO	Project Development Objective
PD	Project Director
PIMSC	Project Implementation and Management Support Consultant
PIU	Project Implementation Unit
PT/VT	Potential Transformer / Voltage Transformer
PMU	Project Management Unit
ARAP	Abbreviated Resettlement Action Plan
ROW	Right-Of-Way
STI	Sexually Transmitted Infections
STG	Secondary Transmission and Grid
SEA/SH	Sexual Exploitation and Abuse/Sexual Harassment
SAFWCO	Sindh Agricultural and Forestry Workers Coordinating Organization
SEPA	Sindh Environmental Protection Act
SEPA	Sindh Environmental Protection Agency
SEQS	Sindh Environmental Quality Standards
NEQS	National Environmental Quality Standards
SPM	Suspended Particulate Matter
SIDA	Sindh Irrigation and Drainage Authority
SRSO	Sindh Rural Support Organization
SSWMC	Sindh Solid Waste Management Company
SEP	Stakeholder Engagement Plan
SOE	State-Owned Enterprise
SO_2,	Sulfur Dioxide
SF_6	Sulfur Hexafluoride
TDS	Total Dissolved Solids
TH	Total Hardness
T&D	Transmission and Distribution
TL	Transmission Line
UC	Union Council
UNFCCC	United Nations Framework Convention on Climate Change
UNO	United Nations Organization
VCB	Vacuum Circuit Breaker
WMP	Waste Management Plan
WAPDA	Water and Power Development Authority
WB	World Bank
WBG	World Bank Group
WHO	World Health Organization

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1 Introduction

The Hyderabad Electric Supply Company (HESCO) is planning the conversion of the Khipro grid Station from 66-kilovolt (kV) to 132-kV and the construction of an associated 132-kV transmission line from Kandiari to Khipro (these works will be described as the proposed subproject in this document). All components of the proposed subproject are located within the District Sanghar, Sindh Province.

HESCO is undertaking the proposed subproject under the Electricity Distribution Efficiency Improvement Project (EDEIP), with financial assistance from the World Bank (WB). The EDEIP also includes the Peshawar Electric Supply Company (PESCO) and the Multan Electric Power Company (MEPCO), in addition to the Power Division of the federal Ministry of Energy.

This Environmental and Social Impact Assessment (ESIA) has been prepared to address the potential environmental and social (E&S) risks and impacts of the proposed subproject, in compliance with the national/provincial regulatory requirements as well as the WB Environmental and Social Framework (ESF).

1.1 Electricity Distribution Efficiency Improvement Project

1.1.1 Background

Over the past few years, Pakistan has struggled to meet its fiscal targets. One of the key fiscal risks is the underperformance of the State-Owned Enterprises (SOEs), dominated by power sector entities. Therefore, improving distribution companies' efficiencies is a prime and core requirement to reduce the sector's fiscal burden, lower the cost of power supply and attract investments.

Pakistan's electricity sector is in crisis due to the high cost of generation, dependent on imported fuels, which makes the sector vulnerable to changes in fuel prices and currency exchange rates. The higher cost of electricity supply has exacerbated cost recovery challenges for the distribution companies. This has hampered investments, particularly by loss-making electricity distribution companies (DISCOs), to strengthen their networks and has resulted in increased outages and interruptions, costing businesses and affecting household welfare. These inefficiencies in the sector are estimated to be costing Pakistan about 6.5 percent of its gross domestic product (GDP), according to a World Bank report[1]. Also, in terms of reliability of electricity supply, Pakistan is among the lowest-performing countries in the world. It is ranked at 167 out of 190 economies on the electricity indicator in Ease of Doing Business 2019. Moreover, a significant number of households do not have access to electricity and per capita electricity consumption at 471 kilowatt-hour (kWh) is less than one-fifth of the world average, according to the World Development Indicators 2017. While the government is adding low-cost generation and plans to shift the generation mix towards renewable sources, targeting 20

[1] https://www.worldbank.org/en/region/sar/publication/in-the-dark-how-much-do-power-sector-distortions-cost-south-asia

percent by 2025 and 30 percent by 2030, the long-term financial viability of the power sector is dependent on DISCOs' efficiency improvement.

1.1.2 EDEIP Overview

To address some of the problems discussed above, the EDEIP aims to support the targeted DISCOs by providing financial and technical support for investments to modernize their electricity distribution networks and institutional development, resulting in improved operational efficiency in the sector and reliable supply to the consumers. It seeks to help in: (i) physical strengthening of distribution networks; (ii) deployment of modern equipment, technology and information systems; and (iii) providing technical assistance, studies, consultancies and management support. Under the EDEIP, three DISCOs, namely HESCO, MEPCO and PESCO, have been selected.

The project development objectives for EDEIP are to improve electricity supply and operational efficiency in targeted areas of selected distribution companies and strengthen the capacity of power sector institutions to implement reforms.

1.1.3 EDEIP Components

The various components of EDEIP are explained below.

Component 1: Improving Grid Reliability

This component finances investments in Secondary Transmission and Grid (STG) and Energy Loss Reduction (ELR) programs of the DISCOs to improve the reliability of electricity supply and reduce technical losses. The subprojects financed under this Component can be divided into the following categories:

- New Grid Stations: Construction of new 132 kV grid stations and the associated transmission lines.
- Existing Grid Stations: Augmentation, extension, conversion, upgradation and rehabilitation of the existing grid stations and the associated transmission lines.
- Transmission Lines: Construction, rehabilitation and re-conductoring of 132-kV (and below) transmission lines with low-loss conductors, e.g., high-tension low sag (HTLS); and
- Energy Loss Reduction. Expansion and rehabilitation of 33-kV and 11-kV feeders.

Component 2: Modernizing Operations and Management

This component supports modernization of the DISCOs' operations and management functions using the latest equipment, technology and information systems. Major activities include:

- Automation and Information Systems. This entails the upgradation and deployment of information systems and emergency response planning solutions. This will help

improve planning, grid operations and customer services by providing access to and integrating modern information systems.

- Revenue Protection Program. It comprises the installation of Aerial Bundled Cables (ABC), Advanced Metering Infrastructure (AMI), Transformer monitoring System, and other measures to pre-empt theft, reduce losses, improve recoveries, and better service delivery based on access to reliable and timely data.

Component 3: Capacity Building and Technical Assistance

This component helps to build the capacity of the DISCOs with particular focus on:

- Improving operations and maintenance. This covers procurement of tools, equipment, hardware, software, consulting and non-consulting services for improved operations and maintenance practices, e.g., for live-line maintenance, upgrade repair workshops, inventory/asset management, etc.;
- Training and capacity building. Conduct studies and assessments, including preparation/updating of manuals, procedures and systems, in particular for human resource management, inventory management, procurement, financial management, customer services and safeguards and assist with their implementation and conduct training programs, including workshops, seminars and post-graduate degrees in relevant fields;
- Project implementation support. This includes financing of: (a) consulting and other services; (b) individual experts/advisors and any incremental staff positions; (c) equipment and software; (d) financial, operational & technical audits; and (e) operating cost of Project Management Units (PMUs).

Component 4: Reform Support

This component supports the implementation of power sector reforms and seeks to improve sector governance.

1.2 Overview of Proposed Subproject

The proposed subproject is being implemented under Component 1 of EDEIP. and comprises the conversion of the existing 66-kV Khipro Grid Station into a 132-kV Grid Station and the construction of a new 132-kV double-circuit transmission line from Kandiari Grid Station to Khipro Grid Station. The proposed subproject is situated within the Sanghar District (See **Figure 1-1**).

The proposed 132-kV grid station equipment will be installed within the boundaries of the existing 66-kV Khipro grid station. The proposed 132-kV Khipro grid station will be equipped with essential electrical and control components, including power transformers, circuit breakers, disconnectors, current transformers, voltage transformers, surge arresters, post insulators, control systems, relay protection systems, metering systems, LV (Low Voltage) switchgears, auxiliary transformers, batteries and chargers. The proposed grid station will be an air-insulated station (AIS). The key construction activities will include land clearing and levelling, excavations

for foundations, concreting for foundations, erection of steel works and gantries, equipment installation, cabling and connections, construction of control building and office block, construction of fencing, and finally, testing and commissioning. The transmission line works involve the installation of double-circuit lattice steel towers, stringing of aluminium conductor reinforced steel (ACSR) conductors, laying of shield wires, fixing of insulators and fittings, and finally, testing and commissioning. The operation and maintenance of the 132-kV Khipro grid station and its associated 132-kV transmission line is also included in the scope of the proposed subproject.

Once completed, the subproject is expected to contribute not only to enhancing energy sector efficiency but also to ensuring broader goals of regional equity, industrial growth, and improved quality of life in underserved areas of Khipro Taluka.

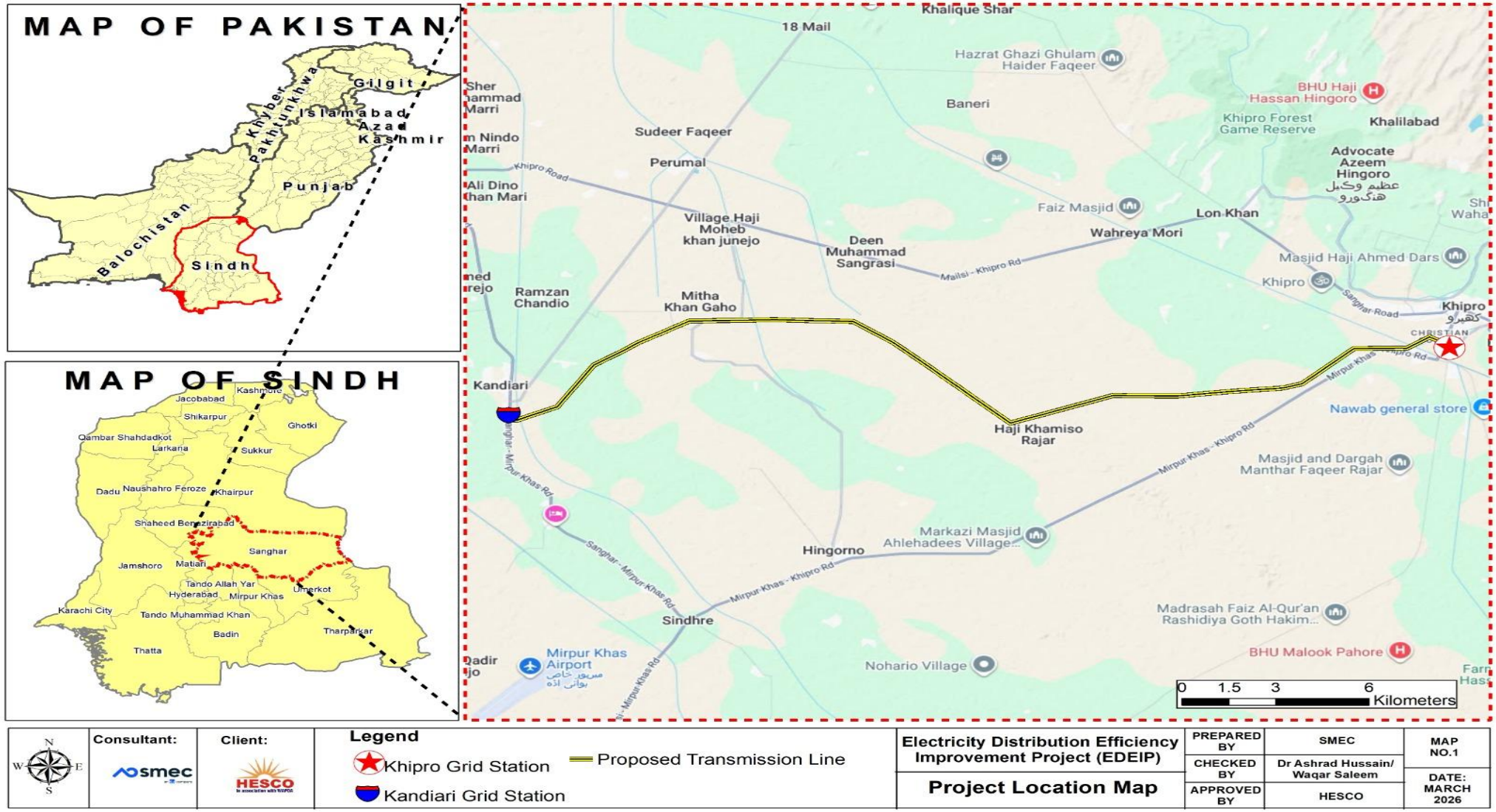

Figure 1-1: Location of Proposed Subproject

1.3 Institutional and Legislative Framework for Environmental and Social Management

The key regulatory institution for the management of E&S aspects of the proposed subproject is the Sindh Environmental Protection Agency (SEPA). The key provincial legislation to manage the E&S aspects of the proposed subproject is the Sindh Environmental Protection Act, 2014, which is comprehensive and provides the legislative framework for the protection, conservation, rehabilitation, and improvement of the environment in Sindh. Under this Act, HESCO will seek environmental approval for the proposed subproject from SEPA.

In addition to the national/provincial legal requirements, the subproject will also comply with the World Bank's Environmental and Social Framework (ESF) as well as the Environmental and Social Standards (ESSs).

1.4 E&S Scoping

The E&S scoping was carried out during the preparation of this ESIA. The scoping considered all potential E&S impacts and issues and assessed their relevance to the proposed subproject's nature, activities involved, and environmental and social settings; see **Table 1-1**.

Table 1-1: E&S Scoping

E&S Aspects	Relevance for Proposed Subproject	Scoping
Soil erosion and contamination	Soil erosion is relevant since it may be caused by the excavation activities during the grid station (GS) and TL construction works. Soil contamination is also relevant since it may be caused by effluent releases from construction sites and workers' camps for all subproject components.	Scoped in
Air quality deterioration, including dust and exhaust emissions	Relevant since it may be caused by excavation for GS and TL construction works, vehicle operation during construction works, and the operation of construction machinery.	Scoped in
Noise	Relevant since it may be caused by construction machinery operation and vehicle movement.	Scoped in
Water contamination	Relevant since it may be caused by effluent releases from construction sites and workers' camps for all subproject components	Scoped in
Damage to crops and built-up structures	Relevant since the TL route passes through agricultural land, use can damage crops.	Scoped in
Occupational,	Relevant since these risks may be caused by the	Scoped in

E&S Aspects	Relevance for Proposed Subproject	Scoping
Health and Safety (OHS) risks	construction and operation of the proposed subproject.	
Community Health and Safety (CHS) risks	Relevant since these risks may be caused by the construction and operation of all components	Scoped in
Impacts on biological resources (flora and fauna)	Not Relevant, as the subproject area primarily consists of agricultural land and rural settlements with limited natural vegetation, entirely isolated from any urban zones or major riverine systems. The proposed Khipro grid station site occupies a highly modified, abandoned agricultural field where natural vegetation is virtually non-existent, restricted only to a few young, planted *Conocarpus* trees growing along the path within the existing facility footprint. Meanwhile, the approximately 35 km long transmission line route is aligned entirely along existing rural roads and an established flood protection bund, traversing a heavily altered terrain where sparse vegetation is limited to a few scattered *Prosopis* shrubs growing within the Right-of-Way (RoW). Consequently, the subproject area does not support any ecologically significant flora or fauna, sensitive habitats, or species of conservation concern, and no designated wildlife sanctuaries or other protected areas are located within or in the immediate vicinity of the proposed interventions. The localized screening and habitat assessment for both the grid station site and the TL route have been added to Table 1-1, while the detailed Critical Habitat Assessment (CHA) report for the subproject area is placed as Annexure-1.	Scoped out
Blocked roads and routes	Relevant since the construction works of GS and TL can potentially block roads and local routes.	Scoped in
Waste generation	Relevant since it may be caused by construction activities and camp operations.	Scoped in
Labor influx	Relevant to the proposed subproject since it will engage technical and non-technical personnel, including construction workers.	Scoped in
Sexual exploitation and abuse/sexual harassment (SEA/SH)	Relevant since TL construction and O&M activities will be carried out near communities.	Scoped in
Child labor	Relevant since the contractors can potentially	Scoped in

E&S Aspects	Relevance for Proposed Subproject	Scoping
	engage underage workers.	
Physical cultural heritage	Not relevant since no sites are known to exist that are archaeologically, historically, or culturally significant within the subproject site or in its immediate vicinity. However, Chance Find procedures have been included in the mitigation measures discussed later in the document.	Scoped Out
Resettlement impacts	Proposed conversion of GS will be carried out within the boundary of Khipro GS, causing no resettlement impacts or land acquisition. However, TL works can potentially cause land value diminution, damage to crops and built-up structures as TL route passes through agricultural land.	Scoped In
Damage to existing infrastructure and public utilities	Relevant since the proposed project TL construction works can potentially damage the existing physical infrastructure (such as roads, water channels).	Scoped in

The aspects that have been scoped in have been further assessed and their mitigation and control measures have been described later in this ESIA. The aspects that have been scoped out have not been further discussed in this ESIA.

1.5 Area of Influence (AoI)

The AoI for the grid station includes the entire grid station site and a corridor of 500 meters (m) around it. The AoI for the associated transmission line will be a corridor 500 m wide (250m on either side of the TL centreline) (see **Figure 1.2** and **Figures 1.3** to **1.9**). The potential E&S impacts of the proposed subproject are likely to be confined to these AoIs.

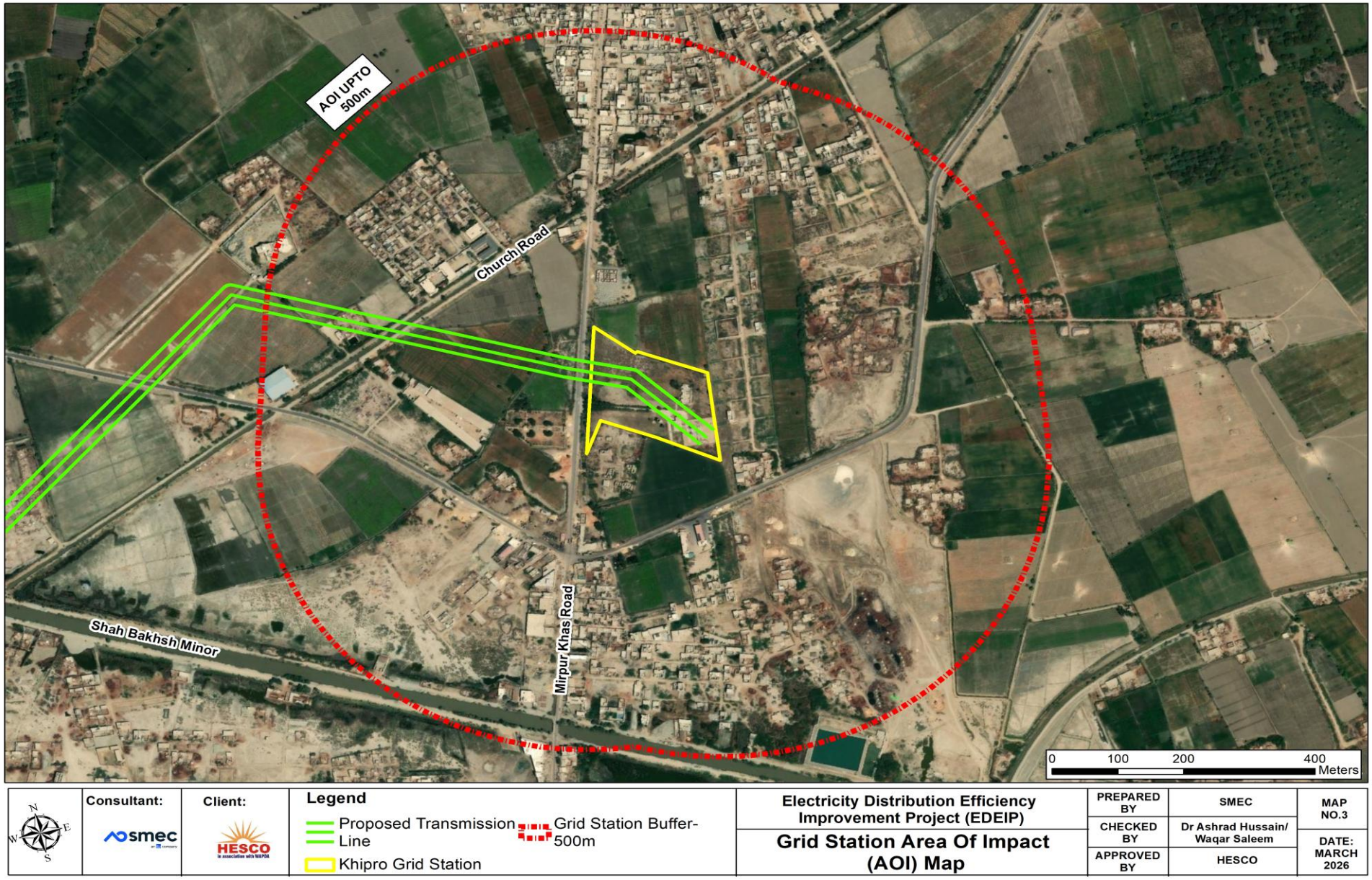

Figure 1-2: AOI of Khipro Grid Station

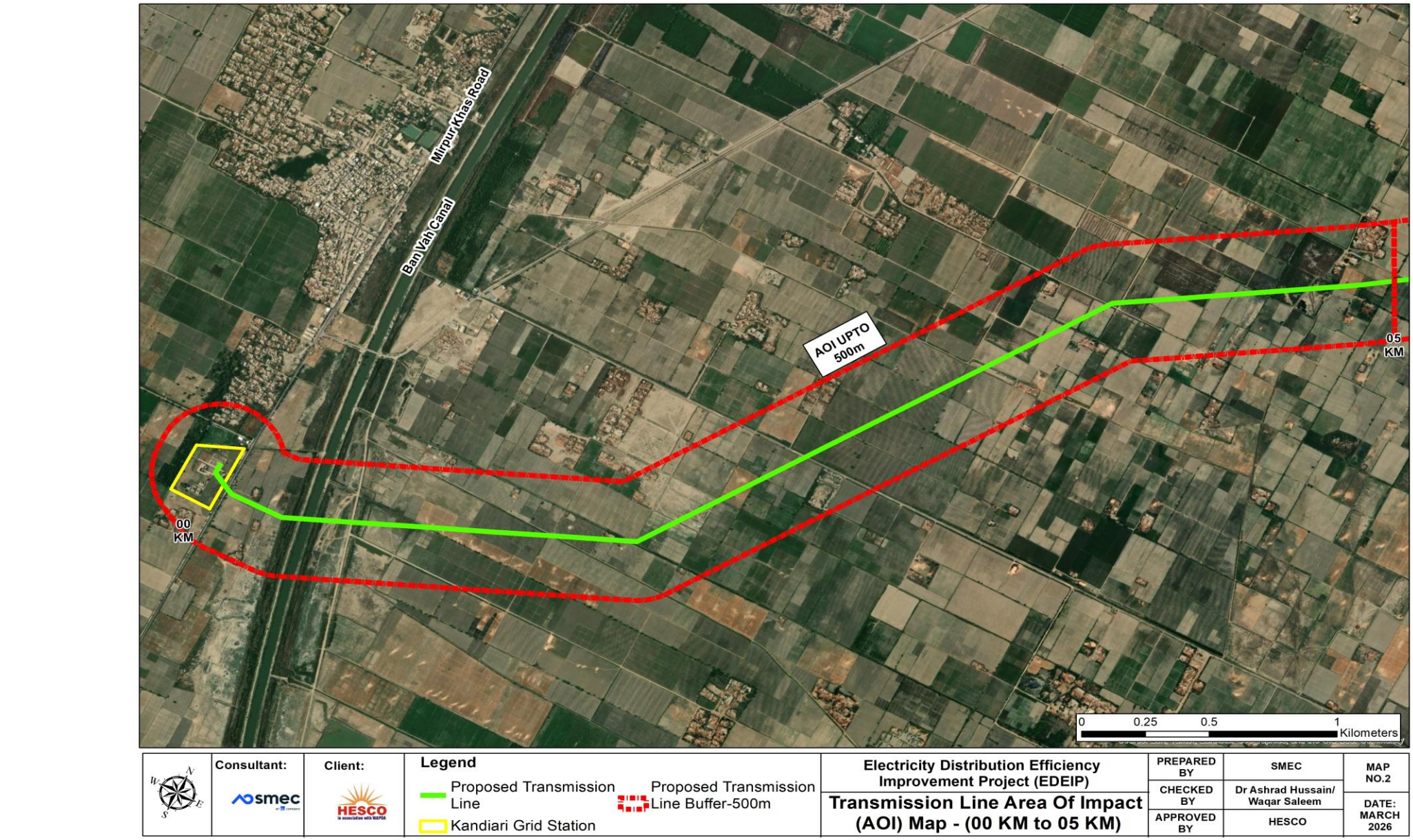

Figure 1-3: AOI of Proposed Transmission Line (00 KM to 05 KM)

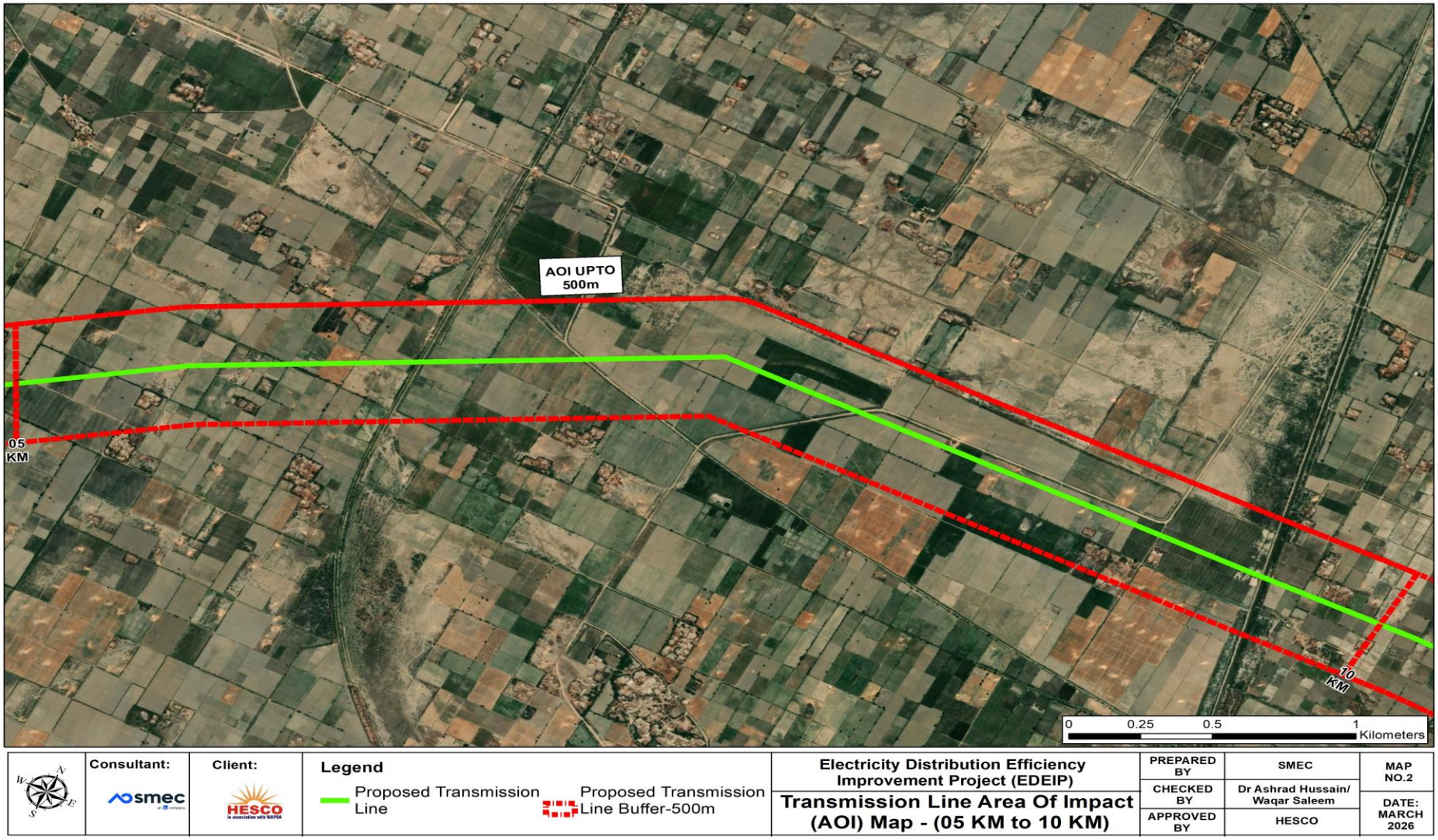

Figure 1-4: AOI of Proposed Transmission Line (05 KM to 10 KM)

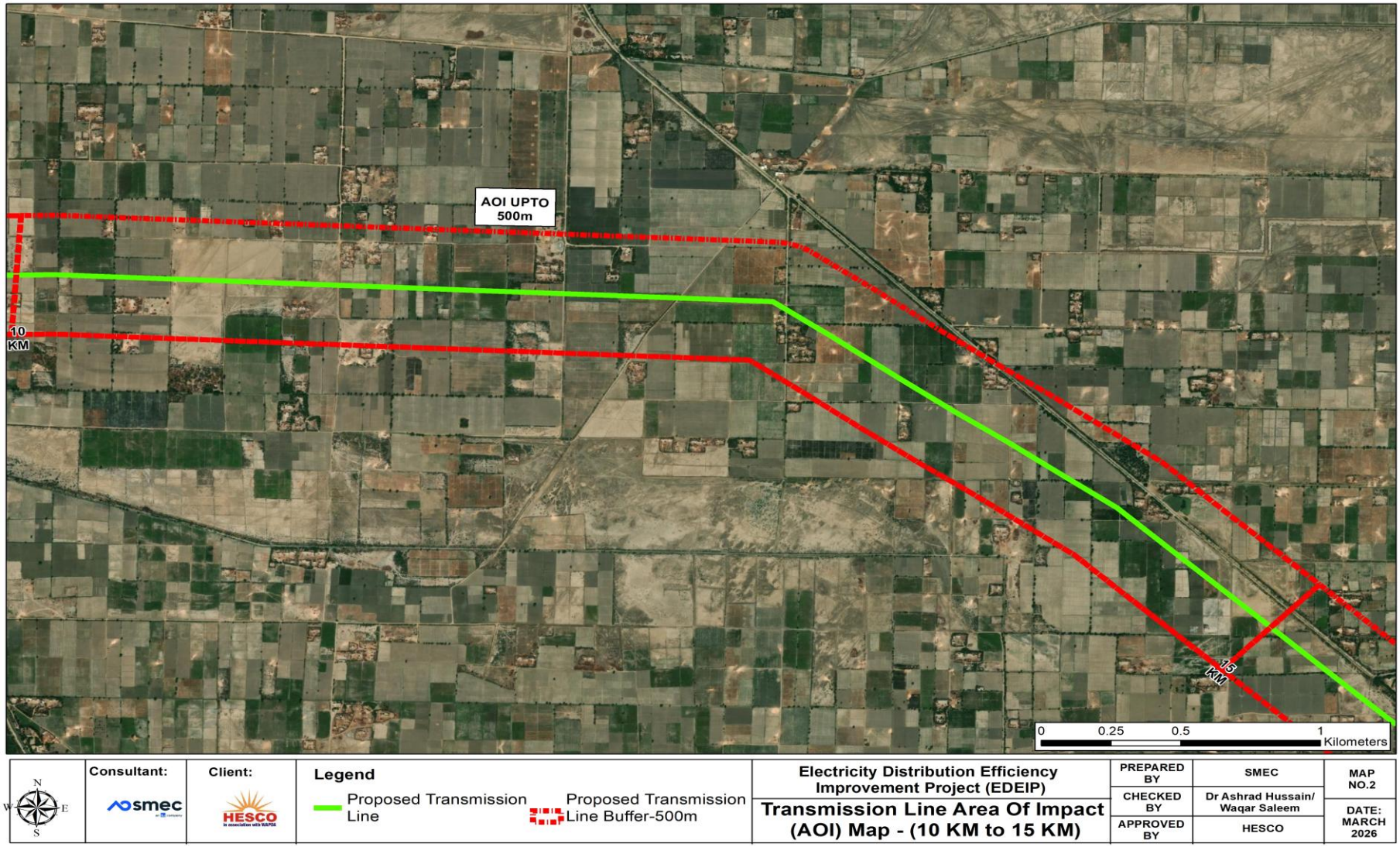

Figure 1-5: AOI of Proposed Transmission Line (10 KM to 15 KM)

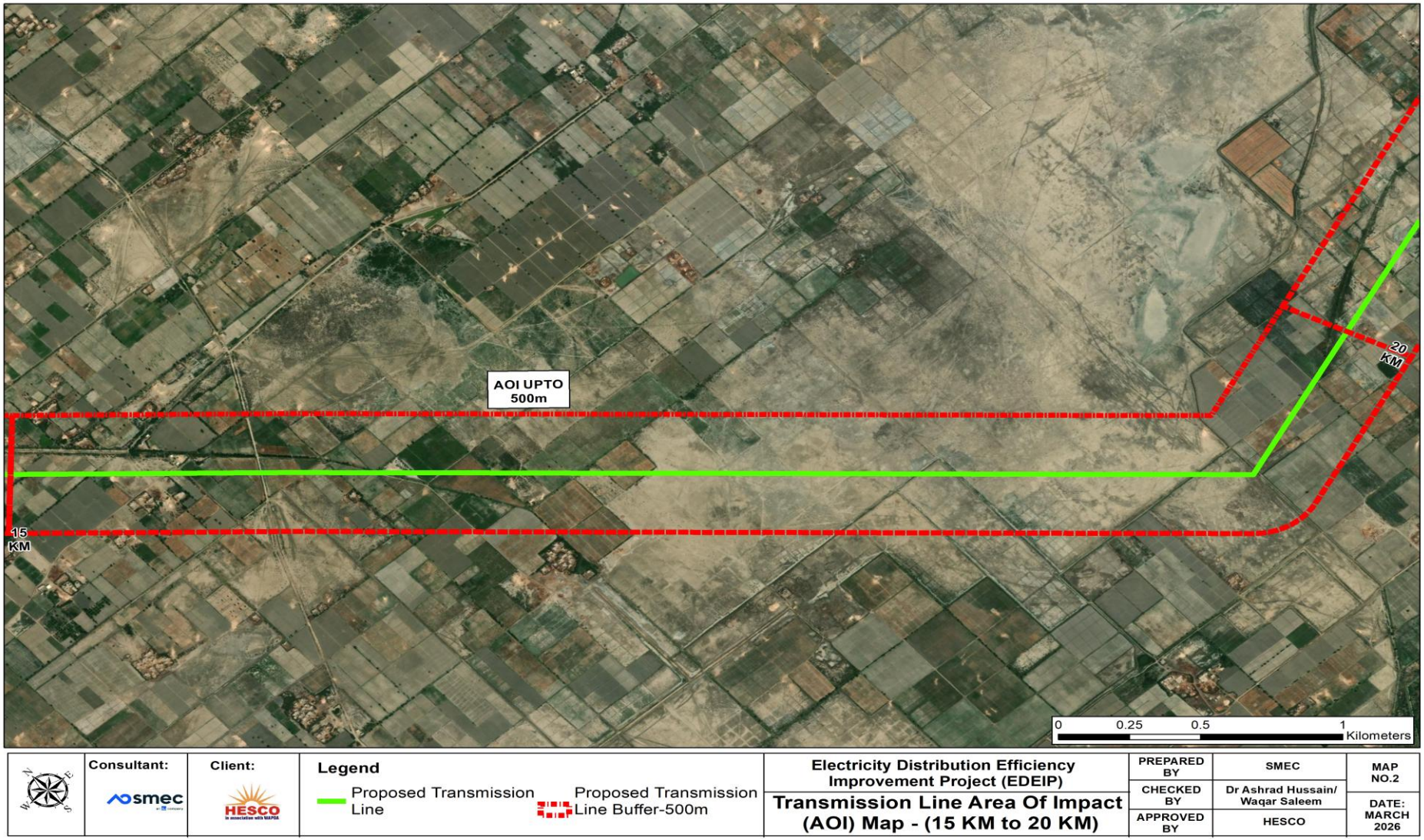

Figure 1-6: AOI of Proposed Transmission Line (15 KM to 20 KM)

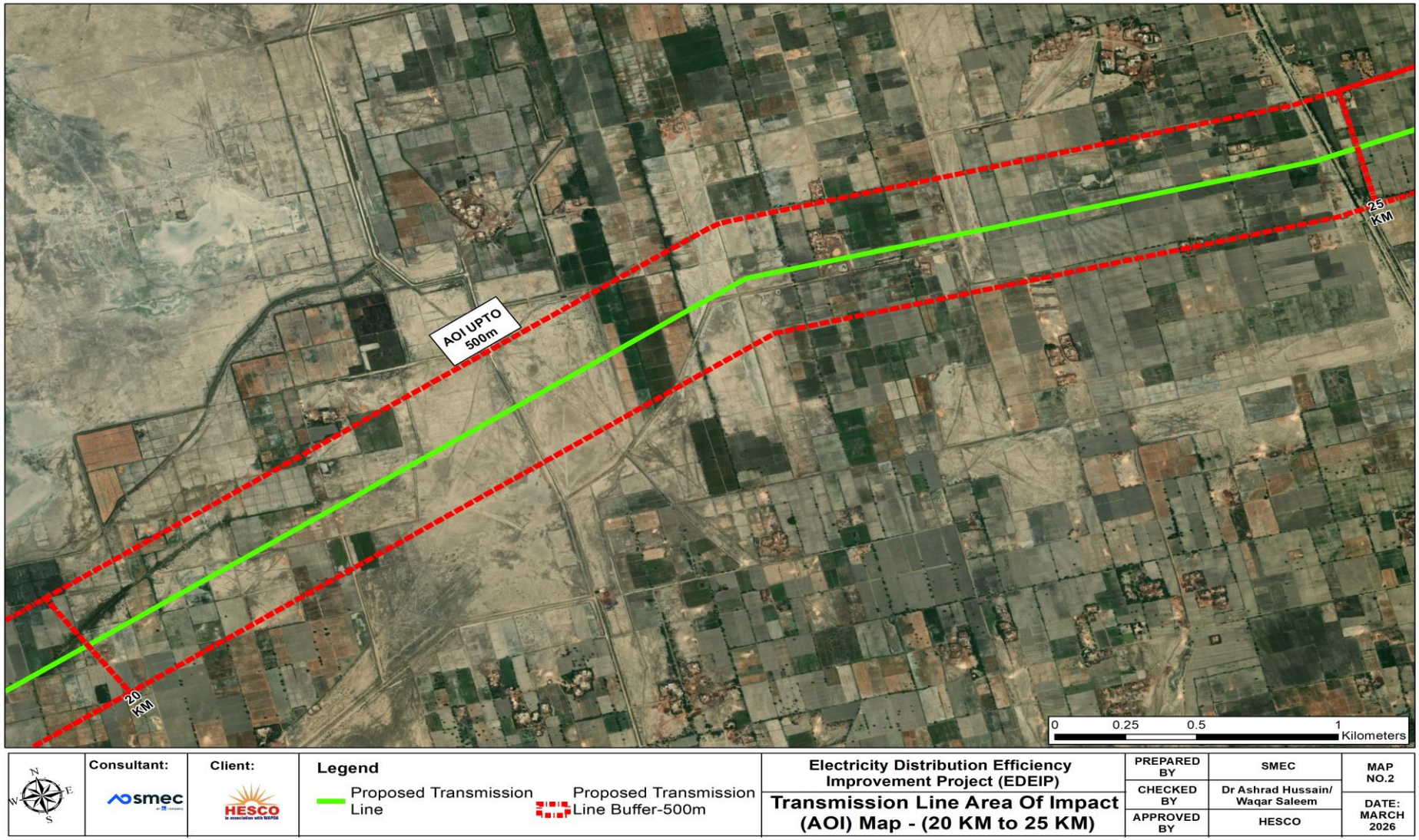

Figure 1-7: AOI of Proposed Transmission Line (20 KM to 25 KM)

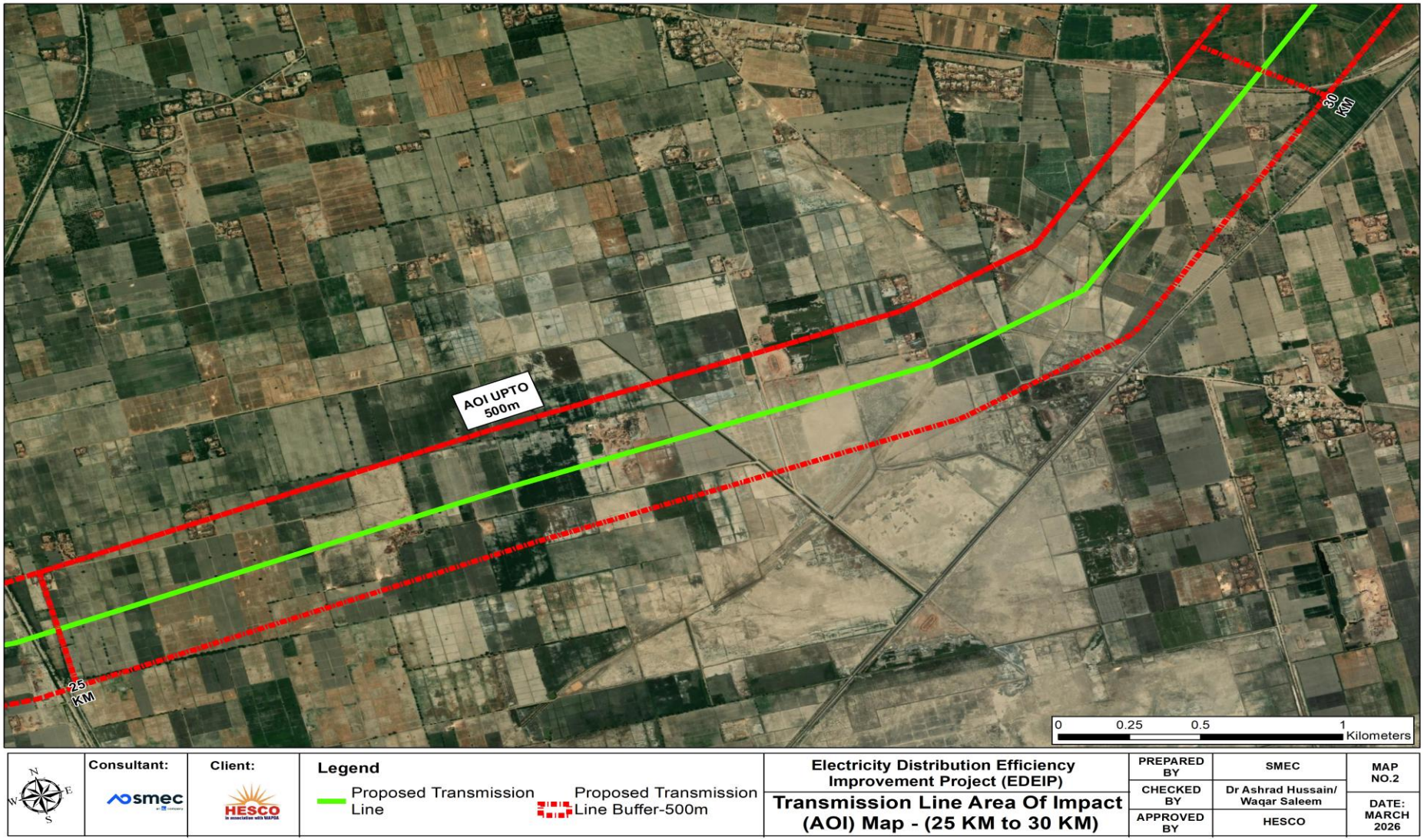

Figure 1-8: AOI of Proposed Transmission Line (25 KM to 30 KM)

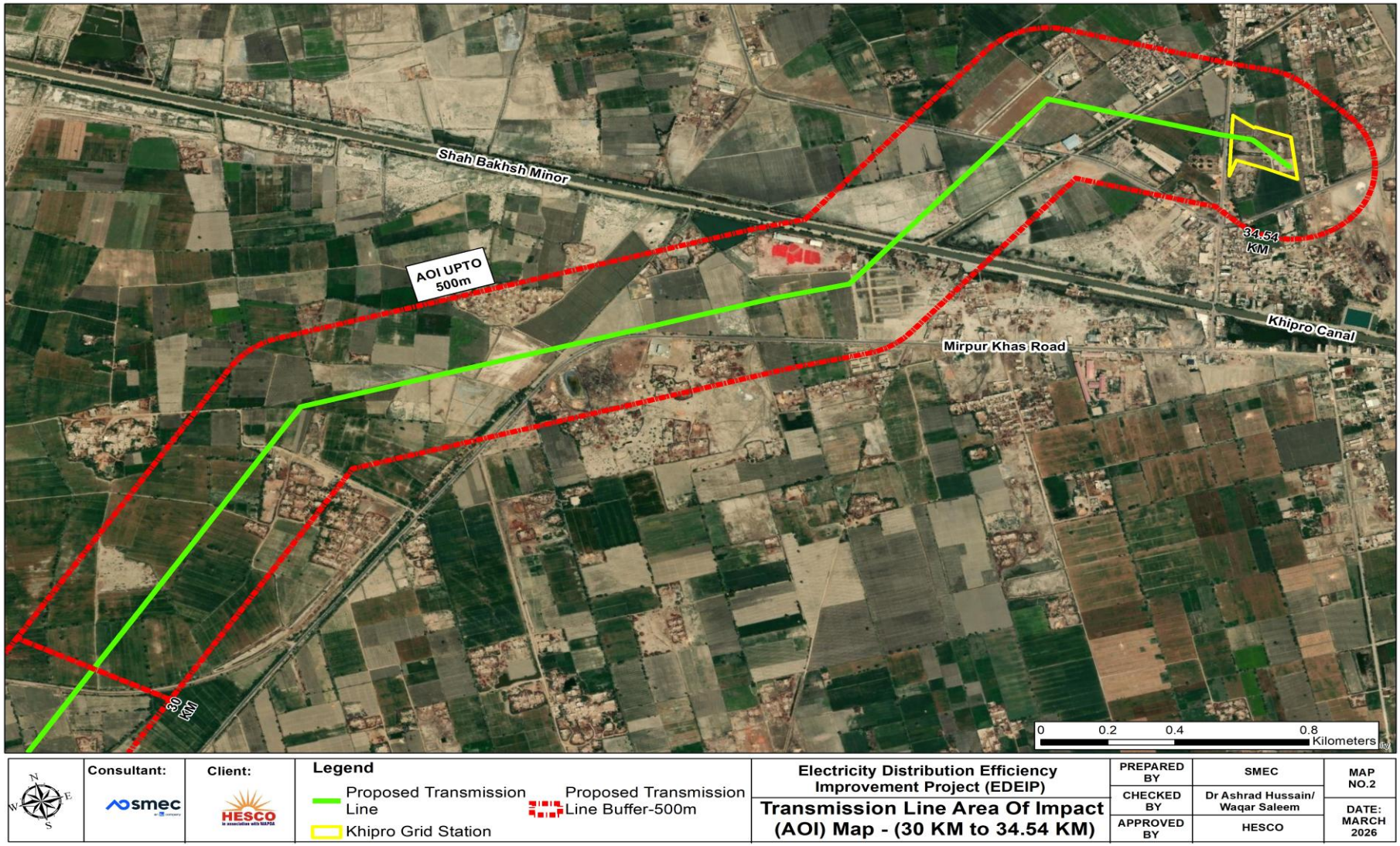

Figure 1-9: AOI of Proposed Transmission Line (30 KM to 34.54 KM)

1.6 Environmental and Social Documents for EDEIP

In compliance with the WB ESF, the following specific environmental and social documents have been prepared for the overall EDEIP:

- Stakeholder Engagement Plan (SEP) –describes various modes of stakeholder engagement, including consultations and grievance redress mechanism (GRM).
- Environmental and Social Management Framework (ESMF) - provides criteria and procedures for environmental and social assessment of various categories of the subprojects under EDEIP.
- Resettlement Framework (RF) - defines principles and procedures for resettlement planning and preparation of resettlement plans for subprojects potentially causing resettlement impacts.
- Labor Management Procedures (LMP) - describe assessment of potential labor-related risks, overview of labor regulation, staff responsibility, policies and procedures.

The current ESIA has been carried out in accordance with the guidelines provided in the above-mentioned ESMF. Similarly, the stakeholder consultations for this ESIA have been carried out following the guidelines provided in the above-listed SEP. The LMP will be applicable to all the subproject personnel, including construction workers.

1.7 Environmental and Social Impact Assessment (ESIA)

1.7.1 ESIA Objectives

The present ESIA has been prepared for the proposed subproject since it can potentially cause significant and lasting negative environmental and social impacts. The ESIA has been prepared to:

- Integrate the environmental and social concerns into the design and implementation of the proposed subproject to ensure that it is environmentally and socially sustainable.
- Consider in an integrated manner, the environmental and social risks, benefits and impacts of the proposed subproject and identify measures to avoid, minimize and manage risks and impacts while enhancing benefits.
- To specify appropriate roles and responsibilities of all implementing agencies/entities and define the necessary monitoring and reporting procedures for managing environmental and social concerns related to the proposed subproject.
- To determine the training, capacity building and technical assistance needed to successfully implement the provisions of this ESIA.
- To comply with the local regulatory and WB policy requirements.

1.7.2 ESIA Study Methodology

The methodology followed in conducting the present ESIA consists of the following steps:

Review of the Subproject Details: At the onset of the study, the subproject details were

obtained from HESCO and studied carefully. Meetings were held with the concerned officials as needed. Attempts were made to obtain as much information as was available at this stage on the subproject.

Review of Relevant Legislation, Policies, and Guidelines: In order to determine the policy, legal and institutional environment for the subproject, the applicable policies, guidelines and legislation concerning the subproject's environmental and social aspects were reviewed, as listed below.

- Policies and legislation of the Government of Pakistan and the Government of Sindh
- The World Bank ESF, Environmental and Social Standards (ESSs), Guidelines, Policies and Directives.

During the present study, the above legislations, regulations, and framework were studied in depth to determine their relevance and applicability to the proposed subproject, in addition to determining and specifying actions to be taken by the project proponents / implementing agencies to fulfil the associated requirements.

Review of Secondary Literature: Under this task, relevant published and unpublished reports and documents were identified and reviewed. These include, among others, similar environmental assessment reports, particularly of donor-funded projects, project documents, environmental and social management frameworks, environmental monitoring reports, news articles, and research reports. The primary objective of this task was to determine the potentially negative environmental as well as social impacts of projects similar to the proposed subproject and the associated mitigation/management strategies that were proposed to address those impacts. Secondary data was also collected, where applicable, to obtain baseline conditions of the subproject area and its surroundings.

E&S Scoping and AoI Determination: During this phase, key information on the subproject was reviewed, and interaction between the activities and key environmental resources was charted out. A long list of potential environmental as well as social issues likely to arise as a result of the subproject was thus developed. Subsequently, the significant potential impacts were shortlisted, screening out the non-relevant and/or insignificant impacts, based upon their nature and severity. Furthermore, the area of influence of the subproject activities was determined. Thus, the sectoral as well as spatial boundaries of the subproject were determined for the environmental and social assessment.

Stakeholder Engagement: The SEP has been prepared for the EDEIP to identify various modes of stakeholder engagement, including stakeholder consultations and GRM, as mentioned earlier in **Section 1.6**. During the preparation of this ESIA, stakeholder consultations were carried out with communities in and around the AoIs and also with the institutional stakeholders (government departments), in accordance with the guidelines provided in the SEP.

Collection of Baseline Data: During this phase, environmental and social data of the subproject area were collected and compiled in order to develop a baseline of the subproject area's physical and socio-economic environment.

Impact Assessment: Once the baseline data collection was completed, an impact assessment was carried out to identify potentially negative impacts of the proposed activities under the subproject. Subsequently, appropriate mitigation measures were identified to address these potential impacts. To the extent possible, the impact assessment and the associated mitigation measures were subproject- and site-specific.

1.7.3 ESIA Structure

Executive Summary: This provides a general summary of the ESIA contents and key findings, in a vocabulary that is easily understood by the public at large. It concisely covers all aspects of the document.

Chapter 1: Introduction. This Chapter describes the ESIA purpose, objectives, principles and methodology. This Chapter introduces the subproject proponents and provides other relevant information. The layout of ESIA is also described in it to facilitate its reading.

Chapter 2: Legal and Administrative Framework. This Chapter describes the relevant national/provincial environmental and social legal requirements as indicated in various legislation, regulations and guidelines relevant to the subproject and this ESIA, as well as the World Bank's ESSs applicable to the proposed subproject. The Chapter also states how such requirements will be complied with during various phases of the subproject.

Chapter 3: Subproject Description. This Chapter provides a simplified description of the proposed subproject. The subproject description includes the background and purpose of the subproject as well as the components of the subproject.

Chapter 4: Baseline Conditions. This Chapter covers the dimensions of the study area and reviews relevant physical, land-use, and socioeconomic conditions. This Chapter has been compiled on the basis of baseline data collection described earlier in **Section 1.7.2**.

Chapter 5: Environmental and Social Impact Assessment. This Chapter defines the impact assessment methodology and describes the potential impacts that were assessed using this methodology. Mitigation measures are also described in this Chapter to address these impacts.

Chapter 6: Environmental and Social Management Plan (ESMP). This Chapter presents the implementation and monitoring mechanisms for the mitigation measures described in Chapter 5. This Chapter also includes institutional arrangements, training requirements, reporting requirements and the GRM.

Chapter 7: Stakeholder Consultations. This Chapter summarizes the stakeholder engagement activities carried out during the preparation of this ESIA. The Chapter also describes similar activities to be carried out during the subproject implementation.

2 Legal and Administrative Framework

2.1 National Framework

2.1.1 Constitutional Context

The Constitution of Pakistan provides the foundational basis for environmental protection through several key provisions. Article 9 ensures the right to life, which the courts have interpreted to include the right to a clean and healthy environment. Article 14 guarantees the dignity of individuals and the privacy of the home, which can be affected by environmental degradation. Moreover, Article 38 (d) calls for the provision of necessities of life, including clean water and sanitation. Following the 18th Constitutional Amendment, environmental regulations have been devolved to the provinces, giving them autonomy to enact and implement their own environmental laws and standards. Since the late 1970s, Pakistan has progressively developed laws and institutions for environmental management.

The Pakistan Environmental Protection Ordinance (1983) was the first dedicated environmental law, followed by the creation of the Pakistan Environmental Protection Agency (Pak-EPA) in 1984. The late 1980s saw major policy efforts, resulting in the Pakistan National Conservation Strategy and the establishment of provincial environmental agencies. The National Environmental Quality Standards (NEQS) were introduced in 1993. In 1997, the Pakistan Environmental Protection Act (PEPA) replaced the 1983 Ordinance, granting broad enforcement powers to environmental agencies. Regulations for Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) were published in 2000. Before the 18th Constitutional Amendment (2010), environmental legislation was shared between federal and provincial governments under the Concurrent List. Post-amendment and environmental management became the exclusive responsibility of provinces. Consequently:

- The federal Ministry of Environment was abolished and replaced by the Ministry of Climate Change to handle international environmental obligations.
- Provinces had to enact their own environmental laws, although PEPA 1997 remained in effect until provincial laws were passed.
- All four provinces have now enacted laws largely based on PEPA 1997, maintaining consistent environmental protection standards nationwide.

2.1.2 Sindh Environmental Protection Act 2014

The Sindh Environmental Protection Act (SEPA), 2014, is the provincial law adapted from the Pakistan Environmental Protection Act, 1997 (PEPA), with responsibility for environmental management shifted from the Federal Ministry of Environment to the provincial government. The provincial Act closely mirrors the federal PEPA, differing mainly in the designation of responsible agencies.

The Sindh Environmental Protection Act, 2014, is comprehensive legislation and provides the legislative framework for protection, conservation, rehabilitation and improvement of the environment. The 'environment' has been defined in the Act in sub section xii (a) air, water and land; (b) all layers of the atmosphere; (c) all organic and inorganic matter and living organisms; (d) the ecosystem and ecological relationships; (e) buildings, structures, roads, facilities and works; (f) all social and economic conditions affecting community life; and (g) the interrelationships between any of the factors specified in sub-clauses 'a' to 'f'. The notable points of the law are:

- **Section 11:** Prohibition of Excessive Discharges/Emissions; No person shall discharge or emit effluents, pollutants, or noise beyond the prescribed Environmental Quality Standards.
- **Section 15:** Regulation of Motor Vehicle Emissions and Noise: Operation of motor vehicles emitting pollutants or noise above SEQS limits is prohibited.
- **Section 16:** The monitoring, testing and analysis carried out in compliance with or for the enforcement of any provisions of this Act.
- **Section 17-1:** Initial Environmental Examination or Environmental Impact Assessment: Projects must submit and obtain approval for an Initial Environmental Examination (IEE) or an Environmental Impact Assessment (EIA) before construction or operation.
- **Section 17-2b:** EIA Review: The Sindh Environmental Protection Agency (SEPA) reviews and approves, requires modification, or rejects the EIA based on environmental objectives.
- **Section 19:** Environmental Monitoring: The Sindh Environmental Protection Agency (SEPA) carries out or arranges environmental monitoring of projects with respect to which it has approved an IEE or EIA of projects.

Since the subproject is located in the province of Sindh, SEPA will apply for the environmental management of the subproject. Under section 17 of the Sindh EPA Act and the IEE EIA regulations 2021, HESCO will apply for the NOC of IEE.

2.1.3 The Sindh Environmental Protection Agency (Environmental Assessment) Regulations, 2021

The (Environment Assessment) Regulations of 2021 establish the framework for the preparation, submission, and review of the IEE and the EIA. The regulations outline the screening categories of projects that require the preparation of an Initial Environmental Examination (IEE) or an Environmental Impact Assessment (EIA).

The IEE-EIA Regulations 2021 provide the necessary details on the preparation, submission, and review of the IEE and the EIA. The categorization of projects for IEE and EIA is one of the main components of the IEE-EIA Regulations 2021. Projects are classified based on the expected degree of adverse environmental impact. These regulations are set out:

- Key policy and procedural requirements for filing an IEE/EIA
- The purpose of environmental assessment.
- The requirement is that environmental assessment be integrated with feasibility studies.
- The responsibilities of proponents
- Duties of the responsible authorities
- Provides schedules of proposals that the project requires, either an IEE or an EIA
- The environmental screening process of the projects under Schedules I & II
- The procedure for the environmental approval for filing the case with the Sindh-EPA for the granting of NOC.

As per the regulations, the subproject for the construction of (132 kV GS and associated transmission line project falls under Schedule II, Category B (Energy), 4. Transmission Lines up to 132 kV and Grid Stations require an Initial Environmental Examination (IEE). The World Bank ESMF classified the subproject as a moderate-risk project with potential limited adverse environmental and social impacts that are generally site-specific, largely reversible, and readily addressed through mitigation measures. This classification requires the preparation of an Environmental and Social Impact Assessment (ESIA) study for the subproject.

2.1.4 Environmental Regulatory Authority

Since the proposed subproject falls in Sindh province, the Sindh Environmental Protection Agency (Sindh EPA) is the relevant environmental regulatory authority. The statutory functions of the Sindh EPA are to:

- Administering and implementing the Environmental Protection Act, its rules and regulations.
- Reviewing IEE/EIA, preparation of procedures and guidelines.
- Prepare, revise and enforce Environmental Quality Standards (EQS) for industries, municipalities, and vehicular emissions.
- Establishing and maintaining laboratories, certification of laboratories for conducting tests and analyses.

- Assisting local councils, authorities and/or government agencies in the execution of projects.
- Establishing a system of surveys, monitoring, examination and inspection to combat pollution.
- Conducting training for government staff and industrial company staff.
- Provide information and education to the public on environmental issues.
- Publishing annual "State of the Environment" reports.
- Undertaking surveys and qualitative and quantitative analysis of data on air, soil and water quality, and industrial, municipal and traffic emissions.

2.1.5 Other Acts, Regulations and Guidelines

Other relevant legislations, acts and guidelines relevant to this ESIA and E&S aspects of the proposed subproject are listed in **Table 2-1** below.

Table 2-1 Relevant National/Provincial Legislation and Guidelines

Sr. No.	Act	Brief Coverage	Relevance to the Subproject
1	Sindh Environmental Quality Standards (SEQS), 2015	SEQS promulgated in 2016 were used for compliance. Specified standards under SEQS are for: Drinking Water Municipal and Liquid Industrial Effluents; Ambient Air Noise Industrial Gaseous Emissions Municipal and Liquid Industrial Effluents; Treatment of Liquid and Bio-Medical Waste.	The subproject is being implemented in Sindh; hence, it needs to conform with SEQS during all the phases, i.e., construction and operation.
2	National Environmental Quality Standards (NEQS),2000, 2009, and 2010	The National Environmental Quality Standards (NEQS), established under Pakistan Environmental Protection Act, 1997, set permissible limits for various environmental parameters, including air and water quality, noise	The NEQS are applicable during both construction and operational phases. Compliance is required for: • Ambient air quality and dust control

Sr. No.	Act	Brief Coverage	Relevance to the Subproject
		levels, emissions, and effluents from industrial and infrastructure activities. These standards serve as the national benchmark for pollution control and environmental compliance.	from construction machinery and vehicle movement. • Noise levels near communities and • sensitive receptors. Effluent and waste discharge, especially at grid station construction sites and worker camps. Contractors will be required to follow NEQS through the site level environmental management and regular monitoring, as outlined in ESMP.
3	Sindh Wildlife Protection, Conservation and Management Act, 2020	The Sindh Wildlife Act, 2020, is developed for the regulation of activities relating to the protection, conservation and management of wildlife in Sindh.	Although the proposed subproject is located in Sanghar District, it is not situated within any designated wildlife-protected area under the Act. However, the district hosts several wildlife sanctuaries and protected areas; therefore, necessary precautions will be taken during project activities to avoid any disturbance to wildlife and their habitats.
4	Sindh Wildlife Protection, Preservation, Conservation and	The Sindh Wildlife Protection, Preservation, Conservation and Management Rules, 2022 provide a	The rules will be applicable to the labor force and other project-

Sr. No.	Act	Brief Coverage	Relevance to the Subproject
	Management Rules, 2022.	comprehensive framework for safeguarding wildlife in Sindh. They empower the provincial government to declare protected areas, regulate human activities, and enforce conservation measures with community participation. The Rules bridge legal authority and practical conservation, ensuring Sindh's biodiversity is preserved for future generations.	related manpower. The shooting of birds and the hunting of wild animals shall be prohibited.
5	Sindh Solid Waste Management Board Act, 2014.	The Sindh Solid Waste Management Board Act, 2014, regulates the safe disposal of solid waste.	This Act is applicable as the proposed subproject will generate solid and liquid waste, which will be managed and disposed of during the construction and O&M phases as per the legislative requirements of this Act.
6	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 proposed subproject in terms of penalties for affecting human lives and public property. It also addresses the control of noise, air emissions and effluent disposal.
7	Prohibition of Employment of Children Act, 1991	Article 11(3) of the Constitution of Pakistan prohibits the employment of children below the age of 14 years in any construction or any other hazardous employment. In	The act is relevant since contractors will hire labor for the construction of the subproject. The

Sr. No.	Act	Brief Coverage	Relevance to the Subproject
		accordance with this Article, the Employment of Child Act 1991 prohibits child labor (a child under 14 years of age).	contractor will be legally bound not to employ children under 14 years of age.
8	Labor Laws as part of the Constitution of Pakistan 1973	The Constitution of Pakistan contains a range of provisions concerning 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 25 lays down the right to equality before the law and the 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 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: Contract of Employment. Termination of Contract. Working Time and Rest Time; Working Hours. Paid leaves, Maternity Leaves and Maternity Protection. Workers' Representation in the Enterprise.	The labor laws will be relevant as they deal with the employment of labor for the construction of the proposed subproject. The following are the major labor laws that are applicable to the proposed subproject: Bonded Labor System (Abolition) Act, 1992. Employment of Child Act, 1991. Minimum Wages Ordinance, 1961. Industrial Relations Act, 2010. West Pakistan Minimum Wages for Unskilled Workers' Ordinance, 1969.

Sr. No.	Act	Brief Coverage	Relevance to the Subproject
		Equality, pay issues, Trade Union and Employment Associations, Other Laws	
9	International Labor Organization ILO) Conventions	Forced Labor Convention, 1930 (No. 29) Freedom of Association and Protection of the Right to Organize Convention, 1948 (No. 87) Right to Organize and Collective Bargaining Convention, 1949 (No. 98) Equal Remuneration Convention, 1951 (No. 100) Abolition of Forced Labor Convention, 1957 (No. 105) Discrimination (Employment and Occupation) Convention, 1958 (No. 111) Minimum Age Convention, 1973 (No. 138) Worst Forms of Child Labor Convention, 1999 (No. 182)	These conventions are applicable to all workers employed by HESCO, its consultants and its contractors.
10	Guidelines for the Preparation and Review of Environmental Reports, 1997	These guidelines describe the format and content of IEE/EIA reports to be submitted to the provincial EPA for obtaining NOC. The guidelines present: The Environmental Assessment Report Format: Assessing Impacts Mitigation and impact management, preparing an environmental management plan, Reporting, Review and Decision Making, Monitoring and Auditing, and project management	These guidelines apply to the preparation of the ESIA.
11	Guidelines for public consultation, 1997	The guidelines deal with approaches to public consultation and techniques for designing an effective program of	These guidelines will need to be followed for carrying out

Sr. No.	Act	Brief Coverage	Relevance to the Subproject
		consultation that reaches out to all major stakeholders and ensures the incorporation of their concerns in impact assessments.	consultations for this ESIA and during the construction activities.
12	Cutting of Trees (Prohibition) Act, 1975	The Act was enforced in 1975 to place restrictions on cutting trees to restrain unchecked trends of tree falling without replacement plantations.	This act will be applicable to the proposed subproject where the cutting of trees will be involved.
13	Pakistan Climate Change Act, 2017	It is the key climate change law enacted by the Parliament to provide a legal and institutional framework for addressing climate change in Pakistan. Under this Act, Pakistan Climate Change Council (PCCC), Pakistan Climate Change Authority (PCCA) and Climate Change Fund have been established. The other components include: Policy and Planning Framework International Obligations and Reporting Mainstreaming Climate Considerations Awareness, Research and Education, and Coordination Between Federal and Provincial Governments	The Act is broadly applicable to the proposed subproject since the subproject areas are prone to climate change risks such as flooding and extreme heat.
14	Sindh Forest Act, 2012	The Act sought to consolidate and reserve the areas having forest cover or significant wildlife, to regulate the movement and transit of forest produce, and the duty leviable on timber and other forest produce. It also defines the procedure to be followed for declaring an area to be a Reserved Forest, a Protected Forest	This Act is applicable to prohibit the contractor from carrying out any tree cutting.

Sr. No.	Act	Brief Coverage	Relevance to the Subproject
		or a Village Forest.	
15	Sindh Factories (Amendment) Act, 2021	The Act regulates the health and safety of workers and communities residing near the factories or construction sites.	This Act is applicable to the subproject workers as well as the nearby community, including men, adults, women, adolescent working in and near the construction area during the construction phase.
16	Sindh Occupational Safety and Health Act, 2017	The Act contains clauses to determines the responsibilities in relation to the health and safety of all workers at the workplace, cooperation with the employer, contractor, sub-contractors, other self-employed persons, formulating occupational health and safety committees in protecting the health and safety at the workplace, conducting work in a way which does not endanger anyone's health and safety at the workplace, providing information which may affect the health and safety of others to the employer, contractor, subcontractors, other self-employed persons and following and enforcing the regulations, standards, guidelines and code of practices.	This Act is applicable since the construction and O&M activities pose OHS risks.
17	Electricity Act, 1910	This Act governs the supply and use of electrical energy and extends to the whole of Pakistan.	This Act is relevant since HESCO supplies and uses electricity.
18	Sindh Transparency and Right to Information Act, 2016	As per this Act, it is expedient to provide transparency and freedom of information to ensure that all citizens have better access to public information, to make the Government	This Act is applicable as the proposed subproject is a public sector initiative and will need to be transparent for

Sr. No.	Act	Brief Coverage	Relevance to the Subproject
		more accountable to citizens, to enforce the fundamental right to information in all matters of public importance, and to ensure transparency in all Government matters.	public.
19	Protection against Harassment of Women at the Workplace Act, 2010	The objective of this Act is to create a safe working environment for women, which is free of harassment, abuse and intimidation with a view toward the fulfillment of their right to work with dignity. The Act builds on the principles of equal opportunity for men and women and their right to earn a livelihood without fear of discrimination as stipulated in the Constitution. The Act requires all public and private organizations to adopt an internal Code of Conduct and a complaint/appeals mechanism aimed at establishing a safe working environment, free of intimidation and abuse, for all working women. It should also establish an Ombudsman at the federal and provincial levels.	This Act is applicable to the subproject in the case of the employment of women workers during the construction and O&M phases.
20	Sindh Prohibition of Child Employment Act, 2017	The Act prohibits the employment of children and regulates the employment of adolescents in certain occupations and works and the matters connected therewith. The act determines that no child shall be employed or permitted to work in any establishment and no adolescent shall be employed or permitted to work in any hazardous work.	This Act is applicable since contractors will hire labor for the construction of the subproject. The contractor will prohibit any child employment for construction or O&M activities of the proposed subproject.
21	Sindh Bonded Labor (Abolition) Act, 2015	This Act prohibits the use of any bonded labor in the province.	Construction activities will be carried out in the

Sr. No.	Act	Brief Coverage	Relevance to the Subproject
			subproject, where the contractor will hire labor. The law is relevant as it deals with the employment of labor for the construction of the proposed subproject.
22	Canal and Drainage Act, 1873	As per the Act, the Provincial Government is entitled to use and control for public purposes the water of all rivers and streams flowing in natural channels, and of all lakes, sub-soil water and other natural collections of still water in their respective territories.	This Act is applicable as the proposed subproject involves crossing canals and drains.
23	Sindh Irrigation and Drainage Authority, 1997	The Act entails the establishment of the Sindh Irrigation and Drainage Authority (SIDA) in the Province of Sindh for equitable distribution of Irrigation water and effective drainage and flood control, sustainable on a long-term basis through participation of beneficiaries in the operation and management of the irrigation and drainage network and to provide for matters connected therewith or incidental thereto.	This Act is applicable to the proposed subproject as the proposed transmission line passes over irrigation canals and drains. The proposed subproject will require prior approval from SIDA to ensure compliance with irrigation and flood safety standards.
24	National Disaster Management Act, 2010	The Act aims to provide in all the provinces of Pakistan an effective disaster management system and matters connected therewith or incidental thereto.	This Act is applicable to the proposed subproject due to its location. The proposed Project requires special consideration of flood disasters and risk management strategies as per the Act.
25	Hazardous Substances	As per these rules, license to import	These rules are

Sr. No.	Act	Brief Coverage	Relevance to the Subproject
	Rules, 2014	or transport a hazardous substance is to be sought and this license shall be accompanied by an environmental impact assessment of the project involving the generation, collection, consignment, transport, treatment, disposal, storage, handling or import of a hazardous substance. The environmental impact assessment shall include a safety plan and a waste management plan if hazardous waste is generated by the project.	applicable to the proposed subproject due to the involvement of hazardous waste handling, use and disposal during different construction activities at the construction stage.
26	Sindh Minimum Wages Act, 2015	The Act delineates the regulation of minimum rates of wages and various allowances for different categories of workers employed in certain industrial and commercial undertakings and establishments, and for matters connected therewith and ancillary thereto. The Act envisages the establishment of the Minimum Wages Board and the notification of minimum wages for every fiscal year.	This Act is applicable to the subproject to ensure that the minimum wages and allowances will be given to the labor (skilled and unskilled) employed for the construction and O&M.
27	Sindh Differently Able Persons (Employment, Rehabilitation and Welfare (Amendment) Act, 2017	The Sindh Differently Able Persons (Employment, Rehabilitation and Welfare) Amendment Act, 2017, was enacted to amend the 2014 Act, significantly increasing the mandatory employment quota for persons with disabilities in both public and private sectors from two percent to five percent. It focused on improving the rehabilitation, welfare, and economic inclusion of DAPs in Sindh.	This Act is applicable as the proposed subproject involves serious occupational health and safety issues during the construction phase and may cause serious injury to workers/staff, causing permanent disability and affecting differently-abled individuals.

Sr. No.	Act	Brief Coverage	Relevance to the Subproject
28	Sindh Commission on the Status of Women Act, 2015	Under the Act, a Commission is formed to examine the policies, programs, and other measures taken or to be taken by the Government for gender equality, women's empowerment, political participation, and representation, and to make suitable recommendations to the concerned authorities.	This Act is applicable because the proposed subproject may involve female staff/workers and local resident women, who may be directly or indirectly linked to subproject activities.
29	Gender Equality as part of the Constitution of Pakistan, 1973	The articles of the Constitution of Pakistan deal with the employment of male and female labor having different religions, political affiliations, sects, colors, castes, creeds, and ethnic backgrounds.	The articles are relevant as they may deal with the employment of male and female labor having different religions, political affiliations, sects, color, caste, creed and ethnic backgrounds for the construction of the proposed subproject.
30	Pakistan Antiquities Act, 1975	The Pakistan Antiquities Act of 1975 ensures the protection of physical cultural resources in Pakistan. The Act is designed to protect especially notified "antiquities" from destruction, theft, negligence, unlawful excavation, trade and export. The law prohibits new construction in the proximity of a protected antiquity and empowers the Government of Pakistan (and Provincial Governments after the introduction of the 18th Amendment to the Constitution of Pakistan) to prohibit excavation in any area which may contain articles of archaeological significance.	No cultural heritage sites are known to exist in the subproject areas. However, the Chance Find procedures have been included in this ESIA.

Sr. No.	Act	Brief Coverage	Relevance to the Subproject
31	Sindh Cultural Heritage (Preservation) Act, 1994	The Act 1994 provides rules and regulations to preserve and protect ancient places and objects of agricultural, historical, archaeological, artistic, ethnological, anthropological and national interest in the province of Sindh.	No cultural heritage sites are known to exist in the subproject areas. Chance Find procedures have been included in this ESIA.
32	Land Acquisition Act, 1894	This Act is the primary legal framework governing the acquisition of private land for public purposes in Pakistan, including infrastructure development projects.	Though no permanent land acquisition is envisaged for the proposed subproject, certain provisions of this Act may be relevant for loss of crops and built structures within the TL RoW.
33	Telegraph Act, 1885	This Act provides legal authority to the government and its implementing agencies for the installation and maintenance of telegraph and transmission infrastructure, including poles and overhead lines.	This Act is broadly applicable to the proposed subproject. However, for compensation of land value diminution, a separate Abbreviated Resettlement Action Plan (ARAP) is being prepared in compliance with the WB ESF.

2.2 WB Environmental and Social Standards

The relevant WB ESSs are briefly described in **Table 2-2**.

Table 2-2: Applicable World Bank ESSs

Environmental & Social Standard	Brief Coverage and Relevance to Subproject
ESS-1 Assessment and Management of Environmental and Social Risks and Impacts	Applies to the entire subproject. Requires the preparation and implementation of an ESIA and ESMP to identify, assess, and manage environmental and social risks during the construction and operation of the grid station and transmission line. This ESIA has been prepared in accordance with this ESS.
ESS-2 Labor and Working Conditions	Ensures fair treatment, safe working conditions, and the rights of all workers involved in the subproject. Requires the preparation and implementation of Labor Management Procedures (LMP), grievance redress mechanisms for workers, and enforcement of child labor and safety regulations. The LMP has been prepared for the entire EDIEP, and HESCO will implement it during the proposed subproject execution. This ESIA also includes mitigation and control measures to address labor issues and working conditions in accordance with this ESS.
ESS-3 Resource Efficiency and Pollution Prevention	Relevant to the management of air emissions, noise, solid waste, hazardous materials (e.g., transformer oil), and usage of resources, including water, fuels and others during construction and operation phases. This ESIA includes measures to address efficient resource usage and to manage/prevent pollution, in accordance with this ESS.
ESS-4 Community Health and Safety	Addresses public safety risks from construction activities, traffic, exposure to electromagnetic fields (EMF), and interaction with laborers. Also includes emergency response measures and awareness for local communities. This ESIA includes measures to address community health and safety risks in accordance with this ESS.
ESS 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	Triggered due to the resettlement impacts, including land value diminution and loss of crops and built-up structures that may be caused by the TL construction. An ARAP (provided under separate covers) has been prepared in accordance with this ESS.
ESS-8 Cultural Heritage	Not Relevant as there is no cultural heritage in the proposed project site. However, the ESMP includes chance find procedures to

Environmental & Social Standard	Brief Coverage and Relevance to Subproject
	manage such findings.
ESS-10 Stakeholder Engagement and Information Disclosure	Requires continuous engagement with stakeholders, particularly affected persons, women, and vulnerable groups. An SEP has been developed, and consultations have been carried out at all subproject locations in accordance with this ESS.

2.3 Gaps between National/Provincial Regulations and WB Standards

Table 2-3 outlines the key gaps between Pakistan's national and provincial regulatory frameworks and the World Bank's ESSs as applicable to the subproject. While Pakistan has a foundational set of environmental, labor, and land acquisition laws, several areas do not fully align with the more comprehensive and inclusive requirements of the World Bank. Notable gaps include the absence of formal Labor Management Procedures, limited provisions for informal land users under the Land Acquisition Act, lack of structured stakeholder engagement throughout the project lifecycle, and insufficient guidance on community health, safety, and biodiversity management. To address these discrepancies, the project has adopted additional instruments such as the ESMP and SEP to ensure compliance with World Bank standards and promote responsible, inclusive, and sustainable project implementation.

Table 2-3 Relevant ESS and Gap Analysis with Local Legislation

Area	National / Provincial Regulations	World Bank Standards	Identified Gaps	Measures to address Gaps
Environmental Assessment	Requires IEE/EIA under SEPA 2014 for certain categories. Focus is mostly biophysical.	ESS1 requires a comprehensive ESIA that includes social, health, and labor risks, with an ESMP and monitoring plan.	National laws focus more on environmental impacts, while WB requires integrated environmental and social risk management.	This ESIA has been prepared in line with World Bank ESSs, incorporating environmental and social baseline, impact assessment, mitigation hierarchy, ESMP, stakeholder engagement, grievance redress mechanism, and monitoring plan to bridge regulatory gaps, and with greater focus on OHS, CHS, SEA, SH, and grievance management.
Labor and Working Conditions	Labor laws exist (e.g., Sindh Prohibition of Employment of Children Act, 2017), but enforcement is weak; no requirement for LMP.	ESS2 requires a formal Labor Management Procedure, workers' GRM, safety plans, and non-discrimination.	Lack of a requirement for LMP and a worker-specific grievance mechanism in national laws	In accordance with this ESS: The LMP has been prepared and will be implemented during the subproject execution. This ESIA also clearly describes risks and impacts associated with labor and working conditions.
Community Health and Safety	Covered indirectly under PEPA or OHS laws; limited guidance on	ESS4 includes detailed provisions on EMF exposure, road safety, fire	National standards do not provide detailed protocols on EMF or community-level	This ESIA includes measures to address CHS issues, including SEA/SH risks, in

Area	National / Provincial Regulations	World Bank Standards	Identified Gaps	Measures to address Gaps
	EMF, fire safety, or emergency response.	prevention, and emergency preparedness.	safety planning.	accordance with this ESS.
Involuntary Resettlement	Governed by the Land Acquisition Act (1894), which focuses on landowners and not on informal users or tenants. No livelihood restoration provisions.	ESS5 mandates compensation at replacement cost, livelihood restoration, and inclusion of informal occupants in the resettlement planning.	The Land Acquisition Act lacks provisions for non-titleholders, economic displacement, and transitional support.	HESCO has prepared an ARAP to address the involuntary resettlement impacts caused by the proposed subproject, in accordance with this ESS.
Stakeholder Engagement	Public hearing required only for EIAs, not IEEs; often treated as a one-time event.	ESS10 requires ongoing, inclusive, and gender-sensitive stakeholder engagement and disclosure throughout the project lifecycle.	Stakeholder engagement is not institutionalized or gender-inclusive under national law.	In accordance with this ESS: • The SEP has been prepared and is being implemented. • Consultations have been carried out during the preparation of this ESIA. • HESCO has established GRM to address community complaints and grievances.

3 Subproject Description

This Chapter describes the proposed subproject and its components, its technical specifications, construction and O&M activities, and temporary facilities to be established by the contractor.

The existing legacy 66-kV Khipro Grid Station will be technically converted to a modern 132-kV system. Immediately following the successful structural completion, rigorous pre-commissioning testing, and formal energization of the new 132-kV Khipro Grid Station alongside its incoming/outgoing 132-kV transmission line from the Kandiari Grid Station the legacy 66-kV substation assets will be permanently taken offline. The entire old configuration will be systematically de-energized, safely isolated, and physically uncoupled from the active transmission network to eliminate any residual electrical, operational, or safety hazards.

Once deactivated, the older 66-kV equipment, including the two legacy power transformers (10/13 MVA and 6/3 MVA units), obsolete outdoor switchgear, analog control panels, breakers, and isolators, will cease active functionality but will remain physically secured in place within the existing 1.5-acre boundary lines under the strict ownership of HESCO.

3.1 Baseline Profile of the Existing Grid Station Infrastructure

3.1.1 Current Technical Configuration

The existing 66kV Khipro Grid Station operates as an Air-Insulated Substation (AIS) occupying a total land area of approximately 1.5 acres. The land is entirely owned by HESCO and is enclosed within a defined perimeter boundary wall. The legacy technical components currently active on-site include:

- Power Transformers**:** The station operates with two power transformers stepping down voltage to the 11-kV distribution level:
- Transformer T-1**:** A 10/13 MVA capacity unit equipped with an incoming circuit breaker and three active outgoing 11-kV feeders.
- Transformer T-2**:** A 6/3 MVA capacity unit operated via high-voltage fuses and serving one active outgoing 11-kV feeder.
- Outgoing Distribution Feeders**:** A total of four active 11-kV radial feeders originate from the station, distributing power to domestic, commercial, and agricultural consumers across Khipro. Due to load growth and the extensive lengths of these feeders, the system experiences frequent thermal overloading and significant voltage drops during peak hours.
- Switchyard and Control Equipment**:** The outdoor yard house is unconventional equipment, including mechanical circuit breakers, isolators, current transformers (CTs), and potential transformers (PTs). The indoor facilities consist of a manual, analog control room panel setup.

3.1.2 Operational Staff Colony Baseline & Social Footprint

To support continuous, 24/7 operational and emergency maintenance workflows, residential facilities are located within the secure boundaries of the grid station property:

- The residential staff colony consists of four permanent residential quarters. These units are strictly designated for essential operational staff, typically including the Grid Station In-charge, shift operators, and line superintendents.
- At present, two of the quarters are occupied by operational staff and their families, totaling approximately 12 inhabitants. The remaining quarters are currently vacant or used for temporary shift rests.
- The proposed structural upgrades, civil excavations, and electrical installations for the 132-kV capacity conversion will be confined strictly to the open, unutilized yard areas of the grid station compound. No structural demolition, relocation, or disturbance will occur to the staff colony buildings.
- All essential residential utilities, including domestic water lines, electricity connections, and internal access roads, will be maintained with zero interruption throughout the construction phase. Any transient environmental impacts (such as localized noise or fugitive dust) near the quarters will be monitored and managed under the framework of the subproject's Environmental and Social Management Plan (ESMP).

3.2 Subproject Needs and Objectives

The proposed subproject comprises the conversion of an existing 66-kV Khipro grid station to a 132-kV Grid Station, along with the construction of its In/Out 132-kV transmission line from Kandiari grid station to Khipro grid station in Sanghar District.

The existing distribution system in Sanghar district and the surrounding areas is overloaded and has no capacity for further expansion. These areas frequently experience low-voltage issues and power breakdowns due to lengthy 11-kV feeders, overloaded circuits, and growing demand from urban expansion, industrial growth, and population increase. In line with the overall objectives of the EDEIP and HESCO's Secondary Transmission and Grid (STG) program, the proposed subproject is designed to address the above-described longstanding challenges in the electricity distribution network.

The proposed subproject aims to:

- **Capacity Enhancement and Overload Relief:** Alleviates severe thermal overloading in the Khipro electricity distribution network by systematically replacing aging 66-kV infrastructure with modern 132-kV equipment, including the installation of a higher-capacity 20/26 Mega Volt Ampere (MVA) power transformer. This creates the technical

headroom necessary to safely satisfy growing energy demands driven by rapid regional population increases, urban expansion, and agricultural intensification over a 15 to 20-year planning horizon.

- **Loss Reduction and Infrastructure Modernization:** Drastically reduce technical transmission losses (I^2R thermal dissipation losses) inherent to legacy low-voltage distribution lines. Elevating the operational voltage threshold to 132 kV significantly improves HESCO's operational energy accounting while minimizing frequent power outages caused by overstretched radial feeders and obsolete switchgear.
- **System Reliability, Automation, and Operational Safety:** Maximizes network redundancy by integrating the station into the robust regional power grid backbone. This enables the implementation of an advanced Substation Automation System (SAS) at the 132-kV level for real-time monitoring and advanced protection coordination, while maintaining strict procedural safety protocols aiming for zero operational accidents.
- **Stabilization of Local Voltage Profiles:** Significantly improves localized voltage regulation and eliminates extreme end-of-line voltage drops. This delivers a stable and "stiff" power supply quality across urban, semi-urban, and rural tail-end consumers, ensuring that domestic appliances, commercial machinery, and agricultural tube wells operate safely at their optimized, rated technical efficiency.
- **Inclusive Regional and Socio-Economic Development:** Promotes sustainable socio-economic growth in underserved areas of the Kandiari-Khipro Corridor by delivering a continuous, high-quality electricity supply to crucial public and private infrastructure, including domestic households, rural schools, public healthcare hospitals, agricultural farms, and local Small to Medium Enterprises (SMEs), which currently suffer from severe chronic voltage fluctuations.
- **Regulatory and Environmental Compliance:** Guarantees strict operational alignment with the National Electric Power Regulatory Authority (NEPRA) regulations, supporting transparent quarterly monitoring and tracking of network progress, while systematically minimizing the regional environmental footprint through optimized, automated grid management.

Upon completion, the grid station developed under the proposed subproject will support improved efficiency in the energy sector while also advancing regional development and enhancing electricity service delivery in underserved areas of the Kandiari-Khipro Corridor.

3.3 Location of Khipro Grid Station

The 66-kV Khipro Grid Station is situated in Khipro Taluka, Sanghar District,Sindh, approximately 2 km southeast of the Khipro town center. The conversion works of the grid station under the proposed subproject will be carried out within the boundary of the existing 66-kV Khipro grid station. The GS is bound by agricultural fields and rural settlements to the north, while local roads and minor canals define the eastern and southern borders. To the west, the area opens toward the broader arid plain characteristic of the region, with patches of scrub vegetation and occasional salt-

affected lands. Overall, the immediate surrounding area is characterized by a mix of vast agricultural lands (primarily cotton, wheat, sugarcane, and chili crops), scattered rural communities, and the typical semi-arid landscape of lower Sindh.

3.4 Technical Details for Proposed Grid Station

The 132-kV Khipro Grid Station is designed as an outdoor, open-air substation for reliable integration into the existing transmission network. The GS will have two dedicated 132-kV line bays. Each line bay includes outdoor-type circuit breakers, disconnectors with earthing switches, current transformers (CTs), voltage transformers (VTs), all mounted on galvanized steel structures with phase-to-phase air insulation.

One 132/11.5 kV power transformer will step down the voltage for distribution feeders. The 132 kV AIS shall be an outdoor air-insulated switchgear, while the 11 kV switchgear will be an indoor metal-clad switchgear with vacuum circuit breakers. Key technical parameters include rated voltage of 132 kV (maximum), power frequency withstand voltage of 275 kV, lightning impulse withstand voltage of 650 kV, and busbar current rating of up to 3,000 Amperes (A). The design ensures high reliability, minimal footprint, low maintenance, and immunity to environmental factors such as humidity, pollution, and saline conditions common in Sindh. Advanced protection and control systems, including numerical relays for distance, differential, and overcurrent protection, along with Supervisory Control and Data Acquisition (SCADA) compatibility.

3.5 Distribution Network

The proposed 132kV Khipro Grid Station will serve as the primary supply point for the local distribution network. Upon completion of the conversion, a total of 6 outgoing 11kV feeders will be connected to the new switchgear.

These feeders are categorized based on their load profile as follows:

- **Rural/Agricultural Feeders:** Primarily serving the agricultural tube wells and rural settlements in the Sanghar District.
- **Urban/Domestic Feeders:** Providing electricity to the residential and commercial areas of Khipro town and its immediate outskirts.

3.6 In/Out Transmission Line

The In/Out transmission line for the proposed sub-project consists of a new, about 35 km long, 132 kV double-circuit overhead line originating from the existing 132-kV Kandiari Grid Station and terminating at the Khipro Grid Station. The alignment mainly traverses rural and agricultural areas of District Sanghar.

This new transmission line will be constructed to provide a reliable and high-capacity power supply path, replacing the existing single-circuit, lower-capacity 66-kV Mirpurkhas-Khipro line. The transmission line would include construction of concrete foundations, installation of new lattice towers, stringing of suitable ACSR conductors, along with associated hardware, insulators, and earthing systems suitable for 132-kV operation.

Most of the TL route is located on agricultural land. No physical displacement of households or impact on built-up structures is anticipated in this segment.

3.6.1 Transmission Line Clearance Requirements

NEPRA has formulated and enforced a comprehensive set of regulations and codes, including the NEPRA Grid Code and Distribution Code[2], which prescribe minimum vertical and horizontal clearance requirements for the planning, design, and construction of overhead transmission and distribution lines. These clearances are critical for ensuring public safety, maintaining service reliability, and preventing electrical hazards across diverse geographical and infrastructural settings. These are shown in **Table 3-1**.

Table 3-1: Transmission Line Clearance

Description	**m**
Across Street Intersection	6.71
Along Streets	–
Across Private Property, Footpaths and Places Inaccessible to Vehicular Traffic	–
Roads and Highways	7.92
Rivers and Major Canals (from High Flood Level)	9.14
Inside Railway Station Limits	10.97
Outside Railway Station Limits	8.53
Vertical Clearance	5.18
Horizontal Clearance	6.10
Earth Part of Line (Insulated Services, Guys, Earth wire, etc.)	3.35
Telegraph Lines	3.35
400 V Lines and below	2.74
11 kV Lines	2.74

[2]*https://nepra.org.pk/Legislation/6-Codes/6.1%20Distribution%20Code%20%202005/Distribution%20Code%202005.pdf*

Description	**m**
33 kV Lines	2.74
66 kV Lines	3.66
132 kV Lines	3.66

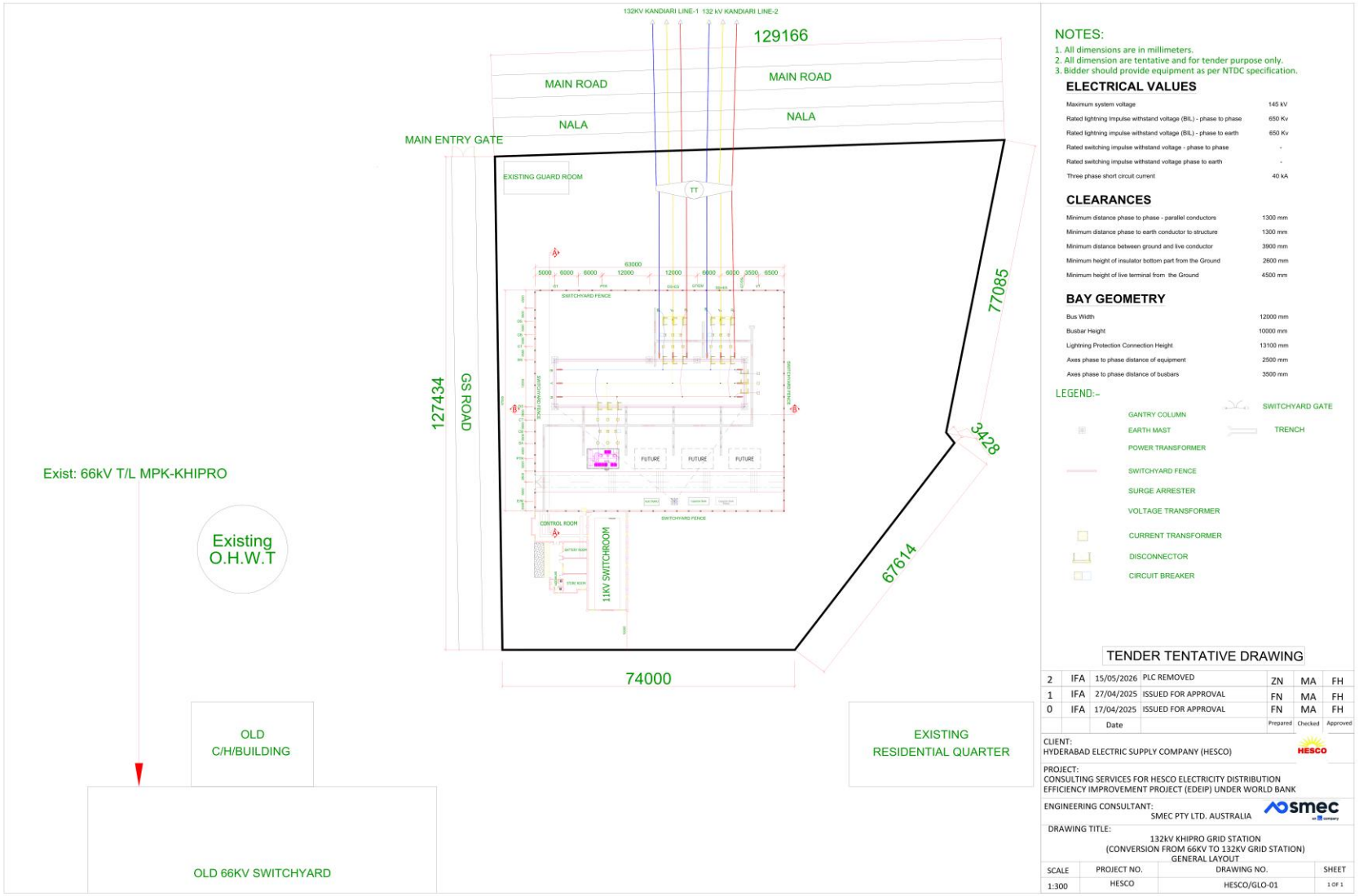

Figure 3-1: General Layout Plan of Proposed Grid Station

3.7 Construction Activities

The proposed subproject involves several key activities, which are described below.

3.7.1 Site Preparation and Civil Works for Grid Station

The conversion of GS requires meticulous planning, site preparation, and development of supporting infrastructure. The proposed conversion of GS will be carried out within the existing grid station premises.

Preparatory works at the construction site will include site assessment and labor mobilization, followed by clearing and levelling activities to remove vegetation and debris, creating a uniform base for structural development. The following preparatory work will be conducted at the site:

a. Site Assessment and Labor Mobilization
b. Clearing and Levelling: Removal of existing vegetation and debris, and levelling of land to create a uniform base for structural development.
c. Foundation Work for Transformer Bays: Excavation and reinforced concrete foundations for power transformers, including oil pits and oil containment systems.
d. Outdoor Switchyard Structures: Construction of reinforced concrete foundations and gantry structures for the 132kV Air Insulated Switchgear. These components are exposed and require specific phase-to-phase and phase-to-earth clearances to ensure atmospheric insulation.
e. Equipment Support Foundations: Preparation of specialized pedestals and support structures for outdoor 40kA circuit breakers, CTs, VTs, and surge arrestors.
f. Control and Relay Room: Construction of a dedicated facility to house the protection panels, battery banks and be separate from the outdoor high-voltage equipment.
g. Access Infrastructure: construction of temporary and permanent access roads designed for heavy transformer transport.
h. Drainage and Earthing Grid: Implementation of comprehensive stormwater drainage and an extensive buried copper earthing mat (grounding grid) to manage step and touch potentials across the outdoor yard.
i. Utility Provisioning: Temporary water and electricity connections for construction works.

3.7.2 Mechanical and Electrical Equipment Installation at GS

The proposed GS construction will involve integrated mechanical and electrical works to ensure operational reliability, safety, and long-term performance of the facility. These activities focus on creating optimal operating conditions for sensitive electrical equipment while providing a safe working environment for personnel.

Key mechanical works will include installation of auxiliary support systems such as Heating, Ventilation and Air Conditioning (HVAC) for the control room to maintain strict temperature and humidity levels, ensuring reliable performance of control and protection equipment. Automated fire detection and suppression systems (gas-based or foam) will be installed in critical areas, including control rooms, battery rooms, and cable basements, to safeguard high-value assets. Ventilation and exhaust systems will manage heat generated by operating equipment and provide noise control where required. Heavy lifting operations using gantry, mobile, or crawler cranes will be carried out for the erection of major components such as power transformers, high-voltage reactors, and line bays. Additional auxiliary mechanical systems will include internal drainage pumps, transformer cooling arrangements, firefighting pipework, and other ancillary equipment. Mechanical testing and commissioning, such as vibration and noise checks for pumps and fans, will be undertaken to confirm compliance with design and regulatory requirements.

In parallel, installation of electrical equipment will cover a comprehensive range of systems to ensure safe and reliable operation. This includes power transformers for voltage regulation and load management; Sulfur Hexafluoride (SF_6) circuit breakers and disconnectors for protection and isolation; current and voltage transformers for monitoring and measurement; and metering and relay protection systems for system control. Surge arresters and post insulators will be installed to protect against overvoltage and maintain insulation integrity. Control systems and switchgear will enhance operational efficiency, while auxiliary transformers and battery-charger systems will provide backup power to ensure the uninterrupted functioning of protection, control, and communication equipment.

3.7.3 Transmission Line Construction

The construction of the 132-kV transmission line will involve several sequential and coordinated civil, electrical, and environmental management activities. The major phases and tasks are outlined below:

1) Route Survey and Pegging: The contractor will conduct a detailed route survey to finalize the alignment, considering terrain, accessibility, environmental sensitivities, and right-of-way constraints. The team will carry out pegging and marking of tower locations using GPS and topographic tools.
2) Land Clearing and Access Preparation: Vegetation within the right-of-way is cleared where necessary, ensuring minimal disturbance to existing land use. Existing access roads to the site may be constructed to facilitate machinery and material transport.
3) Foundation Works: Excavation is carried out at each tower location, followed by the construction of reinforced concrete foundations tailored to soil type and tower load. Foundations are cured and tested before proceeding to erection.
4) Tower Erection: Towers with typical height erected at each foundation site using cranes or gin poles. Safety measures are strictly followed during this high-risk activity, especially when working at height.

5) Stringing of Conductors and Earth Wire: Insulators and hardware fittings are installed, followed by conductor stringing across the erected towers. This includes tensioning and sagging of conductors as per design specifications. An earth wire (grounding wire) is also strung to protect against lightning.
6) Installation of Accessories: Vibration dampers, warning spheres (near roads or air corridors), and anti-climbing devices are installed. Earthing of towers is done to ensure electrical safety.
7) Testing and Commissioning: Electrical and mechanical tests are performed to ensure alignment, tension, insulation integrity, and grounding compliance. After clearance, the line is energized for operational integration.
8) Restoration and Clean-Up: Temporary access roads and disturbed land are restored to their original state as per ESMP. Waste materials are collected and disposed of properly.
9) Environmental and Social Safeguards: Throughout the construction phase, noise, dust, waste, and community safety are managed according to the ESMP.

3.7.4 Construction Equipment

Key Construction equipment and vehicles required for the Grid Station and TL are shown in **Table 3-2**.

Table 3-2: Key Construction Equipment and Vehicles

Type of Equipment/Vehicle	Typical Quantity per Site	Purpose
Mixture Machine	2	Earthworks, foundation excavation
Concrete Mixture	4	On-site concrete mixing for foundations
Heavy Vehicles (Dumper, Trucks, Tractors)	4	Transport of construction materials and spoil
Crane	2	Lifting and positioning equipment and materials
Transit Mixture (Concrete)	4	Transport ready-mix concrete
Steel Binding Device	2	Cutting, bending, and tying reinforcement steel (rebar) for structural concrete elements.
Vibrator	3	Consolidate freshly poured concrete to remove air pockets and ensure uniform density.
Total Station (Survey Instrument)	3	Precise surveying, mapping, and setting out of site coordinates, foundations, and

Type of Equipment/Vehicle	Typical Quantity per Site	Purpose
		structural alignments
Levelling Instrument	4	Ensuring level surfaces and accurate height measurements during construction
Compactor	3	Ground levelling and compaction for foundations and roads
Roller	1	Compaction of asphalt, soil, and granular layers
Cylinder Testing	2	Compressive strength testing of concrete cylinders to verify foundation quality.
Tensioner	1	For sagging
Puller	1	Provide tensioning of conductors and earth wires to the specified sag during stringing.
Reel Rewinder	1	Spool or unspool conductors and wires during installation and maintenance.
Hydraulic Pressing Machine	2	Crimp and assemble compression fittings, sleeves, and dead ends on conductors and earth wires.
Excavator	1	For digging foundations, trenches, and earth excavation works.
Rotary Drilling Machine	1	Used for drilling boreholes for pile foundations.
Reel Carrier	4	Transporting and handling conductor reels during transmission line stringing.

3.7.5 Construction Material Requirements

The estimated quantities of the key construction materials for the proposed subproject are given below.

- 33,960 cubic meters (m^3) of excavation (for foundations, switchyard grading, trenches, and control building basement).
- 4,960 m^3 of plain cement concrete (PCC) (for base layers, blinding, and non-structural works).

- 90,300 m³ of reinforced cement concrete (RCC) (for foundations of transformers, bays, control building, cable trenches, and retaining structures).
- 50,000 cement bags of 50 kg each (primarily for RCC, PCC, masonry, and plastering works).
- 11,820 m³ of crushed stone/aggregate (for sub-base, concrete mixing, and backfilling).
- 7,990 m³ of sand (for concrete, mortar, and plastering).
- 14,000 m³ of brick masonry work (for control building walls, boundary walls, and ancillary structures).
- 500 tons of steel reinforcement (deformed bars for RCC foundations, columns, beams, and slabs); 120 m³/day per day during peak construction (for mixing concrete, curing, dust suppression, and site needs; sourced locally via tankers or bore wells with approvals).

Most of the above construction materials will be procured from licensed local suppliers situated near the grid station site in Khipro or surrounding areas (e.g., cement from nearby factories/distributors, aggregates from approved quarries in Sindh). Additional requirements for crushed stone, gravel, and sand will be met from reliable private crushers/quarries operating with valid Environmental No Objection Certificates (NOCs) from the relevant provincial authorities (such as Sindh EPA). Similarly, cement and steel will be readily available through local distributors of major suppliers in Thatta and Jamshoro Districts, thereby ensuring the timely availability of quality materials throughout the construction phase. Procurement will prioritize environmentally responsible sources to minimize transport-related emissions and comply with project ESIA requirements.

Water will be sourced from a mix of on-site boreholes, nearby tube wells, community water points, and private water tankers, depending on the availability at the location. Water abstraction activities will be carried out in compliance with the Sindh Water Act 2023, ensuring that the rights and needs of local users are not compromised. Wherever feasible, on-potable water will be prioritized for construction purposes to minimize pressure on community water resources. The contractor will be responsible for maintaining detailed records of water usage, ensuring that extraction remains within sustainable limits.

3.7.6 Temporary Facilities

For the proposed subproject site, the contractor will establish workers' accommodations, material storage yards, site offices, and utility areas on-site, within the premises of Khipro and Kandiari Grid Stations. The exact location and size, as well as other details, will be determined based on the contractual requirements, as well as approval from HESCO. The layout plan for the temporary construction facility at the GS site is shown in **Figure 3-2**.

A daily water supply of approximately 3.5 – 4.5 m³, mainly for domestic use, concrete curing, and dust suppression, will be required. Sanitation will be provided via portable toilets or soakage pits, depending on site-specific soil conditions and water table level. Wastewater will be disposed of

through septic tanks or lined soakage pits, designed to meet local environmental and health standards.

During peak construction, the daily solid waste generation is estimated at 35-40 kg per day[3], primarily composed of food waste, packaging materials, and paper. This waste will be segregated and collected in designated bins and disposed of through municipal or contractor-arranged services. Hazardous waste such as used oil, lubricants, paint containers, and oily rags will be generated in small quantities. These will be stored in labelled, leak-proof containers and transported to licensed hazardous waste disposal facilities or returned to suppliers for safe handling, in accordance with the Sindh Hazardous Substances Rules, 2014.

[3]*Considering: 60-65 workers; about 0.6 kg of domestic solid waste generated per day per capita.*

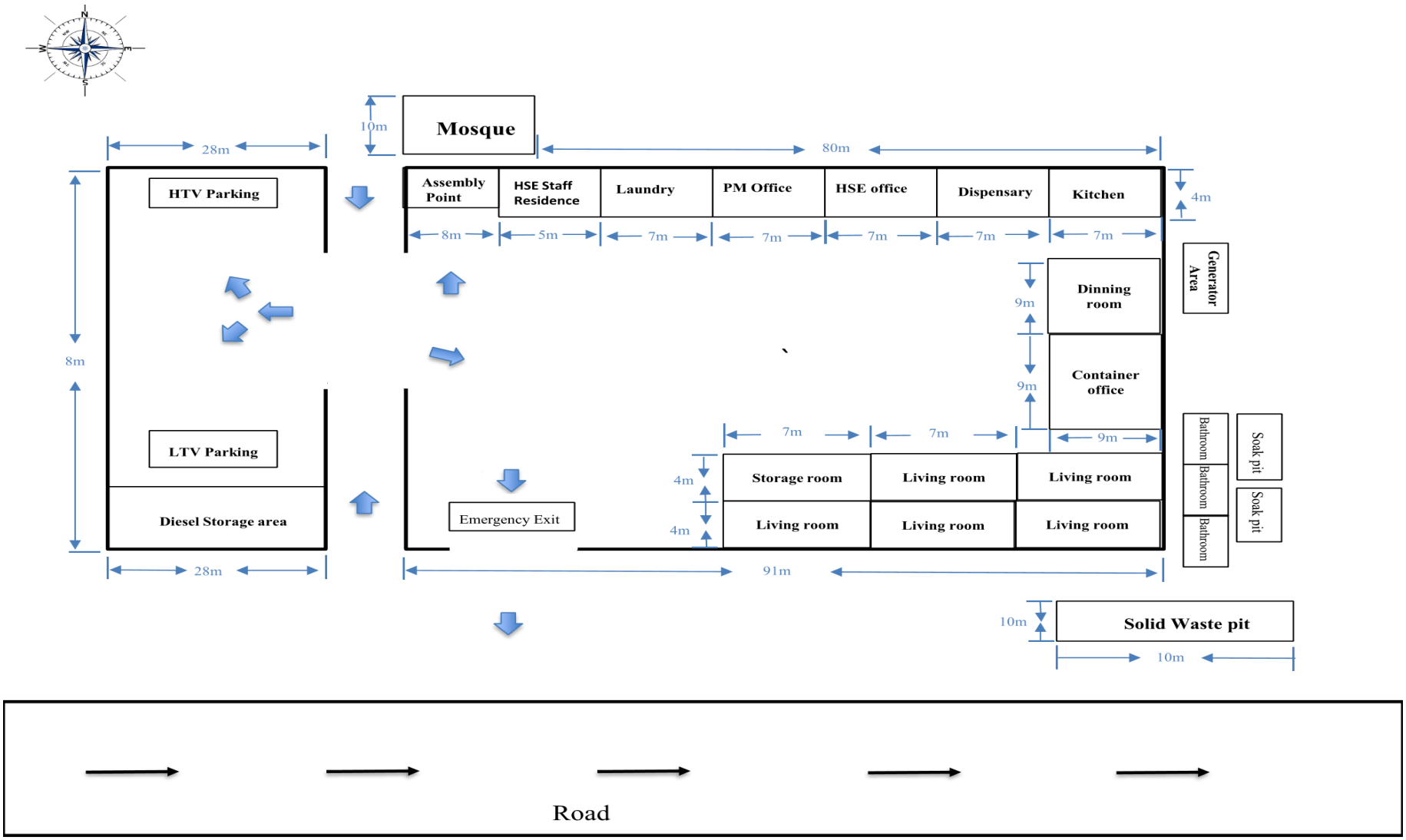

Figure 3-2 Layout Plan of Temporary Camp Construction Facility at GS site

The above site layout plan is generic, and the contractor will need to develop it as per site conditions and construction methodology. The contractor will get the approval of the contractor's camp before the start of construction from the Project Implementation and Management Support Consultant (PIMSC). The contractor will manage all utilities and services at the temporary facilities under the supervision of HESCO and the subproject PIMSC. Regular inspections will be carried out to ensure hygiene, safety, and environmental compliance throughout the construction period.

3.7.7 Construction Schedule

The construction schedule for 132 kV grid station, the proposed subproject, is projected over a span of 12 months, depending on required permits from relevant authorities and the coordination of resources. The tentative timeline is as follows:

Pre-construction Phase (0-4 months):

- Site preparation

a) Detailed design and approvals
b) Procurement of materials and equipment

Construction Phase (5-8 months):

- Site development and civil works

a) Installation of electrical equipment and transmission lines
b) Building and infrastructure construction
c) Environmental and safety measures implementation

Testing and Commissioning (9-10 months):

- Electrical testing and commissioning of the Grid Station

a) Integration with the existing transmission network
b) Final environmental audits and compliance checks

Completion and Handover (11-12 months):

- Final inspections and certification

a) Handover to operational teams
b) Subproject closeout and documentation
c) Defect Liability period

3.8 Operation and Maintenance (O&M) Activities

A simplified description of the O&M activities related to the grid stations and transmission lines is provided below.

Operation Activities

- The grid stations are manned round the clock and important parameters (such as voltage, load and power factor) are regularly monitored. Daily log sheets are filled, recording the key data.
- Regular inspection and monitoring of transformers, switchgear, circuit breakers, relays, earthing systems, and control panels.
- Any abnormality, such as electrical faults in the system, is recorded and the departments concerned are informed to take remedial measures.
- Emergency maintenance, location of faults, repairs and replacement of faulty equipment/material.
- Conducting periodic ground inspections to detect transmission line conductor damage, loose fittings, vegetation encroachment, or tower corrosion.
- Tightening bolts, cleaning insulators, applying anti-corrosion coatings, replacing worn-out fittings, and maintaining grounding systems.
- Responding to faults or damage caused by storms, accidents, or equipment failure; isolating faulty sections and carrying out urgent repairs.
- Scheduled Maintenance

    - Checking/testing of transformers (further discussed below)
    - Testing of breakers
    - Testing of the protection system
    - Transmission line patrolling
    - Washing/replacement of insulators
    - Carrying out repairs or replacements, as needed
    - Restoring the system to normal operating conditions.

Maintenance of Transformers

Power transformer repairs: The minor repairs for the power transformers are carried out at the grid stations; however, for the major repairs, the transformers are transported to the Water and Power Development Authority's (WAPDA's) Power Transformer Reclamation Workshop.

Transformer oil testing: The dielectric strength of the transformer oil filled in the power transformers is tested every year at the grid stations. For this purpose, a simple device called the oil testing set is used. An oil sample is taken from the transformer and a test is performed. A record is maintained for these yearly tests. No action is taken if the test results are within the prescribed limits. However, if the dielectric strength of the transformer oil is found to be less than the allowable limits, the oil is replaced. After every five years, a more comprehensive test is carried out for the transformer oil. Three oil samples are taken from each transformer and sent to WAPDA's High Voltage and Research Laboratory in Faisalabad. At the Laboratory, the following tests are carried out:

- Flash point
- Viscosity
- Moisture
- Gas contents
- Dielectric strength.

Transformer Oil Disposal: The transformer oil is mostly recycled in the transformer workshops. The unusable waste oil is disposed of through licensed service providers in accordance with the SEPA Hazardous Substance Rule (2014). HESCO procedures include a list of approved firms for the disposal of the used transformer oil.

3.9 Methodology and Timeframe for 66kV Feeder Migration

To ensure maximum continuity of supply during the transition from the old 66kV system to the new 132kV infrastructure, the following migration strategy will be implemented.

3.9.1 Operational Continuity Strategy

The existing 66kV Grid Station shall remain fully energized throughout the shifting process. This allows the project team to maintain power to the majority of the service area while individual feeders are migrated one by one.

3.9.2 Step-by-Step Shifting Methodology

The transfer of feeders shall be executed sequentially on a feeder-by-feeder basis to minimize the footprint of any power interruptions:

- Identification and Isolation: The specific 66kV feeder slated for transfer will be identified, and the operational team will isolate it from the existing 66kV grid station bus.
- Permit to Work (PTW): Official shutdown permission will be obtained from the relevant load dispatch or regional control center for that specific circuit.
- Physical Disconnection: The feeder will be switched OFF and physically disconnected from the existing 11kV switchgear.
- Integration at New Facility: Cable terminations, jumpering, and all necessary protection interconnections shall be completed at the new 132kV Grid Station.
- Pre-Energization Testing: Mandatory continuity checks, insulation resistance (IR) tests, and protection logic verification will be performed to ensure the new circuit is healthy.
- Restoration of Supply: The feeder will be energized from the new 132kV Grid Station, and normal supply will be restored to consumers.

3.9.3 Estimated Timeframe and Impact

While the total project migration may span several days, the temporary interruption for consumers on any given feeder is kept to a minimum:

- Duration per Feeder: Approximately three (03) hours, subject to site conditions and operational clearances.
- Sequence: Only one feeder (or a small group of non-critical feeders) will be interrupted at any single time.

3.10 Manpower Requirements

The proposed subproject will require a diverse workforce to complete the various tasks. A mix of skilled, semi-skilled, and unskilled labor will be needed for subproject construction. While the actual manpower needs will be determined by the construction contractors, some estimates have been carried out based on similar works on other projects. The tentative manpower requirement for the proposed works at the Grid Station site and transmission line has thus been estimated to be about 45-50 workers in addition to site supervisors and engineers. The key staff requirements for the construction of the Grid Station and transmission line are given in **Table 3-3** and **Table 3-4** below.

Table 3-3: Key Staff Requirement for Conversion of Grid Station

S. No.	Position/ Role	Number of Staff
1	Civil Engineer	3
2	Electrical Engineer	3
3	Civil Supervisor	2
4	Electrical Supervisor	2
5	E&S (Environment Officer, 01, HSE 01 and Social 01)	3
6	Foreman	2
7	Labor	50
8	Drivers	5
	Total	**70**

Table 3-4: Key Staff Requirement for Construction of Transmission Line

S. No.	Position/ Role	Number of Staff
1	Civil Engineer	3
2	Electrical Engineer	3
3	Supervisor Civil	2
4	Supervisor Electrical	2

S. No.	Position/ Role	Number of Staff
5	E&S (Environment Officer, 01, HSE 01 and Social 01)	3
6	Foreman	2
7	Labor	50
8	Driver	7
	Total	**72**

3.11 Analysis of Alternatives

This Section provides an alternatives analysis, encompassing a comparison of various subproject options based on technical, environmental and social factors. It defines the specific options considered for grid station and transmission line construction activities, with an analysis to identify the most suitable option. In the end, conclusions are given on the selection of environmentally sustainable project design.

3.11.1 No-Project Alternative

The no-project (do-nothing) alternative was thoroughly assessed but ultimately rejected as it would not resolve the persistent power supply challenges in Sanghar District, specifically Khipro City and its surroundings. Without the conversion of 66 kV Khipro Grid Station to 132 kV, existing facilities in the Sanghar District would continue to experience severe transformer overloading, 11kV feeder constraints, high transmission and distribution (T&D) losses, frequent outages, and voltage instability. These issues are exacerbated by rising electricity demand driven by population growth, ongoing rural electrification programs, agricultural expansion (e.g., irrigation tube-wells), and emerging small industries in Khipro tehsil and surrounding areas. This lack of infrastructure would perpetuate high T&D losses, frequent interruptions and voltage instability. Therefore, the conversion of the existing grid will accommodate the rising demand for electricity driven by population growth, urbanization, industrialization, and an increase in rural electrification in Sindh.

In the absence of this subproject, the supply-demand gap would continue to widen, leading to significant short- and long-term socio-economic impacts hindering development in semi-urban areas of Sanghar district. Existing infrastructure would experience accelerated wear and tear, resulting in higher maintenance costs and increased operational risks. While short-term capital expenditures might be avoided, long-term inefficiencies, such as necessary reliance on backup generation, would increase both carbon emissions and economic losses. Ultimately, the do-nothing option fails to meet NEPRA performance standards and HESCO's strategic goals for providing a reliable power supply.

3.11.2 Sitting Alternatives

The proposed conversion of the existing 66-kV Grid Station at Khipro into 132 kV is being carried out on the existing land already in possession of the HESCO. Since the conversion is taking place on the existing site, no new land acquisition is required and no siting alternatives are relevant.

3.11.3 Alternative Route for Transmission Line

The In/out 132 kV TL route for Khipro grid station has been planned to follow the shortest feasible alignments while minimizing the length of the transmission line, avoiding settlements and minimizing environmental and social impacts. The selected route incorporates angle towers to bypass villages and is predominantly routed through cultivated and semi-open land where practicable.

Several alternative alignments were assessed but ultimately rejected due to constraints such as transmission line length, unfavorable topography, proximity to settlements, encroachment on agricultural or forested areas, crossings of water bodies, or potential impacts on protected zones. Multidisciplinary expert teams, including environmental specialists, geologists, and engineers, carried out detailed site inspections to refine and optimize the preferred route, ensuring community acceptance, environmental protection, system reliability, and cost efficiency.

Grid stations such 132kV Sanghar grid station, 132kV Shahdadpur grid Station and 132kV Kandiari grid station were assessed for dedicated feed transmission line to 66kV Khipro grid station, by prioritizing existing corridors where possible, nearest distance between grid station, minimizing crossings of sensitive features, and using angle towers for detours around populated or ecologically sensitive areas, the design reduces land disturbance, avoids resettlement needs, and limits impacts on local agriculture or communities.

The 132 kV double-circuit transmission line for the Khipro grid station was designed to follow the shortest feasible alignment while minimizing environmental and social impacts. By assessing feed options from the Sanghar, Shahdapur, and Kandiari grid stations, planners prioritized existing corridors and utilized angle towers to bypass settlements and ecologically sensitive areas. This approach, refined by multidisciplinary teams of engineers and environmental specialists, avoids resettlement and limits land disturbance by routing primarily through cultivated or semi-open terrain. Ultimately, the selected route optimizes system reliability and cost efficiency while ensuring community acceptance and the protection of local agricultural and forested zones.

Table 3-5 Alternative Selection Summary

S. No	Sending End Grid Station	Receiving End Grid Station	Social aspect	Environmental aspect	Distance(km)	Transmission line length
1	132 kV Kandiari Grid Station	132 kV Khipro Grid Station	Minimal social issues reported	Minimal environmental impact	30.37	Proposed
2	132 kV Sanghar Grid Station	132 kV Khipro Grid Station	Potential for minor land acquisition issues due to longer routes that require more detours around local housing.	Increased land disturbance involves crossing more agricultural land and minor vegetation removal.	49.95	() Rejected
3	132 kV Shahdadpur Grid Station	132 kV Khipro Grid Station	Higher social risk due to maximum length (76.86 km); passes near more settlements and private properties.	Significant environmental footprint; involves multiple water body crossings and potential impact on local trees.	76.86	Rejected

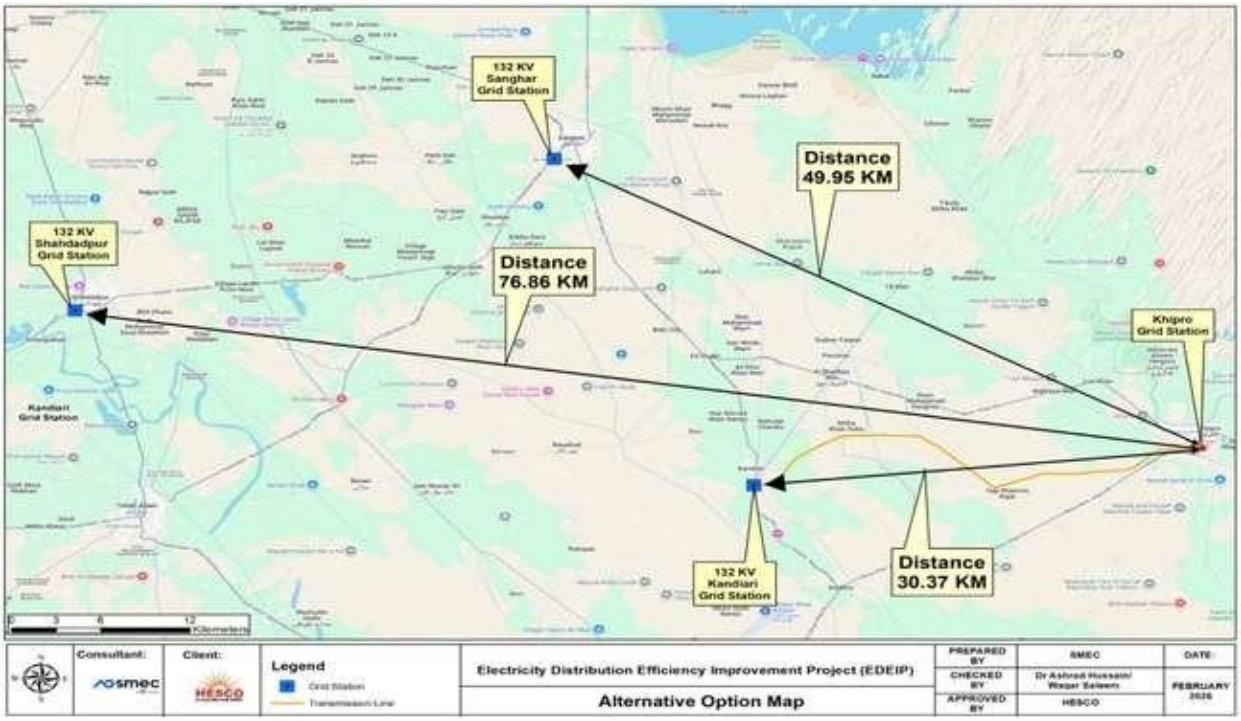

Figure 3-3: Alternative Grid Station for Feed 132 kV Transmission Line for Khipro Grid Station

3.11.4 Technology Alternatives

As part of the project planning and design process, HESCO undertook a comprehensive evaluation of alternative technologies for the conversion of the Khipro grid station to ensure technical suitability, operational reliability, environmental compliance, and cost-effectiveness. In this context, the two most widely adopted technologies for high-voltage substations, AIS and Gas-Insulated Substations (GIS), were examined in detail.

AIS are open-air systems where equipment is exposed and insulated by atmospheric air. They require a larger land footprint and are typically suitable for rural or semi-urban areas where land is readily available. AIS is easier to maintain and less expensive in terms of capital cost.

GIS, on the other hand, is a compact, enclosed system where equipment is insulated using SF_6 gas. GIS is ideal for space-constrained or urban settings due to its smaller footprint and better protection from environmental elements. Although GIS (Gas-Insulated Switchgear) has lower visual and noise impact and requires minimal land clearance, it involves higher construction costs and uses SF_6 gas, a potent greenhouse gas with a long atmospheric life. Special handling and leak prevention are necessary to avoid adverse environmental impacts.

A comparative analysis was carried out based on environmental, technical, financial, and operational factors to determine the most appropriate technology for the proposed grid station. A comparison between AIS and GIS alternatives is shown in Table 3-5.

Table 3-6 Comparison of Technology Alternatives

Criteria	AIS (Air Insulated Substation)	GIS (Gas Insulated Switch Gear Substation)
Insulation Medium	Atmospheric air	SF_6 (Sulfur Hexafluoride) gas
Space Requirement	Requires a large open area, about 3.5-6 acres	Small footprints significantly reduce land acquisition and visual impact. This facilitates community acceptance and streamlines environmental permits for critical infrastructure.
Capital Cost (without land cost)	Lower initial cost	Higher capital investment required
Maintenance	Easier visual inspection but requires frequent, weather-dependent maintenance. Access to large repair crews and equipment. This may require frequent maintenance.	Requires specialized equipment and expertise. However, maintenance intervals are far longer due to protected components. Modular design allows for targeted, less frequent maintenance, which is a significant advantage on a constrained, sensitive site.
Environmental Impact	No greenhouse gas emissions	Risk of SF_6 gas leakage; high global warming potential. Special handling and leak prevention reduce environmental risks.
Social considerations	Large land acquisition may have impacts on people and involve resettlement issues.	Small footprints significantly reduce land acquisition and visual impact.
Operational Safety	Open-air design poses more exposure to environmental conditions and OHS and CHS risks to people.	Enclosed design improves safety from external elements. and low OHS risk during operations
Suitability for Site Conditions	Suitable where land is available; ideal for semi-urban or rural areas.	Ideal for congested or urban environments with limited land and climate-prone areas.
System Expansion	It is easy to expand due to the open layout.	More complex and costly to expand, but it has scalable capacity.
Decision for HESCO	✅ Selected AIS were selected. This decision is	❌ Not Selected GIS was not selected due to its

Criteria	AIS (Air Insulated Substation)	GIS (Gas Insulated Switch Gear Substation)
Subproject	based on the availability of sufficient land in the existing Khipro GS (government-owned), allowing the adoption of AIS technology, which is cost-effective, easier to operate and maintain, and consistent with HESCO's existing infrastructure standards. AIS design also supports open-air installations, facilitating quicker fault detection and more accessible repair or expansion in the future.	significantly higher capital and maintenance costs and because the subproject site does not face land constraints or dense urban encroachment conditions that typically justify GIS installation. Given the rural and semi-urban nature of the selected locations, AIS offers the most technically and economically viable solution for achieving the subproject's objectives.

In view of the fact that the conversion works for the grid station are planned within the existing grid Khipro station, which requires no land acquisition or resettlement issues. Hence, the additional cost associated with the GIS cannot be justified, and the conventional grid station design technology is the preferred option for the proposed grid station conversion.

4 Baseline Conditions

This Chapter presents the E&S baseline conditions of the proposed subproject area. This baseline description focuses on the E&S aspects that have been scoped in, as mentioned in **Section 1.4**.

4.1 Subproject Site Overview

The proposed subproject is located in District Sanghar, in the Khipro-Kandiari corridor. It comprises two main components: the conversion of the existing 66-kV Khipro Grid Station and the construction of an associated 132-kV transmission line.

4.1.1 Khipro Grid Station

The conversion work of the grid station will be carried out entirely within the boundary of the existing 66-kV Khipro Grid Station. The site is situated within Khipro town, surrounded by residential and agricultural areas, approximately 2 km from the city center along the Khipro-Mirpurkhas road.

The immediate surroundings of the grid station include an irrigation canal or protection bund on one side. The other sides consist of vast agricultural land (primarily cotton, wheat, maize, sugarcane, and chili fields), scattered rural settlements, small residential clusters, and occasional institutional buildings such as government schools, basic health units, and water pumping stations. On the eastern side, the desert fringes of the Achhro Thar (white desert) may begin, with sand dunes and scrub vegetation transitioning from irrigated plains.

4.1.2 Associated 132-kV Transmission Line

The associated 132-kV double-circuit transmission line, approximately 34.54 km long, will be constructed to feed the Khipro Grid Station from the Kandiari Grid Station. The transmission line route passes through predominantly rural and agricultural settings.

The community in this area is socially and economically diverse, consisting of residents, including landowners, smallholder farmers, encroachers along canal bunds or roads, livestock herders, and members of the Hari community residing as informal settlers or sharecroppers. Many households depend on agriculture and seasonal labor.

The transmission line corridor is easily accessible via the Sanghar–Khipro road and connections to the National Highway N-5 via Sanghar and linking roads from Hyderabad-Mirpurkhas Road. This location facilitates the transport of materials and equipment during the construction phase.

4.2 Geography and Topography

Sanghar District is situated in the central part of Sindh Province, Pakistan, lying between approximately 25°29′42″–26°28′1″ North latitude and 68°28′18″–70°12′49″ East longitude. The district is surrounded by Khairpur and Shaheed Benazirabad districts in the North and Northwest, Umerkot, Mirpurkhas, and Tando Allahyar districts in the South, Matiari district in the West, Hyderabad district in the Southwest and Jaisalmer and Jodhpur districts of India in the East.

Topographically, Sanghar is divided into 2 broad parts: a green belt in the West and a desert in the East. The main Nara Canal is the dividing line between these 2 sections. The desert comprises sand dunes in the eastern part of Sanghar and Khipro Talukas and stretches over one-third of the area of the entire district. The desert area of Khipro Taluka is known as Achhro Thar (white desert), and it is actually a part of the great Thar Desert, which spreads along the eastern borders of Sindh (shared with India) and the Punjab provinces. The desert earned this name because of its characteristic whitish sand found in most parts of this area. Achhro Thar, then, is distinct from other parts of the great Thar Desert because of the rapid shifting of its sand dunes compared to other parts of the desert in the Tharparkar district, which have relatively more stable dunes. The average elevation of the area is about 50 m above sea level[4].

Overall, the district's elevation is uniformly low, with typical values ranging from approximately 19 to 24 meters above mean sea level in the vicinity of Sanghar city and its surroundings.

4.3 Land Use

Land use surrounding the Khipro grid station is predominantly a semi-urban area, comprising residential and agricultural land. While the route of the transmission line comprises agricultural land, small villages, and irrigation and drainage channels. A small portion of the area also includes barren land and a mix of shrubs and grass.The land use maps for the grid station site and associated transmission line are attached as Annexure –2.

4.4 Climate

The climate of Sanghar District is characterized by sweltering, humid, arid, and windy conditions. Winters are short, cool, and dry, and the weather remains mostly clear throughout the year. Over the course of the year, the temperature typically varies from about 9°C to 43°C and is rarely below 6°C or above 46°C. The climate of the region over the months is presented in Figure 4-1 below.

[4]https://pakistanalmanac.com/sindh-sanghar/

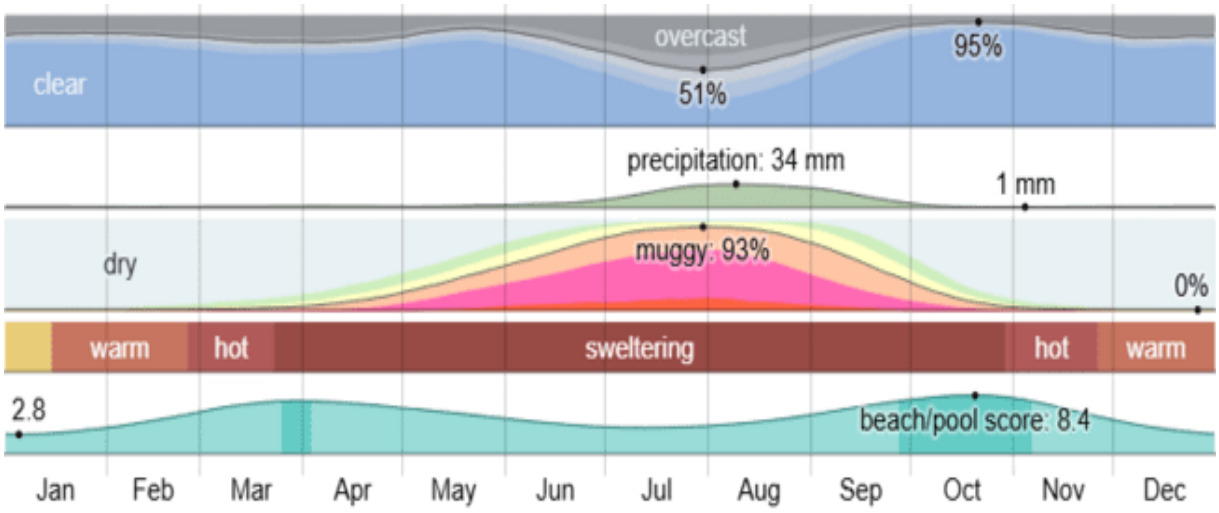

Figure 4-1: Climate Conditions in Sanghar

Source: www.weatherspark.com

4.4.1 Temperature

The hot season in Sanghar spans three months, beginning on April 15 and concluding on July 14. During this timeframe, the average daily high temperature consistently exceeds 39°C. June stands as the hottest month of the year, reaching an average high of 42°C and an average low of 28°C. The picture of the temperature in Sanghar District is portrayed in Figure 4-2 below.

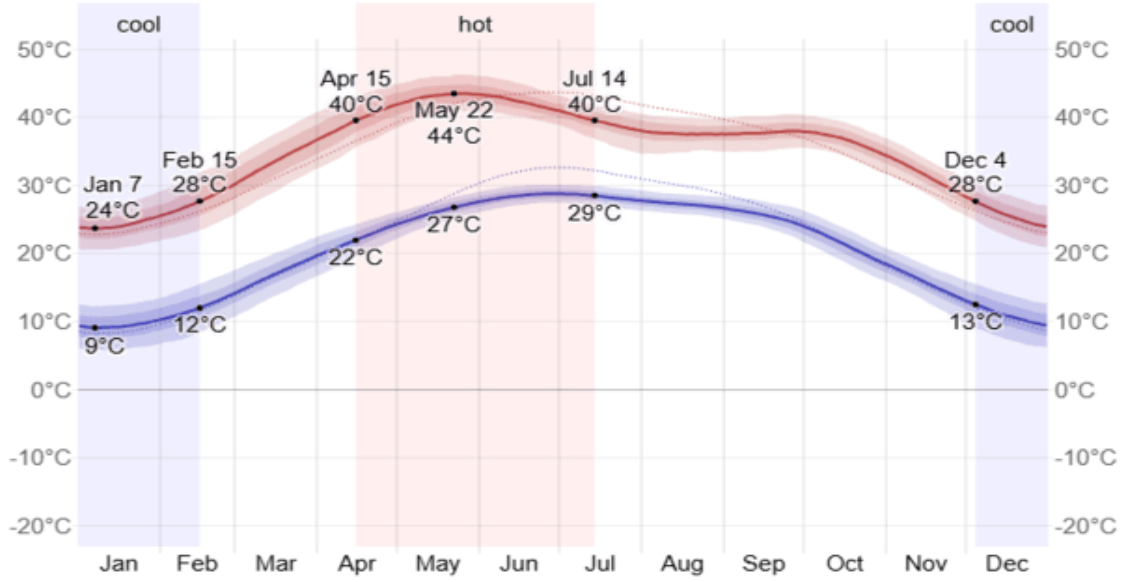

Figure 4-2: Temperature in Sanghar

Source: www.weatherspark.com

4.4.2 Rainfall

To illustrate variation within the months rather than just aggregate totals, rainfall was calculated using a sliding 31-day period centered on each day. It is demonstrated that Sanghar undergoes

some seasonal shifts in monthly rainfall. The rainy season in Sanghar spans 2.7 months, from July 1 to September 22, defined by a sliding 31-day rainfall of at least 13 mm. The peak of this period occurs in August, which is the rainiest month with an average rainfall of 33 mm. Conversely, the predominantly dry period lasts for 9.4 months, extending from September 22 to July 1. The driest month is November, which sees a negligible rainfall of only 3 mm. Month-wise rainfall is depicted in Figure 4-3 below.

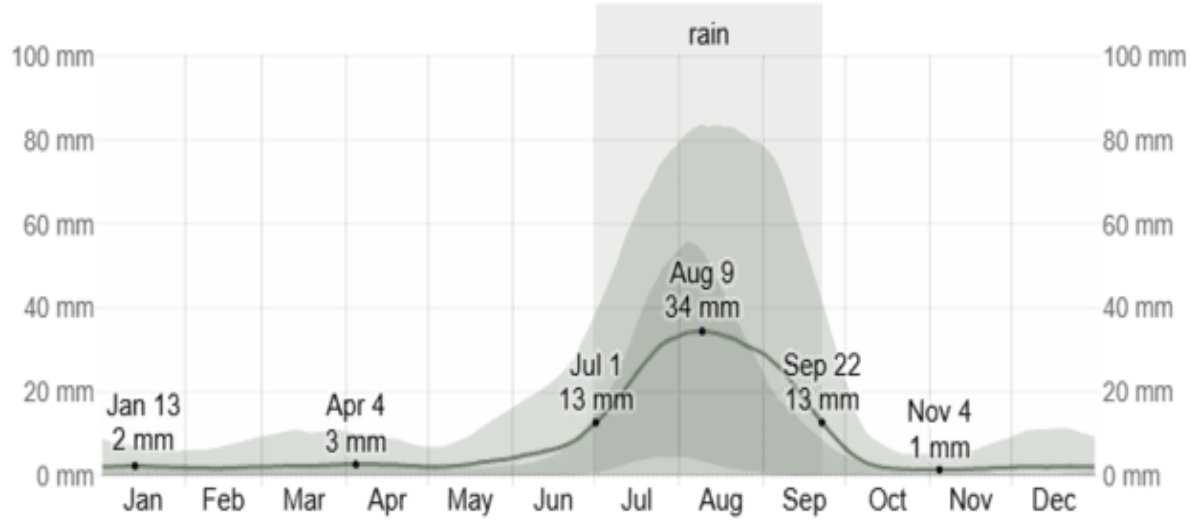

Figure 4-3: Rainfall in Sanghar

Source: www.weatherspark.com

4.4.3 Humidity

Humidity comfort levels are determined by the dew point, as this metric governs the evaporative cooling efficiency of perspiration from the skin. Lower dew points are perceived as drier, while higher dew points indicate elevated humidity levels. Unlike ambient temperature, which typically exhibits significant diurnal variation, the dew point fluctuates more gradually. Due to this stability, muggy conditions often persist overnight despite significant drops in nocturnal temperatures.

In Sanghar, the probability of a day being classified as "muggy" increases sharply during the spring, escalating from 2% to 80% over the course of the season. The annual peak for humidity occurs on July 30, with muggy conditions prevailing 93% of the time. Conversely, December 29 marks the annual minimum, with a 0% occurrence rate for such conditions. These trends are visually represented in Figure 4-4, which depicts humidity patterns in Sanghar.

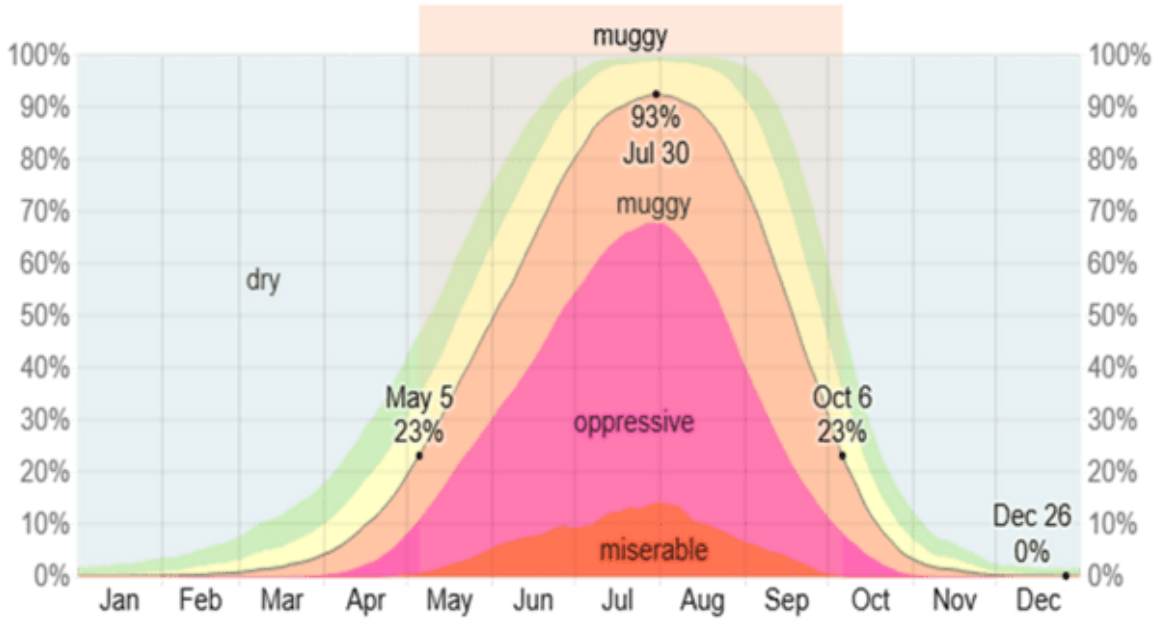

Figure 4-4: Humidity in Sanghar

Source: www.weatherspark.com

4.4.4 Wind

This section analyzes the wide-area hourly average wind vector (comprising both speed and direction) at an elevation of 10 meters above ground level. Local wind conditions are highly dependent on topography and other site-specific factors; consequently, instantaneous wind speed and direction exhibit significantly greater variability than recorded hourly averages.

The average hourly wind speed in Sanghar District undergoes a rapid increase during the spring, rising from 4.5 meters per second (m/s) to 6.3 meters per second(m/s) over the course of the season. For comparative reference, the windiest day of the year is June, with a daily average wind speed of 6.3m/s. In contrast, the calmest day occurs in November, when the daily average wind speed falls to 2.5 m/s. Wind speed in Sanghar is shown in Figure 4-5 below.

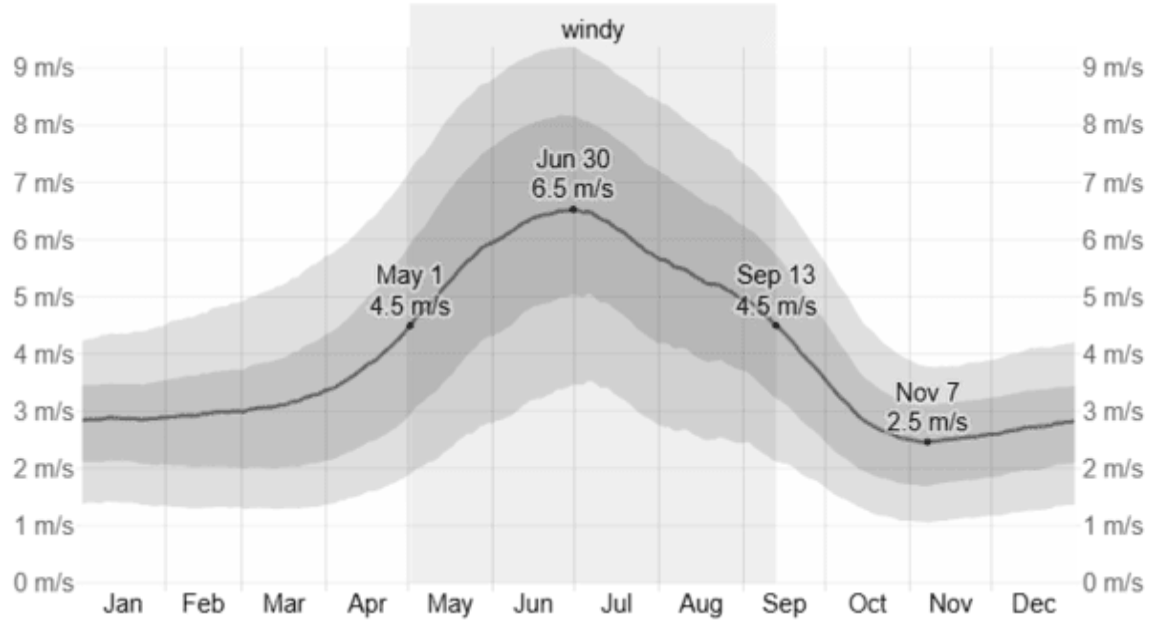

Figure 4-5: Wind Speed in Sanghar

Source: www.weatherspark.com

4.4.5 Hydrology

Sanghar district falls in the lower Indus Plain, where the primary source of surface water is the Nara Canal, which originates from the Sukkur Barrage (River Indus). The area is fed by the perennial canals, including Nara Canal, Jamrao Canal, Mithrao Canal, Thar Canal, Dhoro Canal, Samerjo Canal, Rohri Canal and Naseer Canal of the Sukkur Barrage Irrigation system. Some of the important lakes of the district are Baqar Lake, Makhi Lake, Khipro Lake, Sadhori Lake, Sanghriaro Lake, Dhalor Mori Lake, Sonhari Lake (Sonhari Lake has now been merged into Kinjhar Lake), Gujri Dhand, and the Chotiari Wetland Complex, which is an important wetland complex of Pakistan.

As the proposed subproject activities will be planned in Sanghar and Khipro taluka, water availability is largely dependent on the Nara Canal system and its distributaries, which originate from the Indus River further upstream. These canals serve as the principal source of irrigation water, supporting extensive agricultural activities, particularly for crops such as cotton, wheat, sugarcane, and fodder. A network of smaller irrigation channels, watercourses, and field drains further distributes canal water across farmlands in both towns.

The proposed Khipro-Kandiari transmission line passes over two major irrigation channels, i.e., Ban Wah and Khipro Wah, originating from Chotiari Reservoir and two minor distributaries, Santor Shack and Samaro Wah, originating from Khipro Wah, which serve as irrigation water in the area.

Groundwater in the Sanghar district, specifically the subproject site, is available at depths of 35 ft. to 60 ft. and is significantly compromised. The water table depth decreases as we move away from major canals in the project area. The settlements near the Project area utilize the

groundwater for drinking purposes through hand pumps and motor pumps. The groundwater is also utilized for irrigation purposes through the tube wells. Key physicochemical parameters, such as electrical conductivity (EC), total dissolved solids (TDS), alkalinity, total hardness, and chloride (Cl^-), frequently slightly exceed the recommended limits of the World Health Organization (WHO) guidelines[5].

Water availability in the area is sufficient to meet domestic and irrigation needs. For domestic purposes, the water supply network provides adequate coverage to households. For irrigation, surface water distributed through the Ban Wah, Khipro Canal and Nara Canal serves as a reliable supplementary source for local farming activities. Groundwater accessed at depths ranging from 7 to 15 m is significantly compromised, with key physicochemical parameters frequently exceeding WHO guidelines, limiting its suitability for potable use.

Water availability within the area is deemed sufficient to support construction-phase requirements for the subproject, such as dust suppression, concrete mixing, and domestic use within labor camps. The hydrology of the subproject area is illustrated in Figure 4-6.

[5]*Landar AQ, Jahangir TM, Khuhawar MY, Lanjwani MF, Khuhawar FY. Evaluation of Water Quality of Groundwater of Sanghar District, Sindh, Pakistan: Chemical and Multivariate Analysis. Water. 2024; 16(6):856. https://doi.org/10.3390/w16060856*

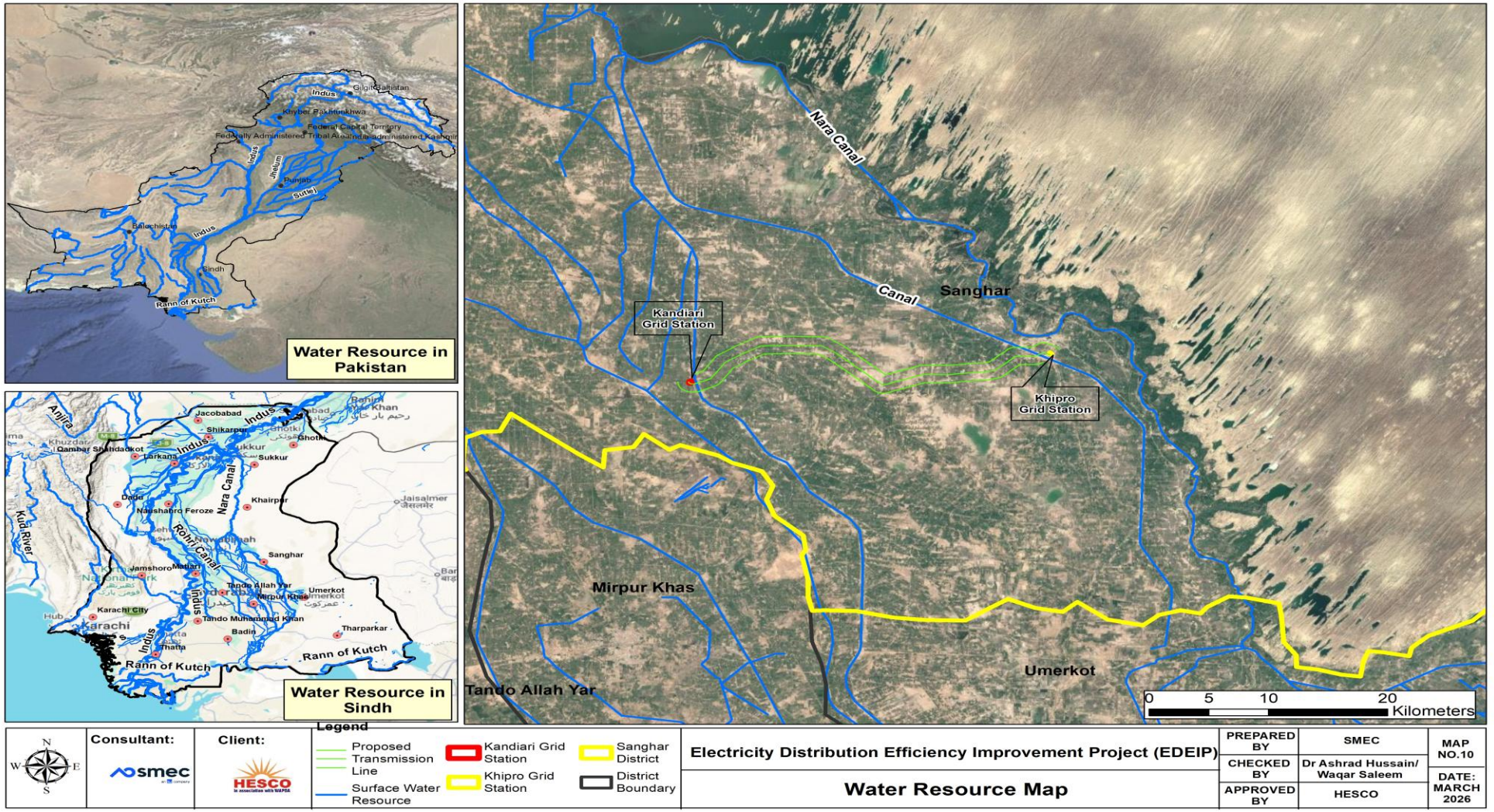

Figure 4-6: Water Resources of Subproject Area

4.4.6 Flooding

Sanghar District[6], particularly Sanghar Taluka and Khipro Taluka, is prone to periodic flooding and waterlogging, largely due to its low-lying position within the broader Indus irrigation plain and its dependence on an extensive canal network for drainage and water management. The district does not lie directly along the Indus River main channel; however, it remains hydrologically vulnerable because of its flat terrain, limited natural drainage, and reliance on man-made irrigation and drainage systems.

Sanghar Taluka, being part of the irrigated alluvial plain, experiences waterlogging and localized flooding mainly during periods of intense monsoon rainfall and excessive canal discharges. The flat topography and low gradient impede natural surface runoff, causing water to accumulate in agricultural fields, low-lying settlements, and road corridors. Historical monsoon events[7], particularly the extreme rainfall of 2015 and 2022, led to widespread inundation across central Sindh, including parts of Sanghar District, affecting agricultural lands, rural infrastructure, and residential areas.

Khipro Taluka lies closer to the Achhro Thar desert and is generally more arid than Sanghar Taluka. However, heavy monsoon rains can cause flash flooding due to poor soil infiltration and a lack of proper drainage. In irrigated areas, excess canal water combined with rainfall may also lead to temporary waterlogging, affecting crops and rural access roads.

The district's drainage infrastructure is largely based on a network of canals, minors, and field drains rather than natural rivers or streams. Where drainage systems are poorly maintained or insufficient, water tends to stagnate, exacerbating waterlogging risks. Rural roads, village settlements, and farmlands in low-lying zones are particularly vulnerable during peak monsoon periods. The flood-prone area map of the Kandiari and Khipro grid Station is shown in **Figure 4-7 and Figure 4-8** below.

[6]https://pdma.gos.pk/Documents/District_Management_Plans/DMP%20Sanghar.pdf

[7]https://pdma.gos.pk/

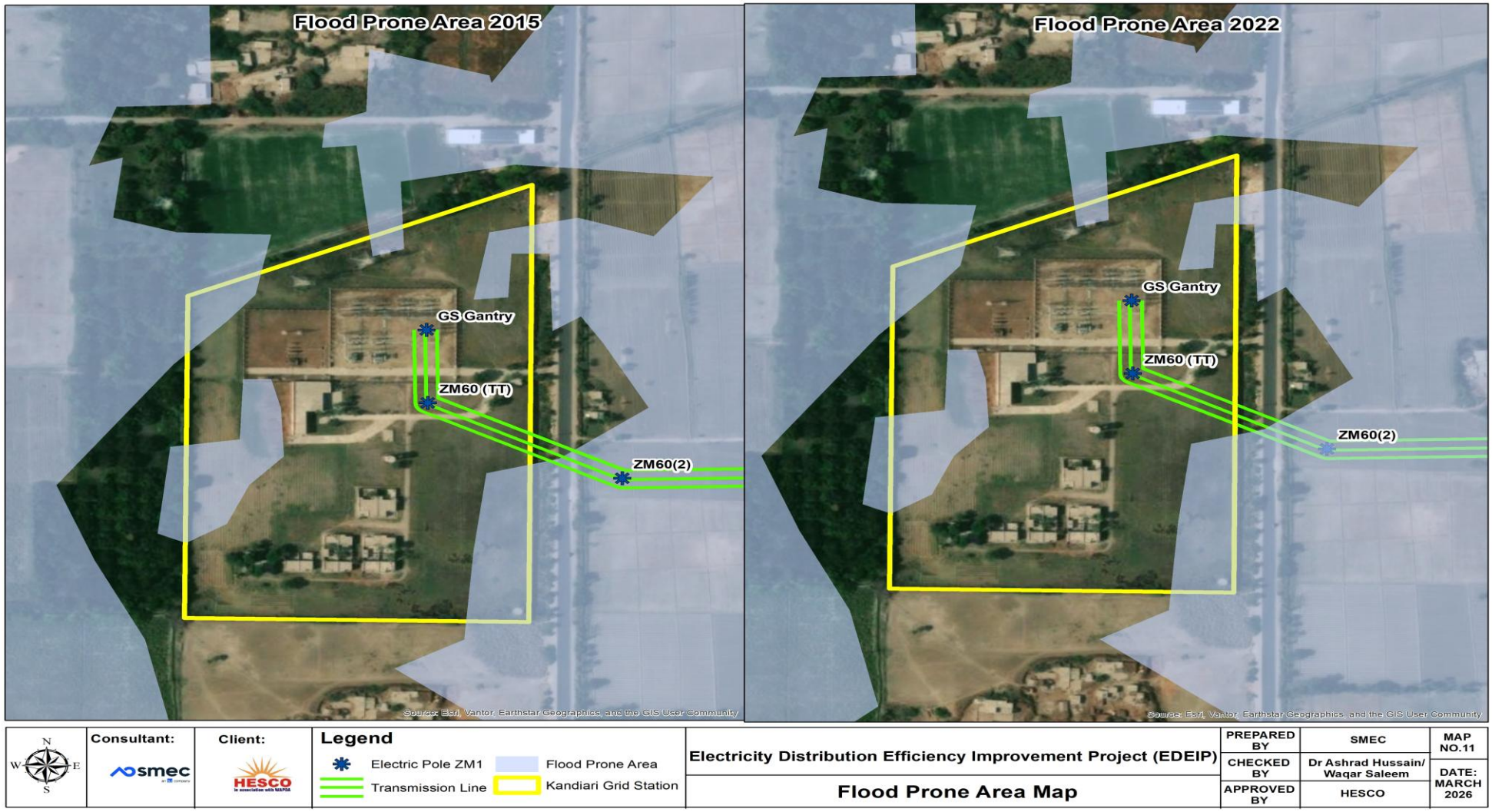

Figure 4-7: Flood-Prone Area Map of Kandiari Grid Station

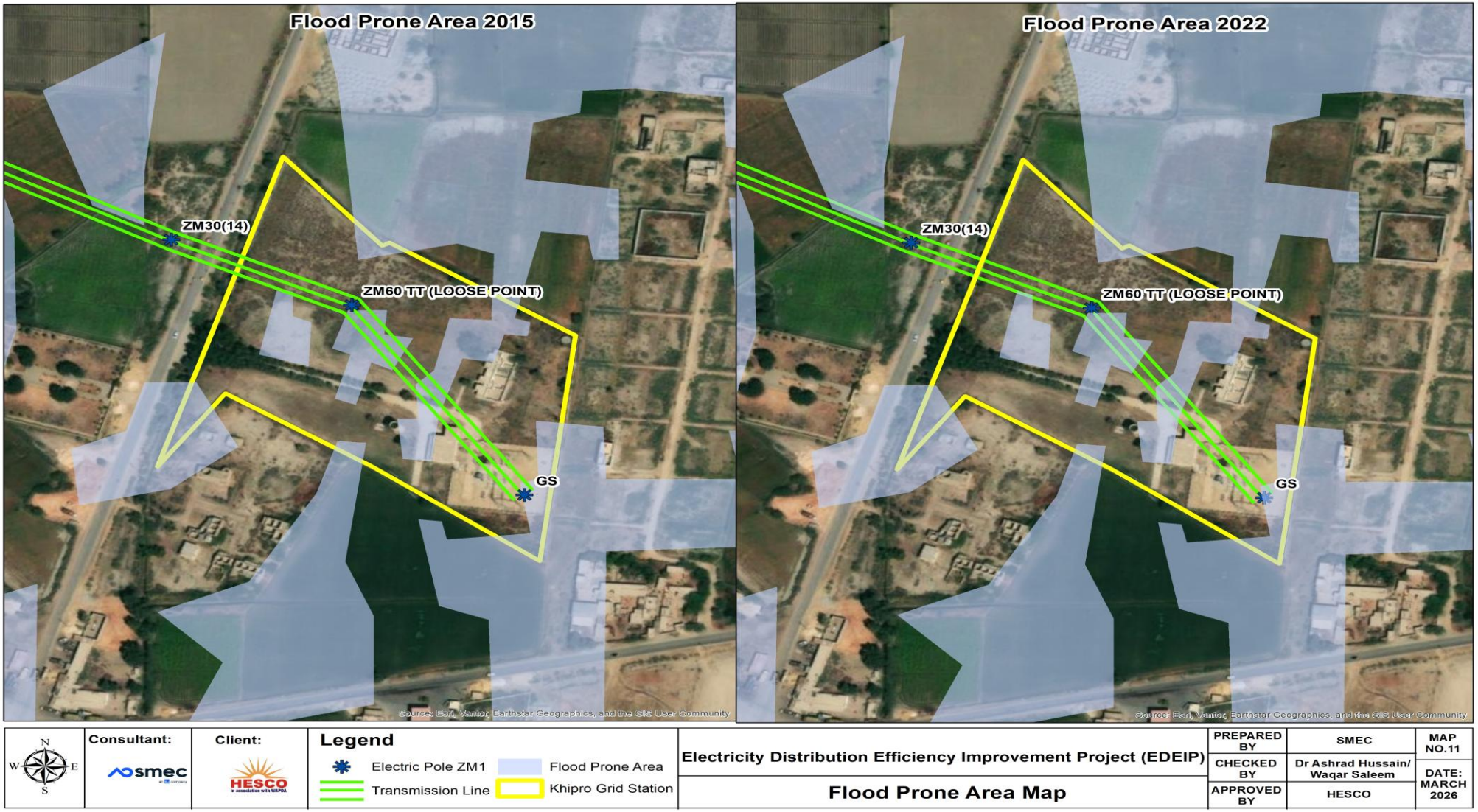

Figure 4-8: Flood-Prone Area Map of Khipro Grid Station

4.4.7 Geology and Soil

On a broader scale, the Indus basin is divided into Lower, Middle and Upper Indus, which comprises Southern Sindh and Northern Sindh. The alluvial sediment deposited by the River Indus in the lower Indus region, in general and in the subproject area, in particular, consists mainly of fine to medium sands, silts and clays of Pleistocene and recent epochs over a basement of tertiary rocks. The subproject area in Sanghar District lies within the extensive Indus alluvial plain, which is predominantly composed of Quaternary alluvial sediments deposited by the Indus River and its tributaries. These sediments primarily include silt, clay, sand, and occasional gravel layers, forming a relatively flat and gently sloping landscape. The underlying bedrock in the region consists mainly of sedimentary rocks, including limestone, sandstone, and shale, though these are generally deeply buried beneath thick alluvial deposits. The entire district is a fertile plain formed by the Indus River with sandy and hard clay loams. The soils of the subproject areas are mainly formed by alluvial sediments deposited by the Indus River. The geological conditions of the subproject area are given in **Figure 4-9**.

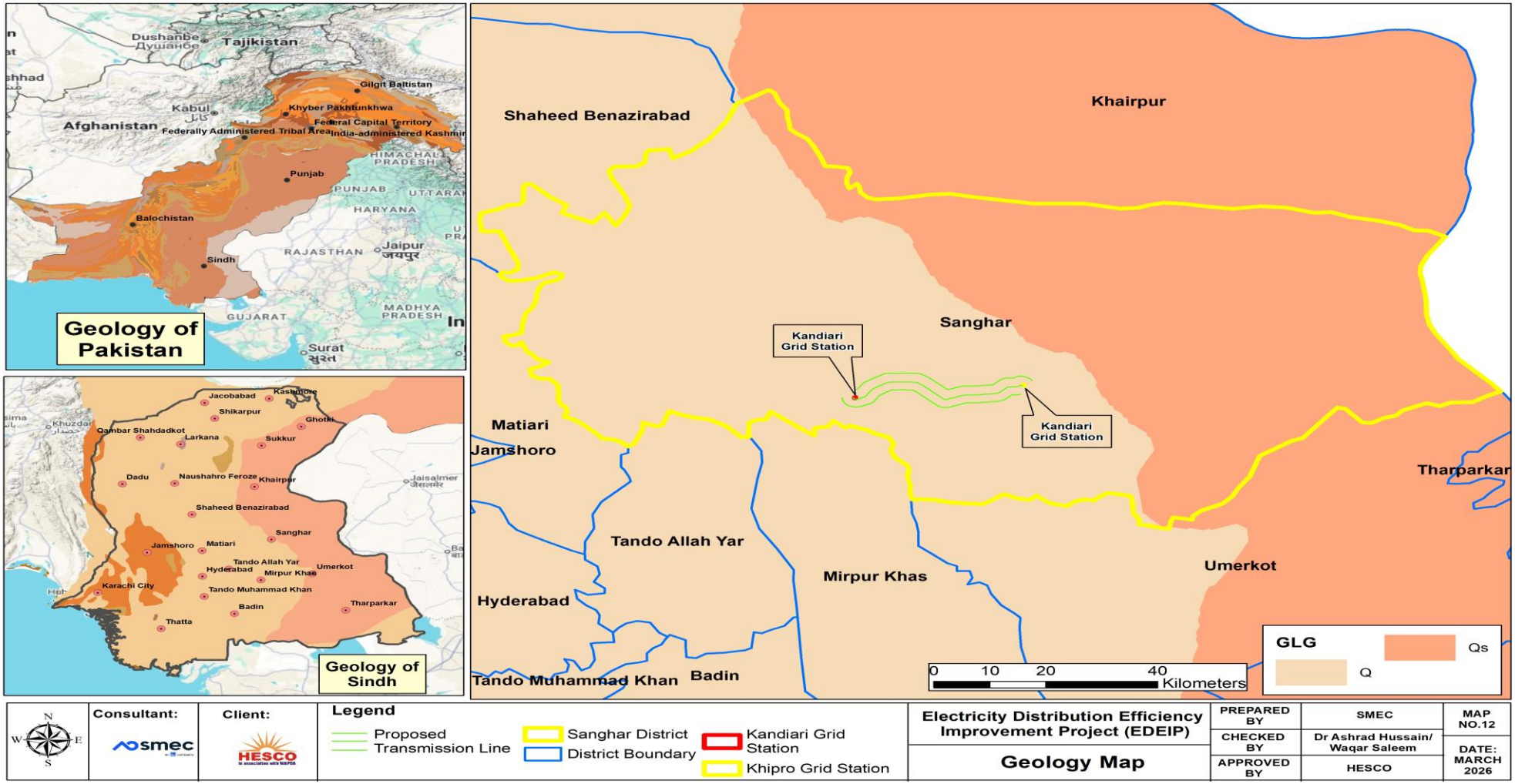

Figure 4-9: Geology of Subproject Area[8]

[8] *Wandrey, C.J., 1998, Geologic map of South Asia (geo8ag): U.S. Geological Survey data release, https://doi.org/10.5066/P9YC1C8G.*

The surface soil samples were collected from the grid station site and the transmission line end point and tested for basic parameters, i.e., Electrical Conductivity, pH, Organic Matter, Soil texture, Sodium and heavy metals. The analysis provides a baseline condition of surface soil at the subproject site. Table 4-1, below, shows the analytical results of soil sampling, and the Laboratory reports are attached in **Annexure-3.**

Table 4-1: Test results of Soil Sampling

S.No.	Parameters	Unit	Test Results			Test Methods
			SS-01	SS-02	SS-03	
1.	Electrical Conductivity (EC)	µS/cm	21490	9910	730	ASTM D 4972
2.	pH	-	8.5	7.9	8.1	ASTM D 2974
3.	Organic Matter	%	2.01	3.51	0.76	ASTM D 2974
4.	Texture	-	Clay	Silty Loam	Clay	ASTM D 2972
	Sand	%	32	37	22	
	Silt	%	22	43	26	
	Clay	%	46	20	52	
5.	Sodium Adsorption Ratio (SAR)	-	6.1	2.9	0.94	ASTM D 5126
6.	Lead (Pb)	mg/kg	BDL	BDL	BDL	ASTM D 8064
7.	Arsenic (As)	mg/kg	BDL	BDL	BDL	ASTM D 8064
8.	Mercury (Hg)	mg/kg	BDL	BDL	BDL	ASTM D 8064
9.	Cadmium (Cd)	mg/kg	BDL	BDL	BDL	ASTM D 8064
10.	Nickel (Ni)	mg/kg	BDL	BDL	BDL	ASTM D 8064
11.	Chromium (Cr)	mg/kg	BDL	BDL	BDL	ASTM D 8064

SS-01 = Grid Station Site Soil Sample
SS-02 = Transmission Line End Point Soil Sample
ASTM = American Society for Testing and Materials
mg/kg = Milligram per kilogram
µS/cm = microsiemens per centimeter
BDL -Below Detection Limit

4.4.8 Seismicity

The project area, located in Sanghar District, lies within the Indus alluvial plain, which is considered a region of low to moderate seismicity in Pakistan. The area is far from the country's major active tectonic boundaries, such as the Chaman Fault system and the Himalayan collision zone, which are responsible for high-magnitude earthquakes in northern and western Pakistan. Seismic activity in and around Sanghar is generally characterized by infrequent, low-magnitude earthquakes, mostly associated with deep-seated regional tectonic stresses rather than local active faults. Sanghar District falls in a low seismic hazard zone, where expected ground shaking is relatively weak compared to northern Pakistan.

The map indicates that the project area falls in Zone 2A, with Peak Ground Acceleration (PGA) varying from 0.08 to 0.24g (Pakistan Building Code of Pakistan, 2007) as shown in **Figure 4-10**. It is a low-damage risk zone, meaning the areas that fall under these zones have a low chance of having an earthquake. The seismic risk in the project area is considered low**,** with rare occurrences of damaging seismic events.

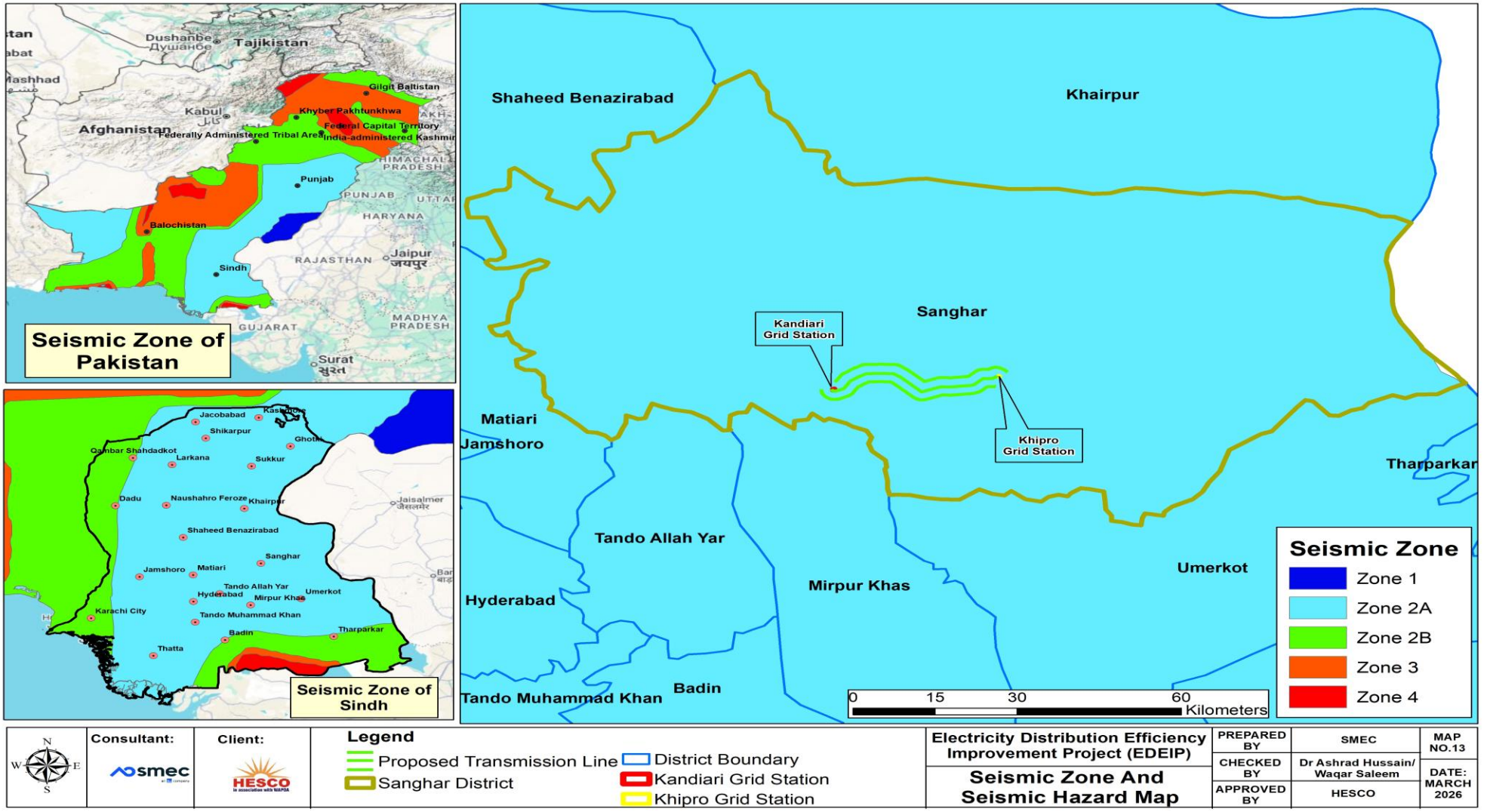

Figure 4-10: Seismicity Map of Proposed Subproject Area

4.5 Environmental Quality

A baseline assessment of environmental quality was conducted to establish baseline conditions for groundwater, surface water, ambient air, and noise levels at the subproject site and its immediate surroundings. This study provides a critical reference point against which any future changes or impacts from project activities can be measured and mitigated. The environmental quality assessment findings are presented in the sections below, and the location map is provided in **Figure 4-11**.

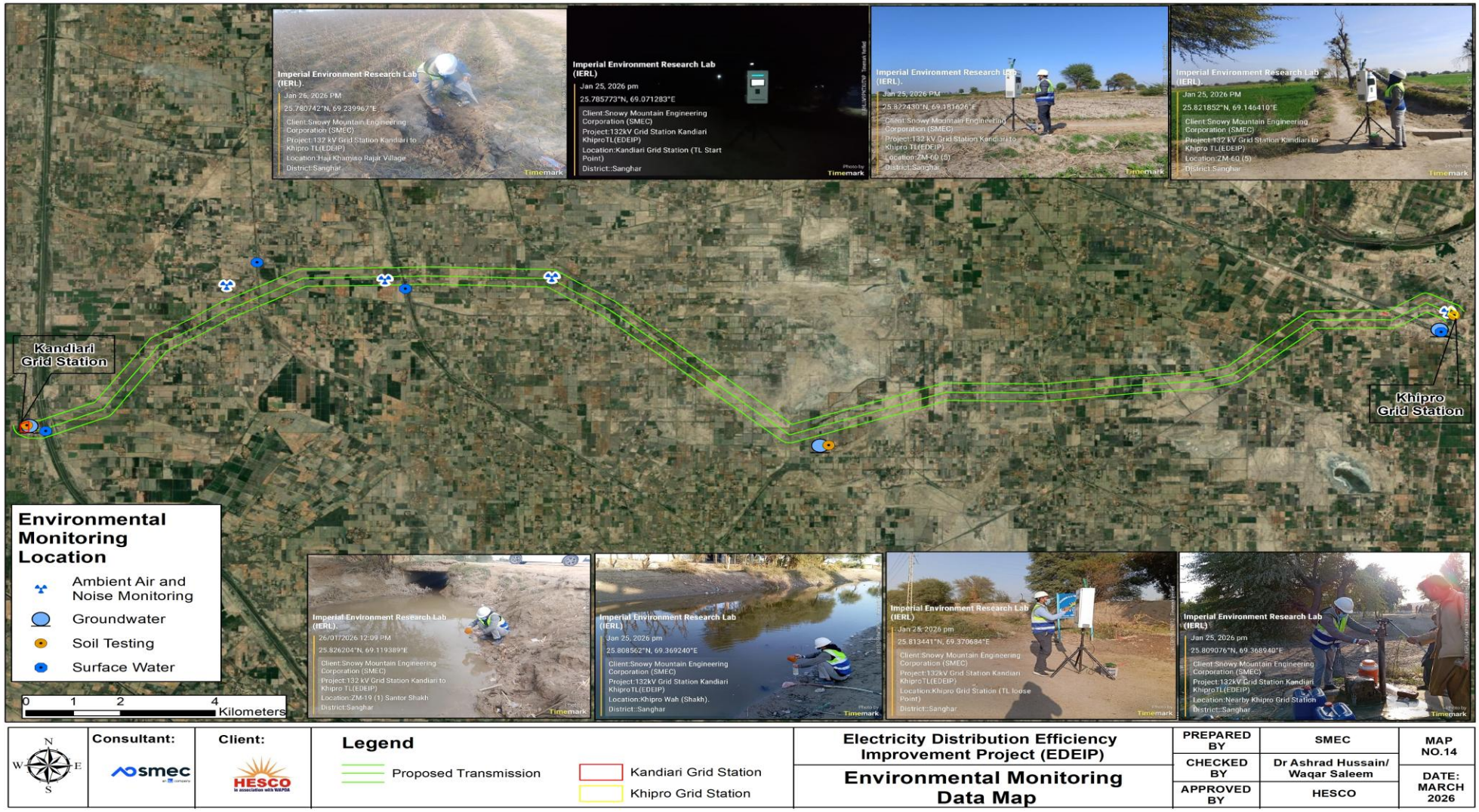

Figure 4-11: Environmental Monitoring Map of Subproject Area

4.5.1 Ground Water Quality

To assess the project area groundwater quality, samples were collected by a SEPA-certified laboratory from the nearest sources within the AOI of the subproject area according to the standard operating procedures based on Sindh Environmental Quality Standards and American Public Health Association (APHA) for water sampling and analysis. Three groundwater samples were collected: two from near Kandiari and Khipro Grid Stations, and one from Haji Khamiso Rajar Village, which is the nearest village to the transmission line. Results of the analysis are attached as Annexure -3 at the end of this report.

The laboratory analysis revealed that the groundwater quality within the subproject area is generally suitable for drinking and domestic use, with the notable exception of the source near the Kandiari Grid Station. At the Kandiari location, the groundwater is characterized as slightly hard and moderately saline, with Total Hardness (530 mg/l), Total Dissolved Solids (1090 mg/l), and Chloride (265 mg/l) all exceeding the recommended SEQS and WHO drinking water thresholds of 500 mg/l, 1000 mg/l, and <250 mg/l, respectively.

In conclusion, the groundwater quality within the subproject area is not fit for drinking and domestic use and is subject to basic disinfection (e.g., boiling or filtration). However, the groundwater at nearby Kandiari grid Station is characterized as slightly hard and moderately saline, with TDS and chloride exceeding SEQS and WHO drinking water standards; therefore, this source is not suitable for direct drinking without any pre-treatment. Though it may be used for non-potable domestic purposes, such as washing and cleaning. Further, it is recommended that periodic monitoring be conducted throughout the construction and operational phases to detect any potential changes in water quality due to project-related activities or surrounding land use. Protective measures, such as proper siting of fuel and chemical storage, waste disposal, and sanitation facilities, should be enforced under the Construction Environmental and Social Management Plan (CESMP) to safeguard this valuable resource.

Table 4-2: Groundwater Quality Analysis Report

S.No.	Parameter	Method	Unit	SEQS Limit*	WHO Limit*	Result		
						Nearby Kandiari Grid Station	Nearby Khipro Grid Station	Haji Khamiso Rajar Village
1.	Temperature	APHA 2550	°C	NGVS	NGVS	25.4	25.4	25.5
2.	pH @ 25°C	APHA 4500 H+B	-	6.5-8.5	6.5-8.5	7.1	7.4	7.0
3.	Odor	APHA 2150 B	-	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
4.	Color	APHA 2120 B	TCU	15	15	9	3	2
5.	Taste	APHA 2150 B	-	Acceptable	Acceptable	Unacceptable	Acceptable	Acceptable
6.	Total Hardness	APHA 2340 C	mg/l	500	500	530	130	160
7.	Total Dissolved Solids	APHA 2540 C	mg/l	1000	1000	1090	270	350
8.	Turbidity	APHA 2130 B	NTU	<5	<5	4.35	1.11	0.84
9.	Chloride	APHA 4500-Cl B	mg/l	<250	<250	265	60	75
10.	Chlorine, Residual	APHA 4500-Cl G	mg/l	0.2 - 0.5	0.2 - 0.5	0	0	0
11.	Aluminum	APHA 3111 B	mg/l	0.2	0.2	BDL	BDL	BDL
12.	Antimony	APHA 3111 B	mg/l	0.005	0.02	BDL	BDL	BDL
13.	Barium (Ba)	APHA 3111 B	mg/l	0.7	0.7	BDL	BDL	BDL
14.	Boron	APHA 3111 B	mg/l	0.3	0.3	BDL	BDL	BDL
15.	Fluoride	APHA 4500-F C	mg/l	1.5	1.5	0.91	0.72	0.70
16.	Nitrate	APHA 4500-NO3-F	mg/l	0.5	50	0.2	0.2	0.3
17.	Nitrite	APHA 4500-NO2-E	mg/l	3	3	0.003	0.004	0.002
18.	Arsenic	APHA 3111 B	mg/l	<0.05	0.01	BDL	BDL	BDL
19.	Cadmium	APHA 3111 B	mg/l	0.01	0.003	BDL	BDL	BDL
20.	Chromium	APHA 3111 B	mg/l	<0.05	0.05	BDL	BDL	BDL
21.	Copper	APHA 3111 B	mg/l	2	2	BDL	BDL	BDL
22.	Cyanide	APHA 4500-CN- G	mg/l	0.05	0.07	BDL	BDL	BDL
23.	Lead	APHA 3111 B	mg/l	<0.05	0.01	BDL	BDL	BDL

S.No.	Parameter	Method	Unit	SEQS Limit*	WHO Limit*	Result		
						Nearby Kandiari Grid Station	Nearby Khipro Grid Station	Haji Khamiso Rajar Village
24.	Manganese	APHA 3111 B	mg/l	0.5	0.5	BDL	BDL	BDL
25.	Mercury	APHA 3111 B	mg/l	0.001	0.001	BDL	BDL	BDL
26.	Nickel	APHA 3111 B	mg/l	<0.02	0.02	BDL	BDL	BDL
27.	Phenols	APHA 4500-P	mg/l	NoGL	<0.002	BDL	BDL	BDL
28.	Selenium	APHA 3111 B	mg/l	0.01	0.01	BDL	BDL	BDL
29.	Zinc	APHA 3111 B	mg/l	5	3	0.002	BDL	BDL
30.	Total Coliform	APHA 9222 B	cfu	0/100ml	0/100ml	4	12	0
31.	Fecal Coliform	APHA 9222 D	cfu	0/100ml	0/100ml	0	0	0
32.	E-Coli	APHA 9222 D	cfu	0/100ml	0/100ml	0	0	0

SEQS = *Sindh Environmental Quality Standards*
WHO = *World Health Organization*
NoGL = *No Given Limit*
APHA = *American Public Health Organization*
BDL = *Below Detection Limit*
NGVS *= No Guideline Value Set*

4.5.2 Surface Water Quality

Surface water quality analysis across the irrigation channels indicates that while all chemical parameters and heavy metals comply with standard guidelines, specific aesthetic and microbiological parameters fail to meet the SEQS and WHO drinking water standards. An objectionable odor was recorded across all four monitored channels (Samaro Wah, Khipro Wah, Santoor Shakh, and Ban Wah), accompanied by widespread biological contamination, as all four sources tested positive for total coliforms, fecal coliforms, and *E. coli* due to the dilution of localized human and animal waste. Furthermore, physical and aesthetic non-compliances were observed in three of the channels, with Samaro Wah exhibiting a color of 17.0 True Color Unit (TCU) and turbidity of 14.8 Nephelometric Turbidity Unit (NTU), Ban Wah recording a color of 17.0 TCU and turbidity of 23.6 Nephelometric Turbidity Unit (NTU), and Santoor Shakh exhibiting the most severe degradation with a color of 37.0 True color Unit (TCU) and a turbidity level of 92.4 Nephelometric Turbidity Unit (NTU).

In conclusion, the surface quality is soft and healthy for human consumption upon primary treatment and meets SEQS and WHO drinking water standards. However, it is recommended that periodic monitoring be conducted throughout the construction and operational phases to detect any potential changes in water quality due to project-related activities or surrounding land use. Protective measures, such as proper siting of fuel and chemical storage, waste disposal, and sanitation facilities, should be enforced under the Construction Environmental and Social Management Plan (CESMP) to safeguard this valuable resource.

Table 4-3: Surface Water Quality Analysis

S.No.	Parameter	Method	Unit	SEQS Limit*	WHO Limit*	Result			
						Samaro Wah	Khipro Wah	Santoor Shakh	Ban Wah
1.	Temperature	APHA 2550	°C	NGVS	NGVS	25.4	25.4	25.4	25.4
2.	pH @ 25°C	APHA 4500 H+B	-	6.5-8.5	6.5-8.5	7.3	7.6	7.2	7.5
3.	Odor	APHA 2150 B	-	Acceptable	Acceptable	Unacceptable	Acceptable	Unacceptable	Unacceptable
4.	Color	APHA 2120 B	TCU	15	15	17	4	37	17
5.	Taste	APHA 2150 B	-	Acceptable	Acceptable	Acceptable	Unacceptable	Unacceptable	Acceptable
6.	Total Hardness	APHA 2340 C	mg/l	500	500	210	350	220	170
7.	Total Dissolved Solids	APHA 2540 C	mg/l	1000	1000	450	730	450	370
8.	Turbidity	APHA 2130 B	NTU	<5	<5	14.8	2.87	92.4	23.6
9.	Chloride	APHA 4500-Cl B	mg/l	<250	<250	95	165	100	85
10.	Chlorine, Residual	APHA 4500-Cl G	mg/l	0.2 - 0.5	0.2 - 0.5	0	0	0	0
11.	Aluminum	APHA 3111 B	mg/l	0.2	0.2	BDL	BDL	BDL	BDL
12.	Antimony	APHA 3111 B	mg/l	0.005	0.02	BDL	BDL	BDL	BDL
13.	Barium (Ba)	APHA 3111 B	mg/l	0.7	0.7	BDL	BDL	BDL	BDL
14.	Boron	APHA 3111 B	mg/l	0.3	0.3	BDL	BDL	BDL	BDL
15.	Fluoride	APHA 4500-F C	mg/l	1.5	1.5	0.61	0.68	0.59	0.58
16.	Nitrate	APHA 4500-NO3- F	mg/l	0.5	50	0.4	0.3	0.3	0.4
17.	Nitrite	APHA 4500-NO2- E	mg/l	3	3	0.006	0.005	0.007	0.005
18.	Arsenic	APHA 3111 B	mg/l	<0.05	0.01	BDL	BDL	BDL	BDL
19.	Cadmium	APHA 3111 B	mg/l	0.01	0.003	BDL	BDL	BDL	BDL
20.	Chromium	APHA 3111 B	mg/l	<0.05	0.05	BDL	BDL	BDL	BDL
21.	Copper	APHA 3111 B	mg/l	2	2	BDL	BDL	BDL	BDL
22.	Cyanide	APHA 4500-CN-	mg/l	0.05	0.07	BDL	BDL	BDL	BDL

S.No.	Parameter	Method	Unit	SEQS Limit*	WHO Limit*	Result			
						Samaro Wah	Khipro Wah	Santoor Shakh	Ban Wah
		G							
23.	Lead	APHA 3111 B	mg/l	<0.05	0.01	BDL	BDL	BDL	BDL
24.	Manganese	APHA 3111 B	mg/l	0.5	0.5	0.009	0.004	0.011	0.004
25.	Mercury	APHA 3111 B	mg/l	0.001	0.001	BDL	BDL	BDL	BDL
26.	Nickel	APHA 3111 B	mg/l	<0.02	0.02	BDL	BDL	BDL	BDL
27.	Phenols	APHA 4500-P	mg/l	NoGL	<0.002	BDL	BDL	BDL	BDL
28.	Selenium	APHA 3111 B	mg/l	0.01	0.01	BDL	BDL	BDL	BDL
29.	Zinc	APHA 3111 B	mg/l	5	3	BDL	BDL	BDL	BDL
30.	Total Coliform	APHA 9222 B	cfu	0/100ml	0/100ml	TNTC	TNTC	TNTC	TNTC
31.	Fecal Coliform	APHA 9222 D	cfu	0/100ml	0/100ml	32	47	79	29
32.	E-Coli	APHA 9222 D	cfu	0/100ml	0/100ml	13	22	41	14

SEQS = *Sindh Environmental Quality Standards*
WHO = *World Health Organization*
NoGL = *No Given Limit*
APHA = *American Public Health Organization*
BDL Below Detection Limit

4.5.3 Ambient Air Quality

The baseline ambient air quality monitoring results indicate that the majority of gaseous and particulate parameters across all five monitoring stations (AQM-01 to AQM-05) are compliant with the Sindh Environmental Quality Standards (SEQS), with only two localized exceedances recorded. First, at station AQM-02, the 24-hour average concentration of Particulate Matter PM 10 was recorded at 151.14 µg/m^3, which slightly exceeds the SEQS limit of 150 µg/$m.^3$ This marginal elevation is directly attributable to temporary dust particles generated by agricultural machinery passing near the monitoring station at the time of sampling, compounded by the localized semi-arid and agricultural landscape characterized by loose topsoil. Second, at station AQM-05 (Nearby Khipro Grid Station), the 8-hour average concentration of Carbon Monoxide (CO) reached 11.53mg/m^3 exceeding the regulatory threshold of 10 mg/m^3 due to transient vehicular emissions or biomass burning near the existing grid station boundaries. To prevent further degradation of air quality during the construction phase, strict mitigation measures, including mandatory water sprinkling for dust suppression, proper maintenance of construction machinery to minimize exhaust emissions, and the enforcement of a zero-burning policy on site, will be rigorously implemented under the Contractor's Environmental and Social Management Plan (C-ESMP).

The results of the ambient air quality monitoring are summarized in **Table 4-4** below. Detailed laboratory reports are provided in **Annexure 3.**

Table 4-4: Average Ambient Air Quality Monitoring (24 hr.) at Subproject Site

Parameters	Unit	Test Methods	Monitoring Duration	SEQS Limit	Average Results				
					AQM-01	AQM-02	AQM-03	AQM-04	AQM-05
Sulphur Dioxide (SO_2)	**$\mu g/m^3$**	UV Fluorescence	24 hours	120	20.39	21.85	20.37	22.45	25.76
Nitrogen Oxide (NO)	**$\mu g/m^3$**	Chemiluminescence	24 hours	40	32.66	36.57	33.98	35.46	38.65
Nitrogen Dioxide (NO_2)	**$\mu g/m^3$**	Chemiluminescence	24 hours	80	48.99	54.98	52.50	53.30	56.37
Carbon Monoxide (CO)	**mg/m^3**	Gas Filter Correlation	08 hours	10	8.04	8.84	6.30	8.80	11.53
Ozone (O_3)	**$\mu g/m^3$**	UV Fluorescence	01 hours	130	52.65	58.74	56.28	56.94	60.23
Particulate Matter ($PM_{2.5}$)	**$\mu g/m^3$**	Gravimetric Sampling	24 hours	75	64.04	71.45	69.06	69.26	72.10
Particulate Matter (PM_{10})	**$\mu g/m^3$**	Gravimetric Sampling	24 hours	150	135.55	151.14	149.31	146.56	148.13
Suspended Particulate Matter (SPM)	**$\mu g/m^3$**	Gravimetric Sampling	24 hours	500	184.74	206.13	204.54	199.76	200.54

AQM-01 = Nearby Kandiari Grid Station ***AQM-03= ZM – 30(05)*** ***AQM-05= Nearby Khipro Grid Station***
AQM-02 = ZM – 19(01) ***AQM-04= ZM – 60(05)***

SEQS = *Sindh Environmental Quality Standards*
$\mu g/m^3$ = *microgram per cubic meter*
mg/m^3 = *milligram per cubic meter*
**(8 Hours standard for CO)*
***(01-hour standard for O_3)*

4.5.4 Ambient Noise

IERL also carried out measurements of noise at the nearby Khipro and Kandiari grid stations and along the TL route at points where residential areas are near, in January 2026. The average daytime and nighttime noise levels were found within the permissible limits of SEQS (55 dBA for daytime and 45 dBA for nighttime for the residential area). This, however, does not exceed the noise levels prescribed for industrial or commercial areas in SEQS and World Bank standards. The average noise levels are given in Table 4-5 below.

Table 4-5: Average Ambient Noise Level Monitoring (24 hr.)

Location	Unit	Day Time Average	Night Time Average
Nearby Kandiari Grid Station	dBA	47.13	39.88
Neary by ZM-19(01)	dBA	46.00	41.25
Nearby ZM-30(05)	dBA	46.44	38.88
Nearby ZM-60(05)	dBA	47.19	37.38
Nearby Kandiari Grid Station	dBA	46.75	38.75

4.6 Findings of Socioeconomic Survey

A socio-economic survey was conducted within the Area of Influence, encompassing villages located along the RoW of the proposed transmission line as well as the AOI surrounding areas of the Khipro Grid Station (GS). The survey aimed to establish a comprehensive socio-economic baseline of the affected communities and to assess their demographic characteristics, livelihood patterns, income sources, access to public services, and overall living conditions.

A total of 96 respondents were surveyed for the collection of socio-economic baseline data. The sample size was determined using a standard statistical formula at a 95% confidence level and a 10% confidence interval, ensuring that the survey results are representative of the population within the study area. Households were selected through a random sampling technique, a probability-based method that provides each household within the AOI with an equal chance of selection, thereby minimizing sampling bias and enhancing the reliability of the findings.

A structured questionnaire was developed to collect information on key demographic and socio-economic indicators, including household composition, education, occupation, income levels, housing conditions, access to infrastructure and services, and community participation. Data were gathered through face-to-face interviews with household heads or adult household members, allowing for the collection of detailed and reliable information.

Following the field survey, the collected data were systematically coded, digitized, and analyzed using the Statistical Package for the Social Sciences (SPSS) software. Descriptive statistical techniques were employed to quantify and interpret the prevailing socio-economic conditions of the study area. The findings of the survey provide a robust baseline for assessing potential project impacts and developing appropriate mitigation and management measures.

4.6.1 Age Composition

The survey results indicate that most respondents belong to economically active age groups. The largest share falls in the 36–45 years category, followed by the 26–35 years group. This indicates that a majority of the population is in their prime working years and actively engaged in agriculture and labor-based livelihoods. Respondents aged 46–55 years represent a moderate proportion, while elderly respondents above 55 years constitute a smaller share, reflecting potential vulnerability in terms of health and income security. The statistical analysis is given in Table 4-6 below:

Table 4-6: Composition of Respondents

Sr. No.	Age Group (Years)	No. of Respondents	Percentage
1	16–25	13	13.5
2	26–35	25	26.0
3	36–45	30	31.3
4	46–55	17	17.7
5	Above 55	11	11.5
	Total	**96**	**100.0**

4.6.2 Level of Education

The survey results given in Table 4-9 reveal a range of educational backgrounds, from illiterate to master's level education. The educational profile of the surveyed respondents reflects moderate literacy levels with a noticeable concentration at the lower levels of formal education. As presented in the table below, a significant proportion of respondents (44.8%) are illiterate, indicating limited access to formal education within the project area. This high percentage of illiteracy suggests potential constraints in accessing skilled employment opportunities and reduced awareness regarding development initiatives and institutional processes.

Among those who have received formal education, 16.7% have completed primary education, while 11.5% attained middle-level education. Together, these categories represent a considerable segment of the population possessing only basic schooling. Respondents with secondary education (Matric) account for 10.4%, and those with Intermediate qualification represent7.3%, reflecting a

comparatively smaller proportion progressing beyond basic education.

Higher education attainment is limited within the surveyed population. Only 5.2% of respondents hold a graduation degree, and a very small fraction (4.2%) possess a Master's degree. Overall, the data indicate that educational attainment within the Area of Influence remains relatively low, with the majority of respondents having an education below matriculation level. This educational pattern has direct implications for employment diversification, income potential, and community participation in development processes.

Table 4-7: Level of Education

Sr. No.	Qualification	No. of Respondents	Percentage
1	Illiterate	43	44.8
2	Primary	16	16.7
3	Middle	11	11.5
4	Matric	10	10.4
5	Intermediate	7	7.3
6	Graduation	5	5.2
7	M.A / Master's	4	4.2
	Total	**96**	**100.0**

4.6.3 Marital Status and Family Structure

Most respondents were married, reflecting early marriage practices prevalent in the AOI. The marital status distribution of the surveyed respondents indicates that a substantial majority (86.5%) are married, while 13.5% are unmarried. This pattern reflects the prevailing social and cultural norms of the rural project area, where marriage typically occurs at an early age and family life is strongly emphasized.

The high proportion of married respondents is consistent with the age distribution of the sample, as most individuals fall within economically active age groups. Married respondents generally represent household heads or key decision-makers, which is particularly relevant in the context of ESIA studies, as they are directly involved in livelihood activities, land management, and community-level consultations. The statistical analysis is given in Table 4-8 below.

Table 4-8 Marital Status and Family Structure

Sr. No.	Marital Status	Number	Percentage
1	Married	83	86.5
2	Unmarried	13	13.5
	Total	**96**	**100.0**

4.6.4 Linguistic Culture

The linguistic composition of the surveyed population reflects the cultural diversity of the project area while indicating a strong dominance of the Sindhi language. As shown in the table, Sindhi is the primary mother language of 54.2% of respondents, confirming that the Area of Influence is predominantly Sindhi-speaking and culturally aligned with the broader regional context of District Sanghar.

Punjabi is the second most commonly spoken mother language, accounting for 21.9% of respondents. This indicates the presence of linguistically diverse groups, likely resulting from migration patterns and settlement expansion over time. Saraiki speakers represent 17.7% of the surveyed population, highlighting another significant linguistic group within the project area. Pashto speakers comprise 6.3% of respondents, reflecting the presence of smaller minority communities. The statistical analysis is given in Table 4-9.

Table 4-9: Languages in the Subproject Area

Sr. No	Mother Language	Frequency	Percentage
1	Sindhi	52	54.2
2	Punjabi	21	21.9
3	Saraiki	17	17.7
4	Pashto	6	6.3
Total		**96**	**100.0**

4.6.5 Caste/ Ethnic Group

The socio-economic survey conducted in the AOI shows that the population is composed of several tribal and caste groups, reflecting the social diversity of the area. However, a few major castes dominate the local demographic structure. The Rajar caste represents the largest **group**, accounting for 22.9% of the respondents, indicating its strong presence in the subproject area. The Wassan caste constitutes 12.5% of the surveyed households, making it the second largest group.

Other significant castes include Shar and Qaimkhani, each representing 10.4% of the respondents. Meanwhile, Samo, Pahor, and Chandio communities each account for 11.8% of the surveyed population. These castes are commonly found across villages of Khipro Tehsil and play an important role in the local socio-economic structure.

Overall, the caste distribution indicates that the Rajar and Wassan communities are dominant, while other major groups such as Shar, Qaimkhani, Samo, Pahor, and Chandio also have a considerable presence in the area. Further details of the caste composition are presented in **Table 4-10**.

Table 4-10 Major Castes in Subproject Area

Sr. No	Caste	Number	Percentage (%)
1	Rajar	19	19.8
2	Wassan	12	12.5
3	Kohli	7	7.3
4	Maghwar	9	9.4
5	Shar	12	12.5
6	Samo	9	9.4
7	Pahor	9	9.4
8	Qaimkhani	10	10.4
9	Chandio	9	9.4
Total		**96**	**100.0**

4.6.6 Occupational Status of the Respondents

The occupational profile of the surveyed respondents indicates a strong dependence on labor-based and agriculture-related livelihoods within the Area of Influence. As presented in Table 4-11, the majority of respondents (51%) are engaged as daily wage laborers. This high proportion reflects the predominantly rural and agrarian nature of the project area, where employment opportunities are largely informal, and income stability depends on seasonal agricultural activities and local labor demand.

Farmers constitute 21.9% of the respondents, representing individuals engaged in cultivation either as landowners or tenant farmers. This segment plays a critical role in local agricultural production, particularly in the cultivation of wheat and cotton. The relatively smaller proportion of farmers compared to laborers suggests that a significant number of households may be landless or possess limited landholdings.

Respondents engaged in small-scale business activities account for 8.3%, indicating limited commercial diversification within the local economy. Similarly, 11.5% of respondents are employed in private sector jobs, while only 7.3% are serving in government positions. The comparatively low percentage of formal employment highlights restricted access to stable salaried jobs and limited industrial or service-sector development in the area.

Overall, the occupational distribution reflects a rural economy characterized by heavy reliance on daily wage labor and agriculture, limited income diversification, and moderate vulnerability to economic fluctuations. This livelihood structure has important implications for impact assessment, particularly in relation to potential temporary disruptions during construction and the need for livelihood support measures.

Table 4-11 Occupational Status of the Respondents

Sr. No.	Type of Occupation	Number	Percentage
1	Labor	49	51.0
2	Farmer	21	21.9
3	Businessman	8	8.3
4	Private Job	11	11.5
5	Government Service	7	7.3
	Total	**96**	**100.0**

4.6.7 Monthly Income of the Respondents

The monthly income distribution of the surveyed households indicates a moderate-income profile within the Area of Influence, with a concentration in the lower-middle income bracket. As presented in the table, the majority of respondents (43.8%) earn between PKR 40,001 and 60,000 per month. This suggests that half of the surveyed households fall within a moderate-income category, likely supported by a combination of agriculture, daily wage labor, and small-scale employment activities.

Approximately 26% of respondents reported monthly incomes ranging from PKR 60,001 to 80,000, reflecting comparatively better financial capacity and potentially more stable or diversified livelihood sources. A smaller proportion (15.6%) earn below PKR 40,000 per month, representing economically vulnerable households that may face greater difficulty in meeting household expenses, particularly during seasonal downturns or unexpected economic shocks.

Only a limited number of respondents fall within higher income brackets, with 14.6% earning PKR 80,001 and above per month. These households are likely engaged in government service, private sector employment, or established business activities, providing relatively stable income streams. The statistical analysis is given in Table 4-12 below:

Table 4-12 Monthly Income of the Respondents

Sr. No.	Monthly Income (PKR)	Number	Percentage
1	< 40,000	15	15.6
2	40,001–60,000	42	43.8
3	60,001–80,000	25	26.0
4	80,001–100,000	7	7.3
5	Above 100,000	7	7.3
	Total	**96**	**100.0**

4.6.8 Household Expenses of the Respondents

Table 4-13 shows that most households have low monthly expenses. The majority of respondents (46.9%) reported monthly expenditures between PKR 40,001 and 60,000. This indicates that more than half of the surveyed households operate within a moderate expenditure range, primarily allocating their income toward essential needs such as food, utilities, education, healthcare, transportation, and agricultural inputs.

A smaller proportion of households (15.6%) reported expenditures below PKR 40,000 per month, representing comparatively low-spending households that may be practicing strict financial management or operating within limited income capacity. Approximately 28.1% of respondents fall within the PKR 60,001–80,000 expenditure bracket, reflecting relatively higher household consumption, which may be associated with larger family sizes or more diversified income sources.

Only 6.3% of households reported monthly expenditures between PKR 80,001 and 100,000, while 3.1% indicated expenditures exceeding PKR 100,000. These households likely have comparatively stronger economic standing and more stable income streams.

Table 4-13 Household Expenses of the Respondents

Sr. No.	Monthly Expenses (PKR)	Number	Percentage
1	< 40,000	15	15.6
2	40,001–60,000	45	46.9
3	60,001–80,000	27	28.1
4	80,001–100,000	6	6.3
5	Above 100,000	3	3.1
	Total	**96**	**100.0**

4.6.9 Ownership Status of the House

The table shows the housing ownership status of the respondents. Of the total households, 55.2% reside in their own houses, indicating moderate residential stability and long-term settlement patterns within the rural communities of Khipro Tehsil.

About 8.3% live in rented houses, suggesting limited reliance on the rental housing market, which is generally underdeveloped in rural settings.

About (36.5%) reside in temporary or semi-permanent houses. These households largely comprise landless laborers, small tenant farmers, and economically vulnerable groups residing on land owned by others. Temporary housing conditions reflect insecure tenure, economic constraints, and increased

vulnerability to environmental and climatic risks. Details are shown in Table 4-14.

Table 4-14 Ownership Status of the House

Sr. No.	Ownership of the House	Number	Percentage
1	Owned	53	55.2
2	Rented	8	8.3
3	Temporary / Informal Shelter	35	36.5
	Total	**96**	**100.00**

4.6.10 Housing Construction Pattern

Out of the total 96 surveyed respondents in the AOI, the majority, 59 respondents(61.5%)**,** were residing in pacca houses. Meanwhile, 25 respondents (26.0%) were living in semi-pacca houses**,** and12 respondents (12.5%)were residing in katcha houses. The findings indicate that although pacca housing was dominant in the surveyed area, a considerable proportion of households still lived in semi-pacca and katcha structures, reflecting mixed housing conditions in the project area.

Table 4-15 Housing Construction Patterns of the Respondents

Sr. No.	Type of House	Number	Percentage
1	Pacca	59	61.5
2	Semi-Pacca	25	26.0
3	Katcha	12	12.5
	Total	**96**	**100.0**

4.6.11 Civic Amenities

Most of the villages located along the AOI lack basic civic amenities such as water supply systems, gas connections, and sewerage networks. Although electricity is available in a few villages, the supply is irregular and unreliable due to frequent load shedding. The local population primarily relies on groundwater sources for drinking purposes. At the same time, wastewater is typically discharged in open areas outside their houses, as proper drainage and sanitation infrastructure are not available.

4.6.12 Source of Water

Most respondents reported having handpumps/ boreholes as their main source of drinking water. This

high percentage reflects the limited availability of formal water supply infrastructure in rural settlements along the project alignment. Table 4-16 shows the main sources of water used by the community. Most households (62.5%) rely on handpumps or boreholes, indicating dependence on local groundwater sources for daily needs. About one-third of respondents (37.5%) use tube wells.

Table 4-16 Source of Drinking Water in the AOI

Sr. No.	Source of Water	Number	Percentage
1	Tube Well	36	37.5
2	Handpump / Boreholes	60	62.5
	Total	**96**	**100**

All respondents expressed dissatisfaction with the quality of the current water supply, citing issues such as unpleasant odors and a noticeable smell, which they attributed to pollutants and contaminants in the water. Additionally, concerns about salinity levels further compounded their dissatisfaction, including a significant perception of poor water quality that affects their daily lives.

4.6.13 Sewerage System

Sanitation infrastructure within the AOI is limited and largely informal. A substantial proportion of households depend on open drains and plot-based disposal systems. Only a minority has access to formal piped sewerage networks. During consultations, respondents highlighted issues such as shallow drainage depth, frequent blockages, and overflow during rainfall. These conditions increase health risks and environmental contamination. Table 4-17 shows the types of sewerage systems used by households in the community. A large proportion (44.8%) relies on open drains, indicating poor sanitation infrastructure and potential health risks. About 33.3% of households use infield or plot-based arrangements, reflecting informal or household-level sanitation solutions. Only 21.9% of respondents have access to a piped sewerage network, suggesting limited coverage of formal sanitation services.

Table 4-17 Satisfaction level with Sewerage System

Sr. No.	Type of Sewerage System	Number	Percentage
1	Piped Network	21	21.9
2	Open Drains	43	44.8
3	In Fields / Open Plots	32	33.3
	Total	**96**	**100.0**

The respondents highlighted that the existing sewerage network is inadequate to meet public needs, and they specifically raised concerns about the insufficient depth of the drainage system, which leads to frequent blockage and overflows.

4.6.14 Irrigation Patterns & Major Crops

Participants were asked about their source of irrigation; the majority indicated they use canal water and tube wells for agricultural fields. The primary crops grown include wheat, maize, cotton and vegetables.

4.6.15 Agriculture

The proposed 132 kV transmission line alignment predominantly crosses irrigated agricultural land between Kandiari and Khipro. Unlike riverine floodplain conditions, the project area consists of cultivated farmland supported by canal irrigation networks.

Temporary disturbances during tower installation may affect standing crops; however, long-term agricultural productivity is not expected to be significantly impacted. Community members emphasized the importance of timely compensation for any crop damage and restoration of affected land. Despite agricultural activity, rural settlements in the AOI face multiple socio-economic challenges, including limited infrastructure, lack of industrial employment opportunities, and moderate poverty levels. Similar to the Khipro Grid Station, the Area of Interest (AOI) is located within a region characterized by cultivated agricultural land and semi-urban settlements. The surrounding landscape reflects a combination of farming activities and developing residential areas, indicating a mixed land-use pattern.

4.6.16 Education and Health Care System

Educational facilities within the Area of Influence (AOI) are limited, with most villages having access only to primary schools, while access to middle, secondary, and higher secondary education requires travel to Khipro town or other nearby urban centers. This limited accessibility contributes to relatively high dropout rates, particularly among girls, due to mobility constraints, safety concerns, and prevailing socio-cultural norms. The residents of the Khipro Grid Station (GS) AOI face challenges similar to those experienced by communities along the proposed transmission line corridor. However, access to educational facilities is comparatively better due to the proximity of Khipro City, which provides greater availability of schools and educational services to the local population. At the district level, Sanghar has a basic but unevenly distributed education infrastructure, comprising approximately 3,022 educational institutions, including about 2,837 primary schools, 105 middle schools, 61 secondary schools, and 19 higher secondary schools, along with several degree colleges and technical institutes concentrated in urban centers such as Sanghar, Shahdadpur, Tando Adam,

Khipro, and Kandiari. Notably, Government Degree College Khipro serves as a key higher education institution for students from surrounding rural areas, including the project AOI.[9]

Sanghar District has a well-established public healthcare network comprising 5 hospital-level government institutions, namely Civil Hospital Sanghar, SIMS Shahdad Pur, Taluka Hospital Tando Adam, Taluka Hospital Khipro, and Taluka Hospital Sinjhoro. In addition, the latest Government of Sindh / NHSP facility listing identifies 6 Rural Health Centers (RHCs) in the district RHC Kandiari, RHC Jhol, RHC Sarhari, RHC Shahpurchakar, RHC Jaffar Khan Laghari, and RHC Jam Nawaz Ali and, based on the itemized Sanghar entries in the same list, 58 Basic Health Units (BHUs) distributed across the district's talukas. In Taluka Khipro, the listed BHUs include Malook Mahar, Kalu Rajar, Haji Hassan Hingoro, Qazi Wali M. Rajar, Hathungo, Kamil Hingoro, Dhilyar, Bilawal Hingorjo, Yameen Hingorjo, Bhit Bhaiti, Khahi, and Hamzo Dars, while Taluka Hospital Khipro / Government Civil Hospital Taluka Khipro functions as the main secondary-care facility for Khipro town and surrounding rural settlements. The PPHI Sindh District Sanghar profile further indicates that PPHI-supported health services are operating in 42 Union Councils, with 100 medical staff, 27 mini labs, and 2 collection points, reflecting the broader scale of primary healthcare coverage in the district.[10] Rural areas, particularly in Kandiari and surrounding villages, face persistent challenges, including shortages of qualified medical staff, limited availability of medicines, and lack of specialized healthcare services. Consequently, residents frequently travel to larger urban centers such as Hyderabad and Karachi for advanced medical treatment.

Limited access to quality education and healthcare services contributes to comparatively lower human development indicators across rural areas of Sanghar District. Field observations and social surveys indicate that infrastructure and service delivery gaps are more pronounced within the AOI, reinforcing existing socio-economic disparities. The broader socioeconomic context of the project area is characterized by slow and uneven development, where agriculture remains the dominant livelihood source. While agriculture provides subsistence and income stability, it is constrained by low productivity, limited diversification, and vulnerability to climatic variations.

4.6.17 Women's Issues and Development Needs

A Gender survey was carried out to assess the condition of women in the area. During the survey, women's concerns and issues were identified to establish the baseline conditions. The women were interviewed by female staff to determine their access to social amenities like education and health facilities, participation in household income-generating activities and decision-making, project impacts on mobility of women and to record gender concerns, if any and provide an appropriate mitigation plan if required. Besides, during the consultation, separate focus group discussions were also

[9]District Education Profile Sanghar – School Education & Literacy Department, Government of Sindh
Annual School Census – Reform Support Unit (RSU), Government of Sindh
Sindh Development Statistics – Bureau of Statistics, Government of Sindh

[10]https://nhsp.gos.pk/wp-content/uploads/2025/06/List-of-HFs-BHUs-RHCs-in-15-Districts.pdf
https://nhsp.gos.pk/wp-content/uploads/2026/02/NHSP-HFs-17-Districts-590-1.pdf
https://ntp.gov.pk/wp-content/uploads/2023/03/Annex-A-Public-Health-Facilities.pdf?utm_source=chatgpt.com
https://pphisindh.org/home/pic/contact-us/HF-SBA.pdf?utm_source=chatgpt.com

arranged with women at selected points in affected villages to address the overall gender issues. FGDs analyzed the existing situation of the affected communities from a gender perspective, assessed the possible project impacts on women of the affected villages and recommended actions to improve gender dimensions. Details of village-wise consultations are given in the public consultation section.

4.6.18 Women Survey Finding

During the focus group discussion with the local women, information was collected related to socioeconomic conditions of women, available education and health facilities, project-related awareness, anticipated project impacts on the mobility of women and their concerns, if any. During the survey, it was observed that the women in project-affected villages mainly reside in the house and do household work. However, few women were found engaged in nursing and stitching at home. However, few women were found engaged in nursing and stitching at home (see Table 4-18).

Table 4-18 Findings of the Gender Survey

Indicator	Findings
Socio-economic Role	The majority of women are confined to domestic roles such as cooking, cleaning, and childcare. Few are engaged in home-based income-generating activities like stitching or nursing.
Education	Basic education is relatively common, but girls rarely pursue higher education or vocational training due to mobility constraints and social norms.
Health Facilities	Access to healthcare is limited. Women consult doctors occasionally, mostly for maternal or emergency needs. Distance and transport are barriers.
Mobility and Travel	Female mobility is restricted. Women seldom travel outside villages unless accompanied by male family members. Travel for education or healthcare is infrequent.
Decision-Making	Women are generally excluded from decision-making at both the household and community levels. Male elders, typically household heads, hold authority.
Project Awareness	Very limited awareness about the project among women. Some expressed concern over construction activities and potential impact on privacy, safety, and daily routines.

4.6.19 Socioeconomic Role of Women

In the subproject district Sanghar, the majority of women (ranging from 90% to 95%) are involved in

domestic household roles. A smaller percentage (5% to 10%) participates in home-based activities such as stitching or nursing. Around 10% of the women are either elderly or not active in economic roles.

4.6.20 Access to Education and Health Facilities

In the proposed subproject AoI, women living in rural areas face several socio-economic constraints due to limited access to education, restricted mobility, and inadequate public services. Educational facilities in many villages are limited, with only a few primary schools available and very limited opportunities for secondary or higher education within the locality. Similarly, access to healthcare and vocational training facilities is inadequate, which restricts women's opportunities for skill development and formal employment. As a result, most women are primarily engaged in household responsibilities and agricultural activities, often without formal recognition or financial compensation.

The absence or poor availability of essential services such as reliable electricity, healthcare facilities, and sanitation infrastructure further increases the daily workload of women and contributes to challenges related to maternal and reproductive health. In addition, prevailing social norms in rural communities often limit women's participation in household and community-level decision-making processes, which further constrains their socio-economic empowerment.

However, the situation is relatively better in urban settlements within the taluka, where women have comparatively greater access to education and employment opportunities in various sectors. Despite this, many residents still rely on Hyderabad city for higher education, specialized healthcare services, and broader employment opportunities. Overall, these conditions highlight a gendered vulnerability in rural areas of Khipro Taluka, where women remain disproportionately affected by limited infrastructure and socio-economic opportunities.

4.6.21 Female Mobility Trends

This survey categorizes women's mobility into three areas: movement within the village, travel to the city for healthcare, and travel for education. The data indicate that most women stay within their village boundaries, and very few travel for higher education or vocational training to the city.

4.6.22 Women's Involvement in Household Decision-Making

The data indicate that the majority of respondents reported having no role in decision-making across all categories, ranging from 75% to 84%. A smaller proportion of respondents were consulted informally, accounting for 10% to 15% of the sample. Active involvement in decision-making was relatively limited, varying between 6% and 12%. These findings suggest that decision-making processes are largely concentrated among a limited group of individuals, while the majority of community members have minimal direct participation.

Table 4-19: Women's Role in Decision Making

Sr. No	No Role in Decision Making (%)	Consulted Informally (%)	Actively Involved (%)	Total (%)
1	84	10	6	100
2	80	13	7	100
3	75	15	10	100
4	75	13	12	100

4.6.23 Pressing Needs of Women

Women in the project area experience a range of socio-economic and infrastructural challenges that significantly constrain their empowerment, wellbeing, and participation in community life. Their activities are largely confined to domestic responsibilities and low-income, home-based work, reflecting broader gender norms that limit women's visibility in public, economic, and decision-making spheres. Field consultations and community interactions highlight several critical needs that must be addressed to reduce gendered inequalities and enhance women's socio-economic status.

Livelihood Opportunities: Most women remain engaged in unpaid household labor or informal home-based activities such as stitching and embroidery. There is a strong demand for vocational training, market linkages, and micro-credit facilities to enable women to develop sustainable income-generating livelihoods.

Education and Skills Development: Low literacy levels and the absence of accessible educational or vocational institutions restrict women's personal and economic development. Adult literacy programs, digital skills training, and structured vocational courses are essential for enhancing their capabilities and independence.

Healthcare and Reproductive Services: Limited access to primary healthcare, particularly maternal and reproductive health services, continues to undermine women's health outcomes. Strengthening local health facilities and mobile outreach services is crucial for addressing these gaps.

Clean and Safe Drinking Water: Reliable access to clean drinking water near households would significantly reduce women's time burdens and exposure to health risks, allowing them more time for productive and educational activities.

Mobility and Safety: Poor Road conditions, inadequate transport, and restrictive social norms

constrain women's mobility. Gender-sensitive infrastructure and community awareness initiatives can help improve women's freedom of movement and sense of safety.

Participation in Decision-Making: Women's involvement in household and community-level decision-making remains minimal. Capacity-building and community dialogue initiatives are needed to foster their participation and ensure their voices are included in local governance processes.

Awareness of Rights and Social Services: Many women lack information about their legal rights and available government schemes. Targeted awareness programs can help them access essential services, claim entitlements, and better navigate institutional systems.

Overall, these gender-specific challenges reflect the broader structural inequalities present in the project area, where limited infrastructure, poverty, and traditional norms jointly contribute to the continued marginalization of women.

4.7 Sensitive Receptors

Sensitive receptors are defined as people, communities, and environmental resources that may be more vulnerable to adverse impacts from the proposed Project due to their location, function, or socio-environmental importance. These receptors require special consideration during the ESIA to ensure that potential negative impacts are identified, assessed, and effectively mitigated. This assessment identifies and evaluates sensitive receptors within the Project's Area of Influence (AoI), including physical and socio-economic components, with a focus on human health, cultural values, and. For the assessment of sensitive receptors, the following methodology is adopted.

Desktop Review: Collection and review of secondary data (land use, population density, health facilities, biodiversity records, and cultural heritage registers).

Field Surveys: On-site reconnaissance to verify receptor presence, condition, and sensitivity.

Stakeholder Engagement: Consultation with local communities, authorities, and key stakeholders to validate receptor significance and potential concerns.

The following sensitive receptors are identified in the subproject areas.

Residential Settlements: Villages, Hamlets, and urban areas located within or adjacent to the Project AoI. Households near construction zones are highly sensitive to noise, dust, and vibration.

Schools and Educational Facilities: Exposure to dust, noise, and traffic may disrupt learning and affect children's health.

Health Facilities (clinics, hospitals, BHUs): Considered highly sensitive due to patient vulnerability to pollution, noise, and restricted access.

Religious and Cultural Sites (mosques, shrines, graveyards, heritage monuments): Require strict protection from disturbance, vibration, or physical damage.

Surface Water Bodies (rivers, streams, lakes): Sensitive to sedimentation, contamination, and hydrological changes.

The location of sensitive receptors is shown in Figure 4-12 below.

List of Sensitive Receptors

- Sardar Niaz Muhammad khan Wassan English medium School, Kandiari
- Christian church
- Public Park
- Veterinary Hospital Khipro
- Jamah Masjid Faizan e Madina
- Muhammadi masjid Khipro

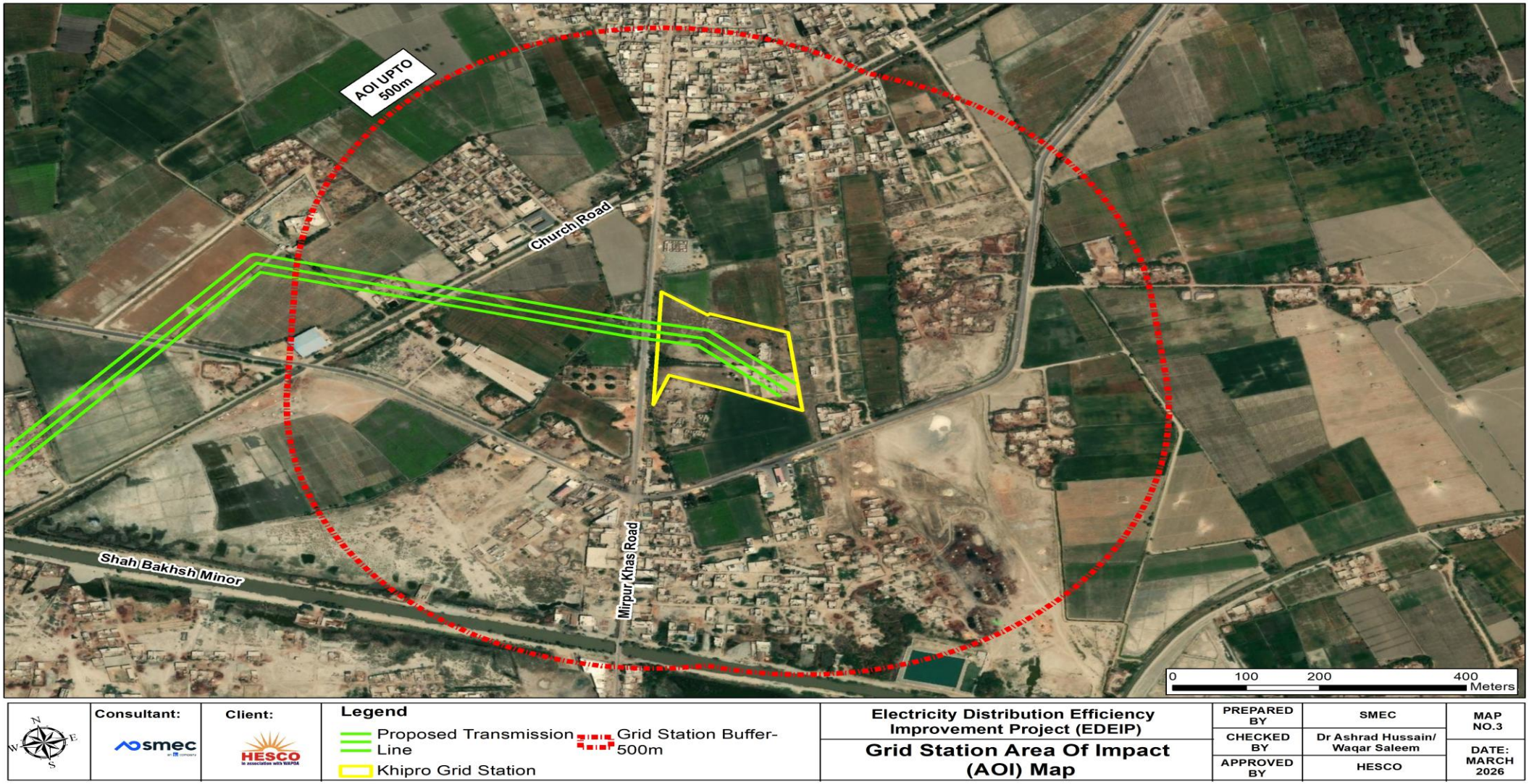

Figure 4-12: Sensitive Receptors in Khipro grid station area

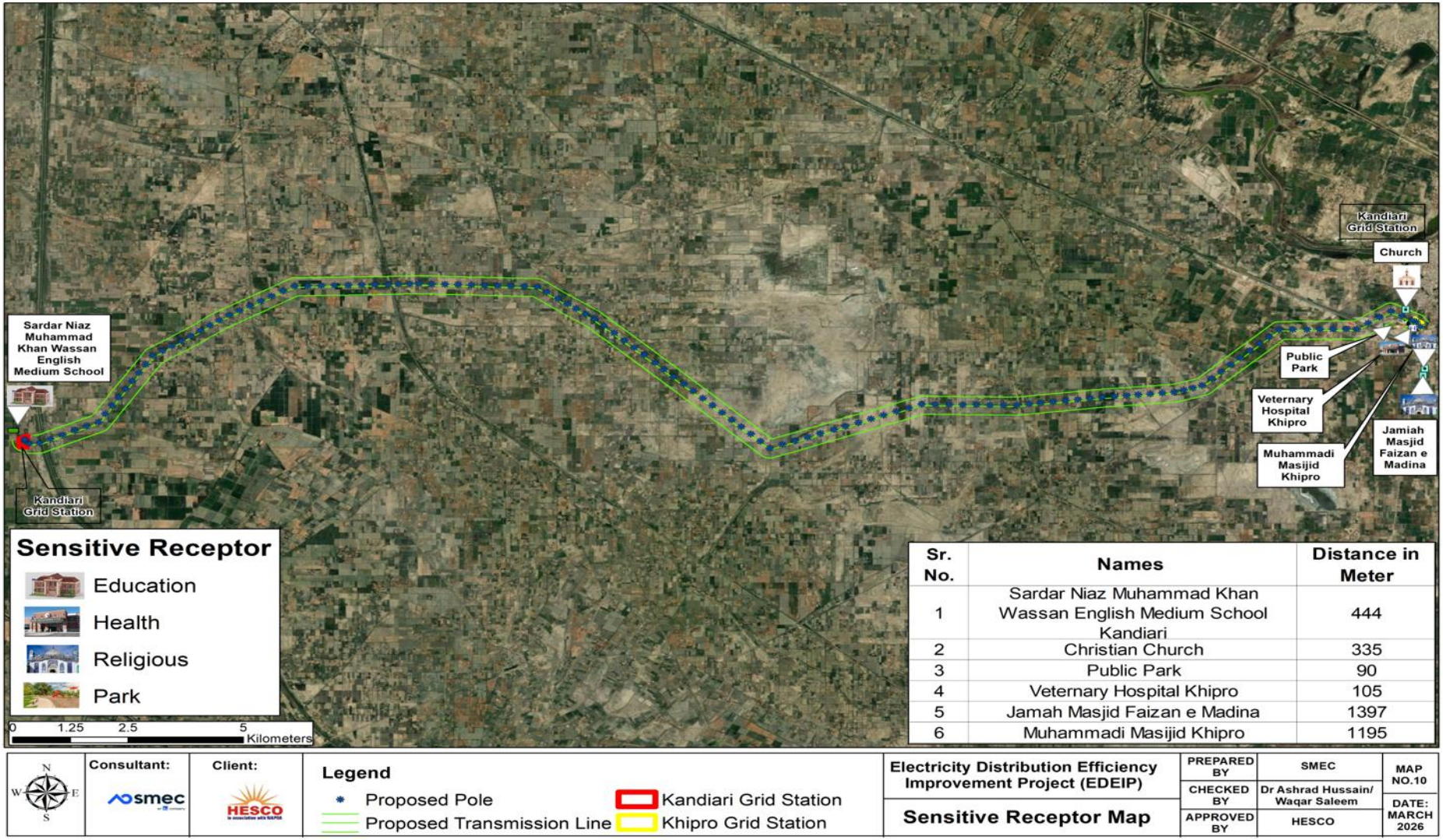

Figure 4-13: Sensitive Receptors in Kandiari-Khipro Subproject Area

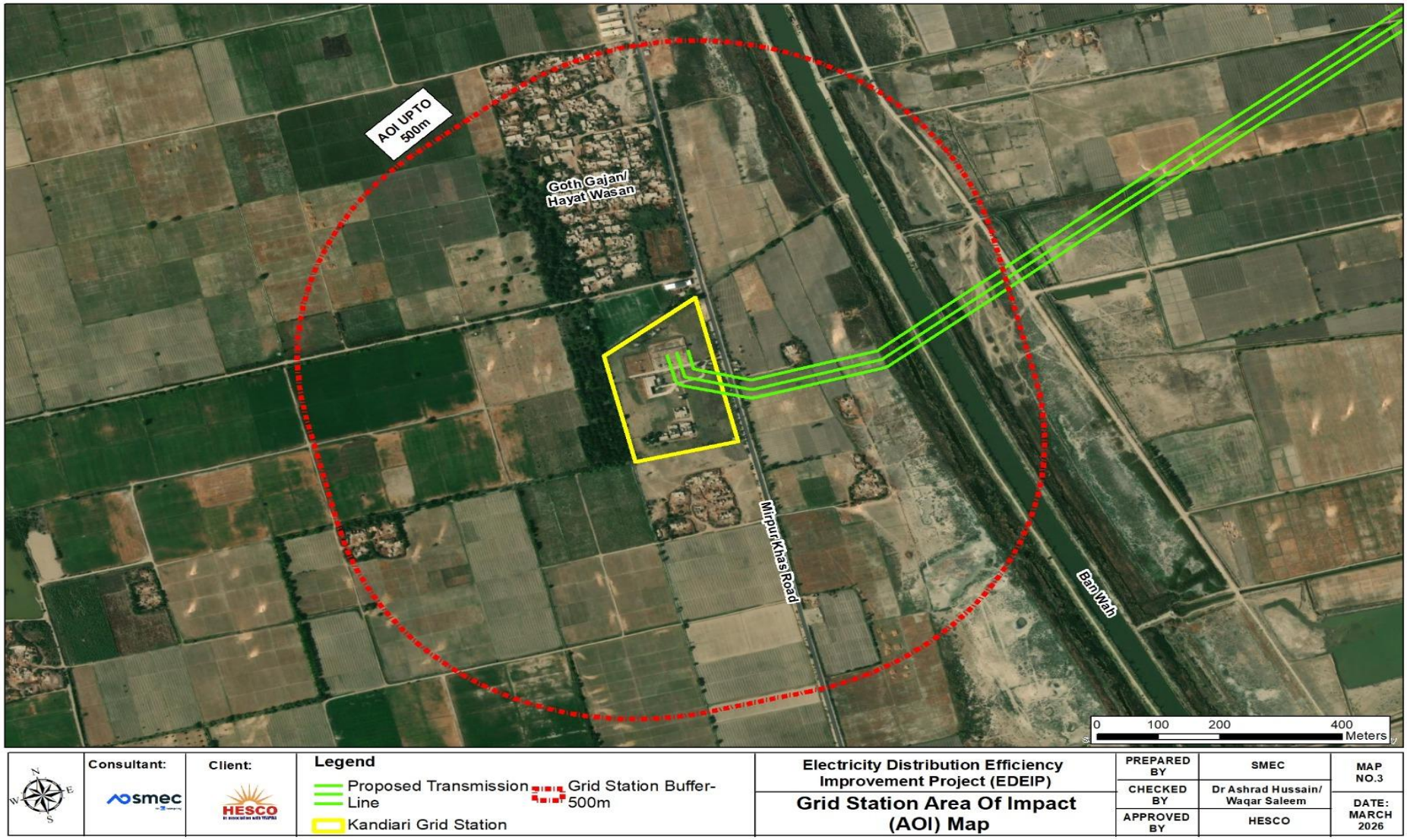

Figure 4-14: Sensitive Receptors in Kandiari Grid Station Area

5 Potential Impacts and Mitigation Measures

This Chapter assesses the potentially adverse environmental and social impacts of the proposed subproject. Also provided in the Chapter are the recommended mitigation measures to minimize, if not eliminate, the potentially adverse impacts.

5.1. Significant E&S Impacts of the Project Siting/Design

Decisions made during the design phase of a project can have far-reaching consequences. For the proposed subproject, the key aspects likely to have significant environmental and social impacts include:

- Compliance with the relevant electrical safety codes during system design.
- Selection of the site for the grid station and the route for the transmission line.
- Choice of equipment.

These design-phase impacts can be readily anticipated and avoided. The specific concerns and appropriate measures to prevent or minimize them are discussed below.

5.1.1. Resettlement Impacts

The conversion of the 66 kV Khipro grid Station to 132 kV will be carried out within the premises of the existing Khipro grid Station, which is under the custody and ownership of HESCO. Since the required land is already available within the existing grid station boundary, no additional land acquisition will be required for the implementation of the subproject. Consequently, the project will not involve any land acquisition-related impacts or displacement of people.

The proposed 132 kV transmission line will affect approximately 117.25 acres (47.44 hectares) of land, including 1.50 acres (0.60 hectares) required for tower foundations and 115.75 acres (46.84 hectares) within the transmission line RoW. Of the total affected area, 83.01 acres (33.59 hectares) is cultivated land and 34.24 acres (13.85 hectares) is non-cultivated land comprising barren land, roads, tracks, and water channel crossings. No land acquisition is required, and land ownership will remain with the titleholders. Overall, 37 landowners will be affected by the proposed transmission line. HESCO has already prepared ARAP to address these resettlement impacts in compliance with the WB ESS5.

Mitigation Measures

- The ARAP mentioned above will be effectively implemented,
- All compensation payments and allowances will be paid to the affected persons before commencing any civil works.
- HESCO and PIMSC will carry out regular monitoring of the ARAP implementation.
- Complete documentation will be maintained for the entire ARAP implementation process.

5.1.2. Health and Safety Risks for Workers and Communities

Improper route selection and inadequate design of electrical equipment and systems can create significant safety risks, particularly electrocution hazards for HESCO workers and nearby communities. Failure to maintain the minimum clearance distances from live components, as required under applicable electrical safety codes, may result in serious injury or loss of life, damage to surrounding property, and substantial harm to electrical infrastructure.

Mitigation Measures

- Route of the TL will avoid settlements to the extent possible.
- The design of the equipment and systems will follow the appropriate electrical safety codes.
- The Project Implementation Management Support Consultant (PIMSC) shall comprehensively review, approve, and audit the design and installation phases to ensure absolute compliance with all applicable safety frameworks.
- Mandatory minimum vertical and horizontal clearance distances between live conductor parts and adjacent buildings, trees, or existing infrastructure shall be rigorously maintained in accordance with utility regulatory standards.
- Warning signage will be used where appropriate and needed.
- Mandatory minimum vertical and horizontal clearance distances between live conductor parts and adjacent buildings, trees, or existing infrastructure shall be rigorously maintained in accordance with utility regulatory standards.

5.1.3. Soil Erosion and Subsidence

Unstable soils at the existing 66-kV Khipro Grid Station site (to be converted) and along the associated transmission line corridor could potentially lead to localized soil erosion and subsidence. However, because this conversion requires installing significantly heavier transformers and taller structures within an existing footprint, the Contractor will be responsible for verifying the sub-surface conditions and implementing engineered foundation designs to eliminate these risks.

Mitigation Measures

For the Grid Station (GS) Conversion:

- The EPC contractor will be contractually required to conduct a detailed geotechnical and soil investigation within the existing 66-kV grid station yard prior to civil design approval. This will verify that the ground can safely support the increased load and vibration of the new 132-kV equipment.
- If the contractor’s geotechnical testing identifies unstable or poorly compacted soil within the existing footprint, the contractor must design specialized foundations to match the site's specific soil bearing capacity.
- The contractor will ensure that new civil structures do not disrupt the existing station's

drainage patterns or trigger localized soil erosion during excavation and structural conversion.

For the Transmission Line:

- The Contractor will verify soil conditions at every tower location. By matching the foundation design to the specific geotechnical results of that spot, the Contractor ensures the structures remain stable and immune to subsidence.
- While the route will bypass highly unstable ground where feasible, in cases where the alignment is fixed, the Contractor must ensure structural stability by utilizing specialized engineering solutions to mitigate any potential for erosion or shifting.

5.1.4. Soil and Water Contamination

The design-related issues related to soil and water contamination include transformer oil containing PCB, appropriate arrangements to collect leaked transformer oil, and waste disposal, including toilet effluents from the grid station. HESCO has discontinued buying PCB-containing transformers; however, the possibility of old transformers having PCB-containing oils cannot be ruled out.

Mitigation Measures

- The transformer procured during the proposed subproject will be Polychlorinated Biphenyls (PCBs) free.
- Leaked oil collection arrangements (such as a channel and a drain pit below the transformers) will be incorporated in the design of the transformer foundations at the grid station

5.1.5. Flood Protection

The proposed subproject is located within the Sanghar District, an area dominated by an agricultural landscape highly susceptible to waterlogging, seasonal inundation, and elevated water tables, particularly during the monsoon season. Constructing the grid station and its associated transmission lines necessitates extensive land leveling and the introduction of impermeable surfaces. These interventions risk altering local hydrological and drainage patterns. Without robust and proactive mitigation measures, these altered drainage conditions could result in severe equipment damage and catastrophic operational failure.

Mitigation Measures

- The Finished Floor Level of the grid station and all sensitive equipment (transformers) will be elevated above the 100-year flood return level, including a minimum safety freeboard of 0.5m to 1m.
- Provide rip-rap protection at drainage outfalls to prevent localized scouring.
- Construct a dedicated internal drainage network to collect and divert surface runoff into

stabilized discharge points.

- Ensure that construction activities do not destabilize the existing irrigation canals and drainage.
- Conduct all construction activities with strict adherence to structural safeguards to ensure that adjacent irrigation canals and existing regional drainage networks remain completely stable and undisturbed.

5.1.6. Aesthetic Aspect

The conversion of the existing grid station may alter and intrude upon the existing natural landscape. Likewise, the installation of a new transmission line can create visual impacts, potentially affecting the scenic quality of the surrounding area. Proper site selection, design optimization, and landscape management measures can help minimize these visual intrusions.

Mitigation Measure

- A tree plantation plan will be prepared for the grid station, without compromising the safety aspects (i.e., required clearances will be maintained). For this purpose, provision will be made in the site layout of the grid station by the contractor.
- The transmission line route will be selected systematically with the least disturbance to the aesthetic value of the area.

5.2. Significant E&S Impacts during Construction Phase

The construction phase will be by far the most significant part of the proposed subproject with respect to environmental and social considerations, since most of the impacts are likely to take place during this period. Various construction activities will invariably create environmental disturbances and social concerns, which may have impacts on the physical resources as well as the people of the area. These impacts can be readily preempted and mitigated. The mitigation measures recommended in this section will need to be incorporated in the execution of the subproject and included in the construction contracts as appropriate. These impacts and their respective mitigation measures are discussed below.

5.2.1. Soil Erosion and Degradation

The soil-related issues include soil erosion, slope stability, and soil contamination. Soil erosion is likely to be caused by the vehicular traffic on unpaved roads, land clearing for construction camps, grid station works, transmission line towers, and subsequent construction activities. Excavation activities for constructing the foundations and borrow pits can potentially cause soil erosion if the excavated soil that is to be used/reused for filling/backfilling is kept unprotected during rains and strong winds. Soil may be contaminated because of fuel/oils/chemicals spillage and leakage, and inappropriate waste (solid as well as liquid) disposal from the construction site and camp. This has a potential impact on the subproject site.

Mitigation Measures

The following mitigation measures will minimize soil erosion and contamination:

Soil Erosion

- Cut and fill at the proposed grid station site will be carefully designed and ideally should balance each other. The surplus soil, if any, will be disposed of at places approved by PIMSC. Such sites will be selected after surveying the area and ensuring that soil deposition will not have any significant impacts, such as loss of productive land, blocked access, natural vegetation and disturbance to drainage.
- If necessary, filling material for the grid station site will be obtained from appropriate locations approved by PIMSC. Such locations will be selected after surveying the area and ensuring that soil extraction will not have any significant impacts, such as soil erosion, loss of natural vegetation and disturbance to drainage.
- The filling material will not be obtained from any cultivation fields or orchards, except where the landowner allows doing so.
- Areas from where the filling material is obtained, or surplus soil deposited, will be landscaped to minimize erosion and hazards for people and livestock.
- Construction camps will be in a stable and flat area, requiring minimal de-vegetation and levelling. The contractor(s) will obtain approval from the PIMSC for this purpose.
- Embankments and excavated slopes will not be left untreated/unattended for long durations. Appropriate slope stabilization measures will be taken by the design (e.g., stone pitching).
- Vehicular traffic on unpaved roads will be avoided as far as possible. The operation of vehicles and machinery close to the water channels and water reservoirs will be minimized.
- After the completion of the construction works, the transmission line route, campsite and other construction sites will be completely restored. No debris, surplus construction material or any garbage will be left behind.
- Photographic records will be maintained for pre-project, during-construction and post-construction conditions of the site (grid station, transmission line/feeder route, camps and access roads).
- Ensure that tower footings are structurally protected with stone pitching or retaining walls if they are located anywhere near seasonal distributaries or water channels.
- Keeps the footprint of the workforce entirely independent of Sindh Irrigation right-of-way (RoW) land.

Soil Contamination

The following mitigation measures will be implemented to prevent soil and water contamination during construction:

- Vehicles and equipment will not be repaired on-site. If emergency repairs are

unavoidable, impervious sheathing will be placed beneath the work area to prevent contamination of soil and water.

- Domestic sewage generated from construction camps will be managed through appropriately designed treatment and disposal systems, such as septic tanks and soakage pits with adequate capacity. Contractors will submit camp layout and waste management plans to the PIMSC for review and approval before establishment.
- Waste oils will be collected in sealed drums and handed over to SEPA-approved waste contractors.
- Inert recyclable materials (e.g., cardboard, empty drums, scrap and used parts) will be segregated and sold to authorized waste contractors. Hazardous waste will be stored separately and managed according to its specific characteristics and regulatory requirements.
- Domestic solid waste from construction camps will be disposed of in an environmentally sound manner to avoid soil contamination. The contractor's waste disposal plan will include detailed procedures for solid waste management.

5.2.2. Surface Water and Groundwater Contamination

The subproject activities that can contaminate soil may also contaminate the surface water and groundwater. These include:

- Disposal of construction waste
- Disposal of solid waste from construction camps
- Release of waste effluents
- Equipment/vehicle maintenance
- Spillage/leakage of fuels, oils and chemicals.

In addition, vehicles and construction machinery operating near the surface water channels can potentially contaminate the surface water. These impacts may be encountered at the proposed site during the construction phase of the proposed subproject.

Mitigation Measures

The mitigation measures proposed to prevent soil contamination will also minimize risks to surface water and groundwater. In addition, the following measures will be implemented during the construction phase:

- Baseline groundwater quality testing will be conducted at the grid station site/within a 500-m buffer zone and at any campsite established outside the grid station before mobilization of construction crews to establish pre-construction water quality conditions.
- Construction debris, solid waste, and untreated effluents will not be disposed of in the irrigation channels.
- Stockpiling of construction materials will not be carried out along the banks of water bodies.

- All fuel storage, vehicle refueling, and mechanical maintenance activities must be strictly restricted to dedicated, designated areas on-site.
- The construction camp will be located within the boundary wall of the grid station. The final camp location will be subject to approval by the PIMSC.
- Contractors will submit detailed camp layout and waste management plans to the PIMSC for review and approval before site establishment.
- Storage areas must be equipped with concrete, bunded secondary containment structures capable of holding 110% of the total storage capacity.
- Groundwater quality monitoring will be conducted every quarter at the grid station site/within a 500-m buffer zone throughout the construction phase to ensure compliance with environmental standards.

5.2.3. Air Quality Deterioration

Construction machinery and vehicles will release exhaust emissions, containing carbon monoxide (CO), sulfur dioxide (SO_2), oxides of nitrogen (NO_X), and particulate matter (PM), among others. These emissions can deteriorate the ambient air quality in the immediate vicinity of the subproject site. Furthermore, construction activities such as excavation, leveling, filling and vehicular movement on unpaved tracks may also cause fugitive dust emissions. Vehicles carrying construction material are likely to result in increased suspended particulate matter (SPM) levels near the haul roads. This can be of potential importance if vehicles pass through areas with a high concentration of sensitive receptors, such as schools and hospitals. At construction sites/material storage sites, the dust levels are also expected to increase due to the unloading of construction materials. Poor air quality due to the release of contaminants and material haul routes can result in possible respiratory irritation, discomfort, or illness to workers and communities.

Mitigation Measures

The following mitigation measures will minimize the emissions and their impact:

- Air quality analysis at the grid station site will be conducted before mobilization of the construction crew to establish baseline conditions of the ambient air quality at these locations.
- The construction camp will be located within the boundary wall of the Grid station.
- Construction machinery, generators and vehicles will be kept in good working conditions and properly maintained to minimize the exhaust emissions.
- Exhaust emissions will be minimized through proper vehicle fitness, anti-smoke checks, and the prohibition of machinery older than 10 years unless retrofitted.
- Fugitive dust emissions will be minimized by appropriate methods, such as spraying water on soil, where required and appropriate. The wastewater from the kitchen and washing area of the construction camp may be used for water spraying.
- Stockpiled soil and sand shall be slightly wet before loading, particularly in windy conditions. Such stockpiles will be covered when necessary.

- Vehicles transporting soil, sand and other construction materials shall be covered with tarpaulin.
- All construction machinery, vehicles, and equipment deployed at the 132-kV Khipro Grid Station and transmission line sites must undergo regular preventive maintenance (including oil changes, air filter replacements, and exhaust tuning) to maintain optimal working conditions.
- Concrete and batching plant to be controlled in line with statutory requirements, will have appropriate dust control mechanisms (such as wet scrubbers) and shall not be close to sensitive receptors.
- The need for large material stockpiles shall be minimized by careful planning of the supply of materials from controlled sources. Stockpiles will not be located within 50 m of schools, hospitals or other public amenities and shall be covered with tarpaulin when not in use and at the end of the working day to enclose dust. If large stockpiles (>25m3) of crushed materials are necessary, they will be enclosed with side barriers and also covered when not in use.
- Regular environmental monitoring must be conducted to ensure that gaseous emissions and ambient noise strictly comply with the Sindh Environmental Quality Standardsthroughout the construction period.
- Dust emissions shall be minimized through good construction practices (such as keeping stockpiles downwind and away from communities) and sprinkling water over the access road.
- Developing and implementing work practices to minimize the release of contaminants into the work environment, including:
    - ✓ Direct piping of liquid and gaseous materials where appropriate
    - ✓ Minimized handling of dry powdered materials, enclosed operations
    - ✓ Local exhaust ventilation at emission/release points
    - ✓ Vacuum transfer of dry material rather than mechanical or pneumatic conveyance
    - ✓ Indoor secure storage and sealed containers rather than loose storage
    - ✓ The stack height of generators will be at least 3 meters above the ground.
    - ✓ Project vehicles will avoid passing through the communities and cultivation fields as far as possible. If unavoidable, speed will be reduced to 15 km/h to avoid excessive dust emissions.
    - ✓ The stack height of generators will be at least 3 m above the ground.

- Project vehicles will avoid passing through the communities and cultivation fields as far as possible. If unavoidable, speed will be reduced to 15 km/h to avoid excessive dust emissions.
- Ambient air quality analysis will be carried out at the grid station site and at the sensitive receptors (such as schools and hospitals) within the AoI on a quarterly basis during the construction phase. Additional mitigation measures will be identified and implemented in case ambient air quality at these sensitive receptors is beyond the prescribed limits defined by NEQS, SEQS and other applicable standards.

5.2.4. Noise and Vibration

Various types of construction equipment and machinery, such as generators, compressors, jackhammers and cutters, will be used during the construction activities. These works will generate high noise levels at the subproject site and in the subproject area.

Each construction activity has its unique noise characteristics due to the use of different equipment items. The potential sources of noise during the preparation, construction, and worksite closure phases for the proposed construction works include equipment, machinery, and transportation used for the construction activities. The equipment used for construction will be the major source of noise.

Since various modern machines are acoustically designed to generate low noise levels, any high noise levels that might be generated will only be for a short duration during the construction phase.

Depending on the construction equipment used and its distance from the receptors, the community and the workers may typically be exposed to intermittent and variable noise levels. During the day, such noise results in general annoyance and can interfere with sleep during the night. In general, human sound perception is such that a change in sound level of 3 decibels (dB) is just noticeable, a change of 5 dB is clearly noticeable, and a change of 10 dB is perceived as a doubling or halving of the sound level.

Due to the various construction activities, there will be temporary noise impacts in the immediate vicinity of the subproject site. The movement of heavy vehicles, loading, transportation and unloading of construction materials produces significant noise during the construction stage. However, these increased noise levels will prevail only for a short duration during the construction phase.

Table 5-1 below represents typical noise levels from various construction equipment.[11] It should be noted that the values indicated in the table may differ depending on the brand and age of machinery provided/used by construction contractors.

Table 5-1: Noise Levels from Various Construction Equipment

Equipment	Peak Noise range at 15m	Typical Peak sound level in a work cycle at 15m	Typical Quieted Equipment sound level at 15m	Construction phase Earthworks	Structure	Installation
Batching plant	82-86	84	84			

[11] *USEPA, 1971;*
http://www.waterrights.ca.gov/EIRD/text/Ch11-Noise.pdf;
http://www.lacsd.org/LWRP%202020%20Facilities%20Plan%20DEIR/4_6_Noise.pdf;
http://newyorkbiz.com/DSEIS/CH18Construction.pdf

Equipment	Peak Noise range at 15m	Typical Peak sound level in a work cycle at 15m	Typical Quieted Equipment sound level at 15m	Construction phase Earthworks	Structure	Installation
Concrete mixer	76-92	85	82		Y	
Crane	70-94	83	80		Y	Y
Excavators	74-92	85	82	Y	Y	Y
Front Loader	77-94	85	82	Y	Y	Y
Water Bowser	85-93	88	85	Y	Y	Y
Graders	72-92	85	82	Y		
Bulldozers	65-95	85	80	Y		
Pavers	87-89	88	80	Y		
Pumps	87-89	88	80	Y		
Diesel Generators	72-82	81	77		Y	Y
Drilling Machines	82-98	90	87	Y	Y	
Compressors	74-88	81	71		Y	
Dumpers	77-96	88	83	Y	Y	
Dump/Flatbed Truck	75-85	80	77	Y	Y	Y

Notes:

- Where the typical value is not cited in the literature, the mean of the peak noise range is assumed.
- Quieted equipment can be designed with enclosures, mufflers, or other noise-reducing features. Where data is not available, a 3 dB(A) reduction is assumed.

Mitigation Measures

- It will be ensured that the noise levels measured at the communities near the subproject site are kept within the acceptable limits of Sindh Environmental Quality Standards (SEQS) (70 dB(A) day and 65 dB(A) nighttime for industrial zones; 45 dB(A) night and 55 dB(A) daytime for residential areas).
- Noise levels will be measured at the key locations, particularly sensitive receptors such as schools and hospitals. If the noise levels are found to be more than the prescribed limits, appropriate measures will be undertaken by the construction team, such as rescheduling the works, using quieter equipment, and/or erecting barriers to protect the communities from excessive noise.
- Vehicular traffic through the communities will be avoided as far as possible. Project routes will be authorized by the PIMSC.

- Vehicle speeds will be kept low, and horns will not be used while passing through or near the communities.
- Vehicles will have exhaust silencers to minimize noise generation.
- Nighttime traffic will be avoided near the communities as far as possible.
  Movement of all subproject vehicles and personnel will be restricted to within work areas to avoid noise disturbance.
- Working hours for construction activities within the communities will be limited to between 8 am and 6 pm (between 6 am and 8 pm during the summer).
- PIMSC will identify additional mitigation measures for the sensitive receptors as needed. Liaison with the community will be maintained. A grievance redressal mechanism will be put in place to address the community complaints, as stated earlier.

5.2.5. Occupational Health and Safety Risks

The construction of subprojects, including site preparation, foundation works, switchyard erection, control building construction, transformer installation, and associated 132 kV transmission line activities (e.g., tower/pole foundations and stringing), involves various occupational health and safety (OHS) risks for workers. These risks arise from the use of heavy machinery, working at heights, handling of electrical components (even if not energized during initial phases), excavation, material handling, and the peri-urban industrial setting in the Khipro-Kandiari region, Sindh.

Key potential OHS risks include:

- Electrocution and electrical hazards: Although the new grid station will not be energized during most construction activities, risks can arise from accidental contact with nearby existing live power lines (e.g., during excavation or crane operations), improper handling of conductors/strings during transmission line works, or residual/induced voltages in equipment. Arc flashes or shocks from temporary power supplies (e.g., generators) are also possible.
- Falls from height: Workers may fall during the erection of lattice structures, installation of busbars/transformers on raised platforms, working on transmission line towers (even short spans), or accessing elevated parts of the control building/switchyard equipment. This is a leading cause of fatalities in utility construction.
- Struck-by/caught-in hazards: Heavy machinery (e.g., cranes, excavators, loaders) and falling objects (e.g., tools, steel beams, insulators) pose risks of being struck, crushed, or pinned. Vehicular movement on site and haul roads can lead to collisions.
- Excavation and trenching hazards: Collapse of trenches or excavations during foundation digging for transformers, bays, cable trenches, or tower footings, potentially causing burial, crushing, or asphyxiation.
- Manual handling and ergonomic injuries: Lifting heavy materials (e.g., steel reinforcement, cement bags, equipment parts) can cause sprains, strains, back injuries, or musculoskeletal disorders.
- Noise and vibration exposure. Prolonged use of jackhammers, compressors, pile drivers

(if used), and heavy equipment can lead to hearing loss, hand-arm vibration syndrome, or fatigue.

- Dust and respiratory hazards: Fugitive dust from excavation, concrete mixing, and material handling, combined with exhaust emissions from machinery, can cause respiratory irritation, silicosis risk (from silica in aggregates), or eye irritation.
- Heat stress and environmental exposure: Sanghar's extremely hot, arid climate (temperatures often >45°C in summer) increases risks of heat exhaustion, heat stroke, dehydration, or reduced concentration leading to accidents during outdoor work.
- Fire and explosion risks: Handling of flammable materials (e.g., diesel for generators, oils), welding/cutting operations, or sparks near combustible waste can cause fires or explosions.
- Other hazards —Slips/trips on uneven ground or oily surfaces, confined space entry (e.g., cable trenches or transformer pits), chemical exposure (e.g., from insulating oils or paints), and biological risks (e.g., animal/insect bites in peri-urban areas).
- These risks will be associated with all subproject sites, and at the construction camp, workshop and storage areas.
- Safety protocols mandated by the project-specific Occupational Health and Safety (OHS) Plan must be rigorously enforced across all construction yards.
- All operators, drivers, and technical laborers must undergo mandatory health and safety inductions, regular toolbox talks, and specialized training for high-risk tasks (such as working at heights or handling hazardous materials).

Mitigation Measures

- The contractor will prepare and implement an occupational and community health and safety management plan, in accordance with the WB ESF12, World Bank Group's Environment, Health and Safety Guidelines13 as well as the World Health Organization Guidelines14, ILO Code of Practice15 and any other internationally recognized OHS standard, such as ISO 4500116 or US OSHA 29 CFR 192617 or any standard specifically mentioned in the bidding documents. The Plans will include applicable safety standards and protocols, requirements of job hazard analysis, training requirements, documentation and reporting mechanisms.
- The Contractor will submit to the PIMSC for approval an emergency evacuation/response plan.
- All OHS protocols will be implemented in true letter and spirit.

[12] *https://www.worldbank.org/en/projects-operations/environmental-and-social-framework*

[13] *https://documents1.worldbank.org/curated/en/157871484635724258/pdf/112110-WP-Final-General-EHS-Guidelines.pdf*

[14] *https://www.who.int/publications/who-guidelines*

[15] *https://www.ilo.org*

[16] *ISO 45001:2018 Occupational health and safety management system, https://www.iso.org/obp/ui/en/#iso:std:iso:45001:ed-1:v1:en*

[17] *https://www.osha.gov/laws-regs/regulations/standardnumber/1926*

- The construction site will have protective fencing to avoid any unauthorized entry.
- The project drivers will be trained in defensive driving skills.
- Vehicular speeds near/within communities will be kept low to minimize safety hazards.
- The campsite will be selected with PIMSC approval
- Firefighting equipment will be made available at the camp.
- Fire extinguishers will be provided throughout camps and work sites. Fire extinguishers will be inspected monthly and maintained as necessary.
- The construction and camp staff will be provided with OCHS training.
- Work in confined spaces will be executed with available safety standards. Adequate monitoring and equipment shall be available to detect deficient oxygen levels.
- All safety precautions will be taken to transport, handle and store hazardous substances, such as fuel.
- An adequate and reliable supply of safe drinking water will be made available at readily accessible and suitable places, including all camps.
- The Contractor will take samples from each supply of drinking water and arrange for analysis of these samples at a Sindh EPA-certified laboratory before their use by the Contractor's staff. The results of these tests for each supply must be submitted to the PIMSC and must demonstrate that each water supply meets national and World Health Organization standards for drinking water.
- The Contractor will provide and maintain adequate hygienic kitchens which are sheltered and separated from the living quarters. Kitchens will include raised and washable surfaces suitable for food preparation.
- The Contractor will provide and maintain adequate hygienic dining areas for staff. Workplaces and camps will be provided with both natural and artificial light. Artificial lighting will be powered by generators in the event of power cuts.
- Public sensitization training will be provided to workers to avoid social conflicts between residents and the construction contractor; the occurrence of any such impacts can be avoided by community-sensitive planning and implementation, and through effective involvement of the local administration.
- The contractor will appoint adequate OHS resources to implement, monitor and report the OCHS management plan to the concerned authorities and PIMSC.
- The contractor must ensure the provision of a first aid facility at the construction site and camp through hiring medics and establishing a dispensary at the campsite.
- A reasonable number of first aid kits will be available on the construction site and within the contractor camp.
- Site personnel will be provided with the appropriate type of personal protective equipment (PPE). The contractor will ensure consistent use of PPE.

Rotating and Moving Equipment

Injury or death can occur from being trapped, entangled, or struck by machinery parts due to the unexpected starting of equipment or unobvious movement during operations. Mitigation measures related to rotating and moving equipment for workers are provided below.

- Where a machine or equipment has an exposed moving part or exposed pinch point that may endanger the safety of any worker, the machine or equipment will be equipped with and protected by a guard or other device that prevents access to the moving part or pinch point. Guards will be designed and installed in conformance with appropriate machine safety standards.
- Turning off, disconnecting, isolating, and de-energizing (Locked Out and Tagged Out -- LOTO) machinery with exposed or guarded moving parts, or in which energy can be stored (e.g., compressed air, electrical components) during servicing or maintenance.
- Selecting and installing equipment, where feasible, to enable routine service, such as lubrication, without removal of the guarding devices or mechanisms.

Vibration

Exposure to hand-arm vibration from equipment such as hand and power tools, or whole-body vibrations from surfaces on which the worker stands or sits, will be controlled through the choice of equipment, installation of vibration-damping pads or devices, and limiting the duration of exposure. Exposure levels will be checked based on daily exposure time and data provided by equipment manufacturers.

Other sources of vibration at the construction site are rollers, compactors or any loose part of machinery, which may cause serious injury or workplace sickness. No equipment or machinery with loose or vibratory parts will be allowed to work. Such issues will be fixed through maintenance of the machinery on a periodic basis. Use of rollers for land grading will be carried out during the daytime and with intermittent intervals to reduce the impacts of vibration on the surrounding environment.

Electrical

Exposed or faulty electrical devices, such as circuit breakers, panels, cables, cords and hand tools, can pose a serious risk to workers. Overhead wires can be struck by metal devices, such as poles or ladders, and by vehicles with metal booms. Vehicles or ground metal objects brought into proximity with overhead wires can result in arcing between the wires and the object, without actual contact. Recommended actions include:

- Marking all energized electrical devices and lines with warning signs.
- Locking out (de-charging and leaving open with a controlled locking device) and tagging out (warning sign placed on the lock) devices during service or maintenance.
- Checking all electrical cords, cables, and hand power tools for frayed or exposed cords and following manufacturer recommendations for the maximum permitted operating voltage of the portable hand tools.
- Double insulation/grounding all electrical equipment used in environments that are, or may become, wet; using equipment with ground fault interrupter protected circuits.
- Protecting power cords and extension cords against damage from traffic by shielding or suspending them above traffic areas.
- Conducting detailed identification and marking of all buried electrical wiring before any

excavation work.

Eye Hazards

Solid particles from a wide variety of construction activities and/or a liquid chemical spray may strike a worker in the eye, causing an eye injury or permanent blindness. Recommended measures include:

- ✓ Use of machine guards or splash shields and/or face and eye protection devices, such as safety glasses with side shields, goggles, and/or a full-face shield.
- ✓ Specific Standard Operating Procedures) may be required for the use of sanding and grinding tools and/or when working around liquid chemicals. Frequent checks of this type of equipment before use to ensure mechanical integrity is also a good practice. Machine and equipment guarding will conform to standards published by organizations such as Canadian Standards Association , American National Standards Institute and International Organization for Standardization (.

Welding/Hot Work

Welding creates an extremely bright and intense light that may seriously injure a worker's eyesight. In extreme cases, blindness may result. Additionally, welding may produce noxious fumes that, upon prolonged exposure, can cause serious chronic diseases. Recommended measures include:

Provision of proper eye protection, such as welder goggles and/or a full-face eye shield, for all personnel involved in or assisting with welding operations. Additional methods may include the use of welding barrier screens around the specific workstation (a solid piece of light metal, canvas, or plywood designed to block welding light from others). Devices to extract and remove noxious fumes at the source may also be required.

Special hot work and fire prevention precautions and SOPs will be implemented if welding or hot cutting is undertaken outside established welding workstations, including Hot Work Permits, stand-by fire extinguishers, stand-by fire watch, and maintaining the fire watch for up to one hour after welding or hot cutting has terminated. Special procedures are required for hot work on tanks or vessels that have contained flammable materials.

Vehicle Driving and Site Traffic

Poorly trained or inexperienced vehicle drivers have an increased risk of accidents with other vehicles, pedestrians, and equipment. Subproject vehicles and delivery vehicles, as well as private vehicles on-site, also represent potential collision scenarios. Subproject vehicle driving and site traffic safety practices include:

- ✓ Training and licensing vehicle operators in the safe operation of specialized vehicles, such as forklifts, including safe loading/unloading and load limits.
- ✓ Ensuring drivers undergo medical surveillance.
- ✓ Ensuring moving equipment with restricted rear visibility is outfitted with audible back-up alarms.
- ✓ Establishing rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures (e.g., prohibiting operation of forklifts with forks in down position), and control of traffic patterns or direction.
- ✓ Restricting the circulation of delivery and private vehicles to defined routes and areas, giving preference to 'one-way' circulation, where appropriate.

Ergonomics, Repetitive Motion, Manual Handling

Injuries due to ergonomic factors, such as repetitive motion, overexertion, and manual handling, take prolonged and repeated exposures to develop, and typically require periods of weeks to months for recovery. These OHS problems must be minimized or eliminated to maintain a productive workplace. Controls may include:

- ✓ Facility and workstation design with 5th to 95th percentile operational and maintenance workers in mind.
- ✓ Use of mechanical assistance to eliminate or reduce exertions required to lift materials, hold tools and work objects, and require multi-person lifts if weights exceed thresholds.
- ✓ Selecting and designing tools that reduce force requirements and holding times and improve postures.
- ✓ Providing user-adjustable workstations.
- ✓ Incorporating rest and stretch breaks into work processes and conducting job rotation.
- ✓ Implementing quality control and maintenance programs that reduce unnecessary forces and exertions.
- ✓ Taking into consideration additional special conditions, such as left-handed people.

Working at Heights

Fall prevention and protection measures must be implemented whenever a worker is exposed to the hazard of falling more than two meters, into operating machinery, into water or other liquid, into hazardous substances, or through an opening in a work surface. Fall prevention/protection measures may also be warranted on a case-specific basis when there are risks of falling from lesser heights. Fall prevention may include:

- ✓ Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area.
- ✓ Proper use of ladders and scaffolds by trained employees.

- ✓ Use of fall prevention devices, including safety belts and lanyard travel limiting devices to prevent access to fall hazard areas, or fall protection devices such as full body harnesses used in conjunction with shock-absorbing lanyards or self-retracting inertial fall arrest devices attached to a fixed anchor point or horizontal lifelines.
- ✓ Appropriate training in the use, serviceability, and integrity of the necessary PPE.
- ✓ Inclusion of rescue and/or recovery plans, and equipment to respond to workers after an arrested fall.

Fire and Explosions

Fires and/or explosions resulting from the ignition of flammable materials or gases can lead to loss of property as well as possible injury or fatalities to project workers. Prevention and control strategies include:

- ✓ Fuel storage areas and generators will have secondary containment in the form of concrete or brick masonry bunds. The volume of the containment area will be equal to 120% of the total volume of fuel stored.
- ✓ Storing flammables away from ignition sources and oxidizing materials. Further, the flammables storage area must be:
    - Remote from entry and exit points into camps
    - Away from facility ventilation intakes or vents
    - Have natural or passive floor and ceiling level ventilation and explosion venting
    - Use spark-proof fixtures
    - Be equipped with fire extinguishing devices and self-closing doors, and constructed of materials made to withstand flame impingement for a moderate period
- ✓ Defining and labelling fire hazard areas to warn of special rules (e.g., prohibition on the use of smoking materials, cellular phones, or other potential spark-generating equipment).
- ✓ Providing specific worker training in the handling of flammable materials and in fire prevention or suppression.

Corrosive, oxidizing, and reactive chemicals

Corrosive, oxidizing, and reactive chemicals present similar hazards and require similar control measures as required for flammable materials. However, the added hazard of these chemicals is that inadvertent mixing or intermixing may cause serious adverse reactions. This can lead to the release of flammable or toxic materials and gases and may lead directly to fires and explosions. These types of substances have the additional hazard of causing significant

personal injury upon direct contact, regardless of any intermixing issues. The following controls will be observed in the work environment when handling such chemicals:

- ✓ Corrosive, oxidizing and reactive chemicals will be segregated from flammable materials and from other chemicals of incompatible class (acids vs. bases, oxidizers vs. reducers, water-sensitive vs. water-based, etc.), stored in ventilated areas and in containers with appropriate secondary containment to minimize intermixing during spills.
- ✓ Workers who are required to handle corrosive, oxidizing, or reactive chemicals must be provided with specialized training and provided with and wear appropriate PPE (such as gloves, aprons, splash suits, and face shields or goggles).
- ✓ Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first aid must always be ensured. Appropriately equipped first-aid stations will be easily accessible throughout the place of work, and eye-washing stations and/or emergency showers will be provided close to all workstations where the recommended first-aid response is immediately flushing with water.

Biological Hazards

Biological agents (Bacteria, Viruses, Toxins, Fungi, and Parasites) represent a potential for illness or injury due to a single acute exposure or chronic repetitive exposure. Biological hazards can be prevented most effectively by implementing the following measures:

- ✓ The contractor will review and assess the known and suspected presence of biological agents at the place of work and implement appropriate safety measures, monitoring, training, and training verification programs.
- ✓ Project contractors must provide good working and sanitation conditions at the camp and work sites. Disease surveillance will be carried out to identify any exposure to parasites, such as hookworm, ascaris, and various mites, chiggers, ticks and dengue.
- ✓ Measures to eliminate and control hazards from known and suspected biological agents at the place of work must be designed, implemented and maintained in close co-operation with the local health authorities and according to recognized international standards.

5.2.6. Community Health and Safety - CHS

This is a risk quite like the OHS risks, but for the nearby communities and non-subproject personnel. These risks are usually associated with excavation and trenches, operation of construction machinery and project vehicles, traffic hazards, electrocution risks, falling objects from heights, improper waste disposal, particularly hazardous waste and exhaust emissions from vehicles and equipment.

Mitigation Measures

- The OCHS Management Plan will be strictly implemented
- The construction area will be barricaded to prevent unauthorized access
- Warning signs will be placed where appropriate/needed
- The construction camp will have septic tanks and soaking pits of adequate size.
- The construction camp will have an appropriate solid waste disposal mechanism.
- The construction camp and site office will have first-aid kits.
- The construction crew will be provided with awareness of transmissible diseases (such as HIV / AIDS, hepatitis B and hepatitis C).
- The construction crew will be provided with mosquito nets and repellents for protection from mosquitoes.
- Guidelines for SEA/SH and violence against children (VAC) will be implemented.
- Liaison with the community will be maintained. In particular, the nearby communities will be informed before commencing the construction works, and testing and commissioning of the system will be carried out, with GRM maintained. Protective fencing will be used where appropriate/possible. An awareness-raising program will be implemented to educate communities about the hazards associated with the grid station, transmission line, feeders, and other electrical systems/equipment. Warning signs will be used at the appropriate locations.
- PIMSC will identify additional mitigation measures for the sensitive receptors as needed.
- HESCO will organize health and safety orientations and skill development awareness-raising sessions for local workers, covering construction safety and the use of personal protective equipment (PPE).
- Flood warning systems will be coordinated with local authorities to alert communities. No waste or effluents will be discharged into the surface water channels, and erosion control will prevent community exposure to unstable structures.

5.2.7. Influx of Labor

An influx of construction workers from other parts of the country can potentially cause risks and impacts such as social conflict, SEA/SH, and communicable diseases. The communities near the grid station site and transmission line route will be at risk associated with the influx of labor.

Mitigation Measures

- Code of conduct (CoC) for workers and employees will be enforced for the protection of local communities, gender-based violence, other social issues, flora and fauna and a ban on tree cutting and hunting. Any violation of the CoC would lead to strict punishment, including termination of employment.
- Inclusion of CoC obligations and the applicable legislation in the contracts of all

employees and workers, with the provision of sanctions and penalties in case of violations.

- Any employee who continues misconduct, carries out duties amateurishly or inattentively, fails to conform to provisions of the contract and CoC, or persists in any conduct which is harmful to safety, health, or the protection of the environment will be terminated.
- Awareness among workers will be created on proper sanitation and hygiene practices to promote proper health.
- Good housekeeping practices will be maintained at the project site.
- Adequate personal hygiene facilities will be provided in good condition with an adequate supply of clean water.
- Arrangements will be made to treat the affected workers on time to control the spread of vector-borne diseases.
- Workers and surrounding communities will be sensitized on awareness and prevention of HIV/AIDS and Sexually transmitted Infections (STIs) through training, awareness campaigns and workshops.
- Free HIV/AIDS and STI screening is provided for site workers
- Counselling sessions will be held to make the workers aware of the risks of HIV/AIDS and STIs.
- The use of drugs and alcohol will not be allowed at the work/construction site.
- Carrying weapons into the workplace premises will be prohibited.
- Adequate security arrangements will be made at all construction sites and temporary facilities.
- The contractor will create awareness among the construction crew to sensitize them about the security situation in the project area, in coordination with private/public security agencies.
- Appropriate fencing, security checkpoints, gates and security guards will be provided at the construction site to ensure the security of equipment, machinery and materials, as well as to secure the safety of site staff.
- The Contractor will ensure that good relations are maintained with local communities and their leaders to help reduce the risk of vandalism and theft.
- The contractor will provide minimum wage to all unskilled labor as per the Sindh Minimum Wage Act 2017 and comply with all legal requirements.
- To avoid conflicts with local people on employment matters, it is recommended that the contractor employ the locals in skilled, semi-skilled, and unskilled work. This will reduce pressure on resources such as residential and health facilities.
- To avoid the influx of labor, local labor for skilled and unskilled categories will be preferred.
- The contractor will proactively manage the potential impacts from labor influx and potential cultural conflicts between local communities and workers, which include the following:

    - ✓ The construction camp will be built in the designated area, located at the maximum possible distance from any settlements.

- ✓ The Contractor's monthly training program will cover topics related to a respectful attitude while interacting with the local communities.
- ✓ World Bank Guidelines on the influx of labor will be used for further guidance.

5.2.8. Gender Issues, including SEA/SH Risks

This is an issue like the one associated with the influx of labor discussed above. The presence of workers and project personnel may cause some gender issues, such as intrusion into privacy, because migrant labor may not be aware of the local customs and culture.

Mitigation Measures

- The routes/places used by the women will be avoided by the project staff as far as possible. If unavoidable, alternate routes should be identified for the communities, if required, especially along routes frequented by womenfolk, such as the route to the local well or water source.
- The construction crew will avoid entering villages and settlements.
- Strict CoC will be observed by the construction crew. Local norms will be respected.
- PIMSC will identify additional mitigation measures for the sensitive receptors as needed.
- Awareness among workers will be created on proper sanitation and hygiene practices, SEA/SH issues, privacy of women, and cultural appropriateness.
- GRM will have a separate mechanism (GRC) to handle SEA/SH cases.
- A SEA/SH service provider will be identified in the subproject area.
- Accountability and response framework will be prepared and implemented for SEA/SH cases.
- Safe spaces will be established/arranged for women in all temporary and permanent facilities.
- SEA/SH awareness will be considered during the recruitment of staff.
- Communities will be informed and consulted before commencing works inside or near the communities.
- WB guidelines on SEA/SH and the influx of labor will be implemented.

5.2.9. Child Labor

During the construction phase of the project, there is a potential risk that contractors or subcontractors may engage underage workers (below 14 years) for unskilled or temporary labour due to the availability of low-cost labour in nearby communities. Such practices would constitute non-compliance with the Sindh Prohibition of Employment of Children Act, 2017, which strictly prohibits the employment of children in any establishment. The involvement of children in construction activities may expose them to health and safety risks, hazardous working conditions, and interruption of their education, thereby resulting in adverse social impacts and legal non-compliance.

Mitigation Measures

- To ensure compliance with the international and local Sindh Prohibition of Employment of Children Act, 2017, the following mitigation measures will be implemented:
- The project will adopt a strict prohibition policy against child labor, ensuring that no person below 14 years of age is employed in any project-related activity.
- Contractors and subcontractors will be required to verify the age of all workers through valid identification documents prior to employment.
- Contractual clauses will be included in all construction contracts explicitly prohibiting the engagement of child labor and ensuring compliance with national labor laws.
- Regular site inspections and labor audits will be conducted by the project management unit to monitor compliance.
- Awareness sessions will be conducted for contractors and workers regarding child labor laws and workers' rights.
- In case any instance of child labor is identified, the contractor will be required to immediately remove the child from work and ensure referral to appropriate social or educational support mechanisms.
- The LMP prepared for EDEIP will be implemented.

5.2.10. Damage to Public Infrastructure

Construction activities, particularly transmission line works and movement of subproject vehicles, may potentially cause damage to the public infrastructure, such as local roads, irrigation channels and drainage.

Mitigation Measures

- Any damage caused by the subproject activities will be completely repaired.
- Damage to the existing infrastructure will be minimized if not avoided altogether through astute planning.
- All damaged infrastructure will be restored to original or better condition.

5.2.11. Loss of Crops and Damage to the Cultivation Fields

The construction activities may potentially damage crops or cultivated fields, causing financial loss to the farmers/landowners.

Mitigation Measures

- Damage to the crops will be avoided during the construction phase.
- Appropriate/adequate compensation will be paid to the grower/landowner in case of any crop loss caused by construction activities by the contractor.
- ARAP is also prepared and affected crop compensation will be paid as per ARAP entitlements.
- Liaison with the nearby communities will be maintained in this regard.
- The grievance redressal mechanism will be maintained continuously.

5.2.12. Blocked Access

The construction activities, particularly the establishment of the construction camp, dumping of construction materials and wastes, excavated soil, transmission line works, and movement of subproject vehicles and construction equipment, can potentially block the local access routes, roads and paths.

Mitigation Measures

- Efforts will be made to avoid any impact on the local roads, routes, and access.
- In case of the blockage of the existing routes, alternate routes will be identified in consultation with the affected communities.
- The contractor will prepare and implement a traffic management plan to minimize impacts on the local routes.
- Community liaison will be maintained throughout the construction phase.
- Restrict movement to designated routes and approved timings.
- Deploy traffic management and safety signage, and immediately repair any damage caused to NHA infrastructure at the contractor's cost in coordination with NHA.
- Ensuring that all project drivers and transport contractors undergo defensive driving training to handle heavy machinery on national transport routes.

5.2.13. Impacts of Power Outage during Shifting of 11-kV Feeders

The conversion of the Khipro Grid Station from 66-kV to 132-kV will require the shifting of existing 11-kV feeders from the old transformers to the new 132-kV substation, resulting in planned, temporary power outages in the affected areas. These shifting activities are expected to cause short-term disruptions of up to three hours per feeder. Given the prevailing loadshedding conditions in Khipro and surrounding regions, residential, commercial, and agricultural consumers are already accustomed to intermittent power supply; therefore, these brief, scheduled outages are not anticipated to cause any significant additional adverse impacts on the local community. Moreover, the outages will be carefully managed within existing power availability windows to minimize inconvenience. For sensitive consumers such as hospitals, water supply schemes, and other critical facilities, prior intimation will be ensured, and temporary backup arrangements will be provided where necessary to maintain uninterrupted essential services.

Mitigation Measures

- Advance Notice: As per HESCO's standard practice, public notices regarding feeder shutdowns will be disseminated through local administration, mosque announcements, and other available communication channels at least 3–7 days prior to the scheduled shutdown.
- Phased Shifting: Feeders will be shifted one by one during the day, ensuring minimal disruption to the power supply.
- Rapid Restoration: Dedicated teams will ensure prompt reconnection and testing after shifting.

- Monitoring: PIMSC and HESCO will monitor the activity and address any unforeseen issues immediately.
- Maintain a dedicated technical standby team at the Khipro Grid Station during the activity to quickly address any unforeseen technical snags or delays, ensuring power is restored safely and promptly.

5.3. Significant E&S Impacts during Operation and Maintenance (O&M) Phase

The O&M activities of the electricity network are environmentally benign by nature and result in very few impacts, which are discussed below.

5.3.1. Soil and Water Contamination

The O&M activities of the grid station generate several types of waste, which can cause soil and water contamination. These are listed below.

- Domestic solid waste from the offices and residences in the grid station
- Sewage from the offices and residences in the grid station
- Wastes from the repair and maintenance activities (discarded equipment and parts, packing materials, used oils and chemicals, cotton rags and the like).
- Leakage and spillage of transformer oil can contaminate soil.

Mitigation Measures

- The grid station will have appropriate solid waste collection and disposal arrangements.
- The grid station will have an appropriate sewage handling system. The grid station's sewage collection system will be connected to the municipality-operated sewerage system, if available. Otherwise, the grid station will have its own arrangements, such as septic tanks and soakage pits.
- Segregate toxic waste streams from general waste at the point of generation. Store them in secure, labeled areas before transferring them to an approved, double-chamber incineration facility for safe thermal destruction.
- Waste oils and chemicals will be disposed of in accordance with their respective Material Safety Data Sheets (MSDS).
- Maintain a comprehensive, updated registry of all relevant MSDS at both the grid station and the maintenance workshop, ensuring they are easily accessible to all personnel.
- MSDS will be made available at the grid station and maintenance workshop.
- In the event of a chemical or oil spill, immediately excavate the affected soil and manage its disposal or treatment as hazardous waste in strict alignment with MSDS guidelines.
- Non-toxic recyclable waste (such as cardboard) will be given away for recycling.
- Toxic waste will be stored separately and incinerated at an appropriate double-chamber incinerator.
- Implement a structured domestic solid waste management plan that includes segregated collection bins (organic vs. inorganic) and partnerships with licensed municipal waste

disposal services.

- The grid station will have channels and drainage pits to collect any leaked oil from the transformers in the grid station. This oil will be sent back to the workshop for recycling.
- Any soil contaminated by the oil/chemical spillage will be removed and disposed of appropriately in accordance with the MSDS of the spilled oil/chemical.
- Spill prevention kits (absorbent pads, booms, and neutralizing agents) will be available at all fuel storage and machinery maintenance areas. In case of a spill, containment will be carried out immediately, the source isolated, and contaminated material collected and disposed of safely.

5.3.2. Occupational, Community Health and Safety Risks

The O&M activities pose significant risks to the HESCO staff. The most significant of these risks is associated with working on or near the live systems and wires. Similarly, working at heights is also a common safety risk for the workers associated with O&M activities.

The operation and maintenance of electricity systems also pose some OCHS risks. Most of the live equipment inside the grid station is either within a double-periphery wall/fencing or within the control panels and control rooms/cable rooms, where access for non-concerned personnel is not allowed. However, the transmission line does pose some CHS risks, particularly in the densely populated areas, and sometimes houses and structures are constructed very close to the transmission line, even under the live wires.

Mitigation Measures

- HESCO will implement the Safety Code prepared by the National Electric Power Regulatory Authority (NEPRA) and its own safety manual.
- O&M staff will be provided with essential protective gear and equipment.
- O&M staff will be provided with safety training. Refresh courses will be arranged on a regular basis.
- Firefighting equipment will be made available at the grid station.
- The Emergency Response Plan (ERP) will be made available at the grid station. Its salient points will be displayed at prominent places within the grid station. The O&M staff will be given training on the ERP. The Environmental and Social Unit (ESU) will review the ERP with respect to the environmental and social considerations and recommend changes if needed. The ERP will include a procedure to inform the nearby communities in case of a fire in the grid station.
- The communities near the grid station and transmission line will be educated on the risk of electrocution and how to avoid accidents.
- Efforts will be made to avoid any physical, acoustic, or logistical impact on local schools, colleges, and academic routines.
- Install highly visible school-zone speed restriction signs and deploy dedicated flagmen to manage safe student crossings during active construction hours.
- The 132-kV Khipro subproject is to eliminate local power deficits. The addition of the

new 20/26 MVA transformer will stabilize line voltage and significantly reduce load shedding across the local grid, directly improving the classroom environment, cooling facilities, and overall learning conditions for students.

- Appropriate signage on safety precautions will be installed at the key locations.
- The trees under the transmission line will be regularly trimmed to maintain 8 m clearance.
- Separation of live parts and public property/other structures/trees will be maintained.
- A Community Liaison will be maintained to raise public awareness about electrocution risks.
- Solid waste and waste effluents from the grid station will be treated/ managed appropriately.
- Flood monitoring and emergency evacuation plans will be integrated into OCHS, with annual drills. Staff training in flood response.

5.3.3. Gender Mainstreaming

Gender mainstreaming will be encouraged in HESCO. Employment opportunities will be created for women. A women-friendly work environment will be established within HESCO facilities (e.g., separate toilets, a system to address sexual harassment).

6 Environmental and Social Management Plan

This chapter provides a structured approach to ensure the potential impacts identified during the ESIA are effectively addressed through specific, measurable, and site-specific mitigation measures. The ESMP includes institutional arrangements along with roles and responsibilities of departments/institutions, monitoring and capacity building requirements, grievance redressal mechanisms, and cost estimates necessary for the implementation of environmental and social safeguards during both the construction and operation phases.

6.1 Institutional Arrangements

HESCO, being the Implementing Agency (IA) of the EDEIP, is responsible for the implementation of the proposed subproject. As IA for EDEIP, HESCO will be responsible for the management and supervision of the project and for ensuring its smooth implementation. It will also play a crucial role in coordinating with other relevant agencies for the successful execution of the Project. HESCO will take appropriate measures for detailed engineering design, implementation, operation, and maintenance of the Project, as well as implementation of environmental and social safeguards compliance. For the dispensation of these functions, HESCO has established the Project Management Unit (PMU) as a dedicated support unit.

6.1.1 Project Management Unit

HESCO has assigned the implementation of EDEIP to its existing PMU, which was established to manage multiple projects headed by a Project Director (PD). PMU is equipped with professional staff. The overall responsibility of environmental and social compliance, including ESMP implementation, will rest with the PMU. HESCO has an existing Environmental and Social Unit (E&S, which will assist PMU in the implementation of ESMP. Currently, Manager Health, Safety, Environment and Social Management (HSE&SM), Assistant Manager (Environment), Assistant Manager (Social), Occupational Health and Safety (OHS) specialist and Gender Specialist are on board in PMU HESCO.

PMU will be supported by PIMSC, deployed for project designing, implementation, supervision, monitoring and environmental and social safeguards planning and management. Contractors will execute the subproject. “The PMU will be responsible for overseeing the environmental and social compliance of PIMSC, including supervision of contractors’ activities to ensure effective implementation of the ESMP.

6.1.2 PIMSC

The PIMSC will be responsible for (i) carrying out detailed engineering designs of the subprojects under EDEIP; (ii) construction supervision of these subprojects; (iii) preparation of E&S documents for EDEIP subprojects, including this ESIA; and (iv) implementation supervision of ESMP (and other E&S documents/plans). The consultants will carry out these

activities through a pool of experts, including an environmental expert, a social expert and a health and safety expert.

6.1.3 Contractor

HESCO will procure the services of contractors for the construction of the proposed subproject. The contractor will be responsible for the implementation of ESMP. For this purpose, the contractor will hire and depute an environmental officer, HSE officer and social officer.

6.1.4 Monitoring & Evaluation Consultants

HESCO/PMU will also engage an independent organization to carry out third-party E&S monitoring during the proposed subproject implementation phase.

6.2 Roles and Responsibilities

The roles and responsibilities of the above entities in the dispensation of environmental and social management tasks and implementation of ESMP of the proposed subproject are given in Table 6-1 below.

Table 6-1: Roles and Responsibilities for E&S Management

Organizations	Responsibilities
PMU/HESCO	● Overall responsibility for the environmental and social compliance, particularly ESIA and ESMP implementation. ● Ensure that all project activities are well-managed and coordinated. ● Apply for environmental clearance of the subproject from the Sindh EPA. ● Ensure compliance with national/provincial legislation and World Bank Environmental and Social Standards. ● Recruit third-party monitoring consultants. ● Review engineering designs to ensure that environmental issues identified in the ESMP have been considered in the design of the subproject facilities. ● Review the bid documents of the contractor and ensure the inclusion of ESMP in the bidding documents and contract agreements. ● Supervise construction activities ● Prepare quarterly monitoring reports on environmental and social

Organizations	Responsibilities
	safeguards compliance. ● Arrange training for contractors, HESCO field staff, and others as needed on the effective implementation of ESMP. ● Supervise PIMSC for the implementation of ESMP. ● Closely coordinate with other concerned agencies, local governments and communities to support implementation of ESMP.
Environmental & Social Unit within PMU/HESCO	● Prepare E&S progress reports on the implementation of ESMP. ● Reviewing consultants' deliverables related to E&S assessment, reviewing bid documents for inclusion of ESMP measures, supervising construction activities, producing periodic monitoring reports, ● Supervising PIMSC for the implementation of ESMP, including mitigation measures ● Carry out direct monitoring of key aspects such as OCHS and GRM ● Closely coordinate with other concerned agencies, including EPA, local governments, and communities, to support the implementation of ESIA, ESMP and other E&S documents/plans.
Contractors	● Prepare Contractor-ESMP (C-ESMP) with site-specific mitigation measures. ● Responsible for implementing ESMP, C-ESMP and standard operating procedures related to environmental and social issues during the construction and operation stages of the subproject. ● Implement mitigation and monitoring measures during the construction and operation stages of the subproject, including measures for water supply and sanitation, landscaping and tree maintenance, traffic safety, solid waste collection and disposal, and OHS issues, etc.) ● Each contractor will recruit Environmental Officer, OHS Officer and a Social Officer, who will be responsible for implementing the contractor's environmental, health and safety responsibilities, implementing the social mitigations at the site, and liaising with government agencies. ● Prepare a monthly E&S implementation status report and submit PIMSC for review and approval.
PIMSC	● Prepare detailed engineering designs for subprojects ● Supervise civil works, ensuring compliance with all design parameters, including quality requirements ● Prepare ESIA, ESMP, and other E&S documents ● Ensuring inclusion of ESIA/ESMP in bidding documents ● Supervise ESIA/ESMP implementation during construction

Organizations	Responsibilities
	● Prepare monthly E&S reports and submit to PMU ● Support the E&S staff of PMU in carrying out their responsibilities ● Providing training on ESMP principles and requirements to contractors, field staff, and others as needed to ensure effective implementation of ESIA ● PIMSC will have an adequate number of dedicated E&S staff. ● Supervise contractors for ESMP implementation ● Prepare quarterly reports and submit to PMU ● PIMSC will have dedicated Environmental Specialist and Social Safeguard Specialists, along with Assistant Environmental Specialists and Social Safeguard officers.
M&E Consultant	● External Monitoring and evaluation of ESIA/ESMP

6.3 Inclusion of Relevant Components of ESMP in Contract Documents

HESCO will include the following Environmental, Social, Health and Safety (ESHS) conditions in the bidding documents to ensure all the mitigation measures proposed in the ESMPs are effectively implemented:

- Past performance of the Contractor on ESHS aspects, including sexual exploitation and abuse and gender-based violence;
- ESHS Staff with the Contractor;
- Mitigation measures to address construction impacts (as given in ESIA/ESMP);
- Payments for implementation of ESHS measures;
- Preparation of C-ESMP before site mobilization and its implementation during construction to manage the ESHS risks;
- Code of Conduct of Contractor's personnel.
- The labor management procedures for construction workers will be included in the contractors' bidding documents.

6.4 Environmental and Social Management During Construction

6.4.1 Environmental Code of Practices

The Environmental Code of Practices (ECoPs) sets out practical guidance for contractors to manage environmental and social (E&S) aspects in a sustainable manner throughout project implementation. These have been developed drawing on construction project experience, including initiatives supported by the World Bank Group in Pakistan and are aligned with the World Bank Group's Environment, Health and Safety Guidelines as well as Good International Industry Practice. The ECoPs are provided in **Annexure 4** and will form part of

the bidding documents to ensure effective application. The ECoPs prepared for the subproject are listed below.

- ECoP 1: Waste Management
- ECoP 2: Fuels and Hazardous Goods Management
- ECoP 3: Water Resources Management
- ECoP 4: Soil Quality Management
- ECoP 5: Erosion and Sediment Control
- ECoP 6: Air Quality Management
- ECoP 7: Noise and Vibration Management
- ECoP 8: Road Transport and Road Traffic Management
- ECoP 9: Labor Influx Management and Construction Camp Management
- ECoP 10: Cultural and Religious Issues
- ECoP 11: Workers' Health and Safety

6.4.2 Construction Stage Mitigation and Monitoring Plan

The Mitigation and Monitoring Plan (MMP) for the construction stage impacts has been prepared on the basis of the impact assessment covered under Chapter 5. The MMP is presented in **Table 6.2**. This plan is subproject-specific and, to the extent possible, site-specific; however, contractors will be required to carry out further detailing of the key aspects to prepare site-specific management plans as part of C-ESMP before commencing the construction activities.

6.4.3 Contractor ESMP (C-ESMP)

The contractor will be required to prepare a site-specific Construction Environmental and Social Management Plan (C-ESMP) before mobilization and commencement of construction works. C-ESMP will be duly approved by PIMSC and PMU. The contractor will implement the approved C-ESMP during the construction phase. The C-ESMP will be prepared based on the prevailing conditions at the construction site and its surroundings. The C-ESMP will consist of subplans on the key E&S aspects, including:

- The Pollution Prevention Plan will be prepared and implemented by the contractor based on the ECOPs and WBG EHS Guidelines (2007).
- Waste Disposal and Effluent Management Plan will be prepared and implemented by the Contractor based on the ESMP, ECOP, and WBG EHS Guidelines (2007).
- Separate water supply and sanitation provisions will be needed for the temporary facilities, including offices, labor camps and workshops, in order not to cause shortages and/or contamination of existing drinking water sources.
- The Occupational Health and Safety (OHS) Plan will be prepared and implemented by the contractor based on the WBG EHS Guidelines (2007), ECOPs, and other relevant standards.

- Quarry Area Management Plan will be prepared and implemented by the contractor based on the WBG EHS Guidelines (2007), ECOPs, and other relevant standards.
- A Traffic Management Plan will be prepared by the contractor after discussion with HESCO and the authorities responsible for roads and traffic. The Plan will be submitted to the PIMSC for their review and approval before contractor mobilization. The Plan will identify the routes to be used by the contractor, procedures for the safety of the local community, particularly pedestrians, and monitoring mechanisms to avoid traffic congestion.
- The Construction Camp Management Plan will be prepared by the contractor. The Plan will include the camp layout, details of various facilities, including supplies, storage, and disposal.
- The Fuel and Hazardous Substances Management Plan will be prepared by each contractor in accordance with the standard operating procedures, WBG EHS Guidelines (2007) and other relevant guidelines, and, where applicable, material safety data sheets (MSDS). The Plan will include the procedures for handling the oils and chemical spills.
- The Emergency Preparedness Plan will be prepared by the contractor after assessing potential risks and hazards that could be encountered during construction.
- Communication Plan to deal with the interaction of the community, complaints management, workers' recruitment, notice of works and workers' conduct with locals.

Table 6-2: Mitigation and Monitoring Plan for Construction and O&M Phases

Issues/ Impacts	Impact sources	Mitigation Measures	Responsibility	
			Execution	Monitoring
E&S impacts of the project Siting/Design				
Avoidance of Sensitive and High-Value Areas	Tree plantation/orchid (if any) within the Right of Way	✓ The siting of transmission facilities must seek to avoid, to the maximum extent possible, areas of tree plantation (Orchid), if any. Alignment of TL adjusted to avoid the tree plantation	Design Engineer of Consultant	PMU/HESCO
Resettlement Impact		✓ The ARAP prepared for the subproject will be effectively implemented, ✓ All compensation payments and allowances will be paid to the affected persons before commencing any civil works. ✓ HESCO and PIMSC will carry out regular monitoring of the ARAP implementation. ✓ Compensation for the tower-restricted land will be paid as per the approved ARAP. ✓ Complete documentation will be maintained for the entire ARAP implementation process. No mitigation measures are required.	PIMSC	PMU-HESCO
Health and Safety Risks for Workers and Communities	Improper design and siting	✓ The design of the equipment and systems will follow the appropriate electrical safety codes. ✓ The PIMSC will ensure that the appropriate electrical safety code is comprehensively applied to all systems and equipment of the subproject. ✓ Minimum distances will be maintained between the live parts and nearby structures and objects. ✓ Warning signage will be used where appropriate and needed.	ESMU/PIMSC	PMU-HESCO

Issues/	Impact sources	Mitigation Measures	Responsibility	
Soil Erosion and Subsidence	Improper site selection	✓ Soil investigation will be carried out before designing the foundation of all buildings, equipment, and transmission line towers/poles. ✓ Areas with unstable soil will be avoided. If unavoidable, the foundations will be designed appropriately based on the geotechnical investigation of the area. ✓ Water bodies will be avoided while deciding the location of the grid station and transmission line towers/poles.	ESMU/PIMSC	PMU-HESCO
Soil and Water Contamination	Improper design of facilities	✓ The transformer procured during the proposed subproject will be PCB-free. ✓ Leaked oil collection arrangements (such as a channel and a drain pit below the transformers) will be incorporated in the design of the transformer foundations at the grid station.	ESMU/PIMSC	PMU-HESCO
Flood Risk	Damage to infrastructure and service interruption	✓ The Finished Floor Level (FFL) of the grid station and all sensitive equipment (transformers) must be elevated above the 100-year flood return level, including a minimum safety freeboard of 0.5m to 1m. ✓ Provide rip-rap protection at drainage outfalls to prevent localized scouring. ✓ Construct a dedicated internal drainage network to collect and divert surface runoff into stabilized discharge points. ✓ Ensure that construction activities do not destabilize the existing irrigation canals and drainage.	ESMU/PIMSC	PMU-HESCO
Feeder Migration Management	Unplanned, extended local power blackouts causing community	✓ Implement a sequential, feeder-by-feeder migration framework to eliminate widespread outages. ✓ Limit planned switchovers to a targeted window of 3 hours per feeder and notify the public via local channels well in advance.	Construction Contractor / HESCO Operators	ESMU/PIMSC

Issues/	Impact sources	Mitigation Measures	Responsibility	
	distress during the 11-kV feeder changeover phase.			
Aesthetic aspects	Intrusion in natural landscape	✓ Tree plantation plan will be prepared for the grid station, without compromising the safety aspects (i.e., required clearances will be maintained). For this purpose, provision will be made in the site layout of the grid station. ✓ The transmission line route will be selected in a systematic way with the least disturbance to the aesthetic value of the area.	ESMU/PIMSC	PMU-HESCO
Construction Phase Impacts				
Soil Erosion and Degradation	Excavation and construction activities, running of vehicles on unpaved roads or tracks	✓ Cut and fill at the proposed grid station site will be carefully designed and ideally should balance each other. The surplus soil, if any, will be disposed of at places approved by PIMSC. Such sites will be selected after surveying the area and ensuring that soil deposition will not have any significant impacts, such as loss of productive land, blocked access, natural vegetation and disturbance to drainage. ✓ If necessary, filling material for the grid station site will be obtained from appropriate locations approved by PIMSC. Such locations will be selected after surveying the area and ensuring that soil extraction will not have any significant impacts, such as soil erosion, loss of natural vegetation and disturbance to drainage. ✓ The filling material will not be obtained from any cultivation fields or orchards, except where the landowner allows doing so. ✓ Areas from where the filling material is obtained, or surplus soil deposited,	Contractor	PIMSC and PMU-HESCO

Issues/	Impact sources	Mitigation Measures	Responsibility	
		will be landscaped to minimize erosion and hazards for people and livestock. ✓ Construction camps will be in a stable and flat area, requiring minimal de-vegetation and levelling. The contractor(s) will obtain approval from the PIMSC for this purpose. ✓ Embankments and excavated slopes will not be left untreated/unattended for long durations. Appropriate slope stabilization measures will be taken by the design (e.g., stone pitching). ✓ Vehicular traffic on unpaved roads will be avoided as far as possible. The operation of vehicles and machinery close to the water channels and water reservoirs will be minimized. ✓ After the completion of the construction works, the transmission line route, campsite and other construction sites will be completely restored. No debris, surplus construction material or any garbage will be left behind. ✓ Photographic records will be maintained for pre-project, during-construction and post-construction conditions of the site (grid station, transmission line/feeder route, camp and access roads). ✓ Vehicles and equipment will not be repaired on-site. If emergency repairs are unavoidable, impervious sheathing will be placed beneath the work area to prevent contamination of soil and water. ✓ Domestic sewage generated from construction camps will be managed through appropriately designed treatment and disposal systems, such as septic tanks and soakage pits with adequate capacity. Contractors will submit camp layout and waste management plans to the PIMSC for review and approval before establishment. ✓ Waste oils will be collected in sealed drums and handed over to SEPA-		

Issues/	Impact sources	Mitigation Measures	Responsibility	
		approved waste contractors. ✓ Inert recyclable materials (e.g., cardboard, empty drums, scrap and used parts) will be segregated and sold to authorized waste contractors. Hazardous waste will be stored separately and managed according to its specific characteristics and regulatory requirements. ✓ Domestic solid waste from construction camps will be disposed of in an environmentally sound manner to avoid soil contamination. The contractor's waste disposal plan will include detailed procedures for solid waste management.		
Surface Water and Groundwater Contamination	Release of contaminated water/effluents from the construction site and camps	✓ Baseline groundwater quality testing will be conducted at the grid station site/within a 500-meter buffer zone. ✓ Construction debris, solid waste, and untreated effluents will not be disposed of in the surface water channels. ✓ Stockpiling of construction materials will not be carried out along the banks of the surface water channels or other water bodies. ✓ Construction camps will be located within the secure boundary of the grid station. Final camp locations will be subject to approval by the PIMSC. ✓ Contractors will submit detailed camp layout and waste management plans to the PIMSC for review and approval before site establishment. ✓ Groundwater quality monitoring will be conducted every quarter at the grid station site/within a 500-meter buffer zone throughout the construction phase to ensure compliance with environmental standards.	Contractor	PIMSC and PMU-HESCO
Air quality deterioration	Operation of construction machinery and	✓ Air quality analysis at the grid station site will be conducted before mobilization of the construction crew to establish baseline conditions of the ambient air quality at these locations.	Contractor	PIMSC and PMU-HESCO

Issues/	Impact sources	Mitigation Measures	Responsibility	
	vehicles	✓ A construction camp will be established inside the grid station site. The contractor(s) will obtain PIMSC approval for this purpose, as mentioned earlier. ✓ Construction machinery, generators and vehicles will be kept in good working conditions and properly maintained to minimize the exhaust emissions. ✓ Fugitive dust emissions will be minimized by appropriate methods, such as spraying water on soil, where required and appropriate. The wastewater from the kitchen and washing area of the construction camp may be used for water spraying. ✓ Stockpiled soil and sand shall be slightly wet before loading, particularly in windy conditions. Such stockpiles will be covered when necessary. ✓ Vehicles transporting soil, sand and other construction materials shall be covered with tarpaulin. ✓ Concrete and batching plants to be controlled in line with statutory requirements will have appropriate dust control mechanisms (such as wet scrubbers) and shall not be close to sensitive receptors. ✓ The need for large material stockpiles shall be minimized by careful planning of the supply of materials from controlled sources. Stockpiles will not be located within 50 m of schools, hospitals or other public amenities and shall be covered with tarpaulin when not in use and at the end of the working day to enclose dust. If large stockpiles (>25m3) of crushed materials are necessary, they will be enclosed with side barriers and also covered when not in use. ✓ Dust emissions shall be minimized through good construction practices (such as keeping stockpiles downwind and away from communities) and		

Issues/	Impact sources	Mitigation Measures	Responsibility	
		sprinkling water over the access road. ✓ Developing and implementing work practices to minimize the release of contaminants into the work environment, including: ✓ Direct piping of liquid and gaseous materials where appropriate ✓ Minimized handling of dry powdered materials, enclosed operations ✓ Local exhaust ventilation at emission/release points ✓ Vacuum transfer of dry material rather than mechanical or pneumatic conveyance ✓ Indoor secure storage and sealed containers rather than loose storage ✓ The stack height of generators will be at least 3 m above the ground. ✓ Project vehicles will avoid passing through as far as possible. If unavoidable, speed will be reduced to 15 km/h to avoid excessive dust emissions. ✓ The stack height of generators will be at least 3 m above the ground. ✓ Project vehicles will avoid passing through the communities and cultivation fields as far as possible. If unavoidable, speed will be reduced to 15 km/h to avoid excessive dust emissions. ✓ Ambient air quality analysis will be carried out at the grid station site and at the sensitive receptors (such as schools and hospitals) within the AoI on a quarterly basis during the construction phase. Additional mitigation measures will be identified and implemented in case ambient air quality at these sensitive receptors is beyond the prescribed limits defined by SEQS and other applicable standards.		
Noise and	Operation of	✓ It will be ensured that the noise levels measured at the communities near	Contractor	PIMSC and

Issues/	Impact sources	Mitigation Measures	Responsibility	
Vibration	construction machinery and vehicles	the subproject site are kept within the acceptable limits of Sindh Environmental Quality Standards (SEQS) (70 dB(A) day and 65 dB(A) nighttime for industrial zones; 45 dB(A) night and 55 dB(A) daytime for residential areas). ✓ Noise levels will be measured at the key locations, particularly sensitive receptors such as schools and hospitals. If the noise levels are found to be more than the prescribed limits, appropriate measures will be undertaken by the construction team, such as rescheduling the works, using quieter equipment and/or erecting barriers to protect the communities from excessive noise. ✓ Vehicular traffic through the communities will be avoided as far as possible. Project routes will be authorized by the PIMSC. ✓ Vehicle speeds will be kept low, and horns will not be used while passing through or near the communities. ✓ Vehicles will have exhaust silencers to minimize noise generation. ✓ Nighttime traffic will be avoided near the communities as far as possible. ✓ Movement of all subproject vehicles and personnel will be restricted to within work areas to avoid noise disturbance. ✓ Working hours for construction activities within the communities will be limited to between 8 am and 6 pm (between 6 am and 8 pm during the summer). ✓ PIMSC will identify additional mitigation measures for the sensitive receptors as needed. ✓ Liaison with the community will be maintained. A grievance redressal mechanism will be put in place to address the community complaints, as		PMU-HESCO

Issues/	Impact sources	Mitigation Measures	Responsibility	
		stated earlier.		
Occupational Health and Safety Risks	Risks associated with construction works, construction machinery, working at heights and confined spaces, electrocution risk, and works over/near water.	✓ The contractor will prepare and implement occupational and community health and safety (OCHS) management plan, in accordance with the WB ESF, World Bank Group's Environment, Health and Safety Guidelines as well as World Health Organization (WHO) Guidelines, ILO Code of Practice and any other internationally recognized OHS standard such as ISO 45001 or US OSHA 29 CFR 1926 or any standard specifically mentioned in the bidding documents. The Plans will include applicable safety standards and protocols, requirements of job hazard analysis, training requirements, documentation and reporting mechanisms. ✓ The Contractor will submit to the PIMSC for approval an emergency evacuation/response plan. ✓ All OHS protocols will be implemented in true letter and spirit. ✓ The construction site will have protective fencing to avoid any unauthorized entry. ✓ The project drivers will be trained in defensive driving skills. ✓ Vehicular speeds near/within communities will be kept low to minimize safety hazards. ✓ The campsite will be selected with PIMSC approval. ✓ Firefighting equipment will be made available at the camp. ✓ Fire extinguishers will be provided throughout the camp and work sites. Fire extinguishers will be inspected monthly and maintained as necessary. ✓ The construction and camp staff will be provided with OCHS training. ✓ Work in confined spaces will be executed with available safety standards.	Contractor	PIMSC and PMU-HESCO

Issues/	Impact sources	Mitigation Measures	Responsibility	
		Adequate monitoring and equipment shall be available to detect deficient oxygen levels. ✓ All safety precautions will be taken to transport, handle and store hazardous substances, such as fuel. ✓ An adequate and reliable supply of safe drinking water will be made available at readily accessible and suitable places, including all camps. ✓ The Contractor will take samples from each supply of drinking water and arrange for analysis of these samples at a Sindh EPA-certified laboratory before their use by the Contractor's staff. The results of these tests for each supply must be submitted to the PIMSC and must demonstrate that each water supply meets national and World Health Organization (WHO) standards for drinking water. ✓ The Contractor will provide and maintain adequate hygienic kitchens which are sheltered and separated from the living quarters. Kitchens will include raised and washable surfaces suitable for food preparation. ✓ The Contractor will provide and maintain adequate hygienic dining areas for staff. Workplaces and camps will be provided with both natural and artificial light. Artificial lighting will be powered by generators in the event of power cuts. ✓ Public sensitization training will be provided to workers to avoid social conflicts between residents and the construction contractor; occurrence of any such impacts can be avoided by community-sensitive planning and implementation, and through effective involvement of local administration. ✓ Contractor will appoint adequate OHS resources to implement, monitor and report the OCHS management plan to the concerned authorities and PIMSC.		

Issues/	Impact sources	Mitigation Measures	Responsibility	
		✓ Contractor must ensure the provision of a first aid facility at the construction site and camps through hiring medics and establishing a dispensary at the campsite. ✓ A reasonable number of first aid kits will be available on the construction site and within contractor camps. ✓ Site personnel will be provided with the appropriate type of personal protective equipment (PPE). Contractor will ensure consistent use of PPE. **Rotating and Moving Equipment** ✓ Injury or death can occur from being trapped, entangled, or struck by machinery parts due to the unexpected starting of equipment or unobvious movement during operations. Mitigation measures related to rotating and moving equipment for workers are provided below. ✓ Designing machines to eliminate trap hazards and ensuring that extremities are kept out of harm's way under normal operating conditions. ✓ Where a machine or equipment has an exposed moving part or exposed pinch point that may endanger the safety of any worker, the machine or equipment will be equipped with and protected by a guard or other device that prevents access to the moving part or pinch point. Guards will be designed and installed in conformance with appropriate machine safety standards. ✓ Turning off, disconnecting, isolating, and de-energizing (Locked Out and Tagged Out -- LOTO) machinery with exposed or guarded moving parts, or in which energy can be stored (e.g., compressed air, electrical components) during servicing or maintenance.		

Issues/	Impact sources	Mitigation Measures	Responsibility	
		✓ Designing and installing equipment, where feasible, to enable routine service, such as lubrication, without removal of the guarding devices or mechanisms. **Vibration** ✓ Exposure to hand-arm vibration from equipment such as hand and power tools, or whole-body vibrations from surfaces on which the worker stands or sits, will be controlled through the choice of equipment, installation of vibration-damping pads or devices, and limiting the duration of exposure. Exposure levels will be checked based on daily exposure time and data provided by equipment manufacturers. ✓ Other sources of vibration at the construction sites are rollers, compactors or any loose part of machinery exposure, which may cause serious injury or workplace sickness. No equipment and machinery with loose or vibratory parts will be allowed to work. Such issues will be fixed through maintenance of the machinery on a periodic basis. Use of rollers for land grading will be carried out during daytime and with intermittent intervals to reduce the impacts of vibration on the surrounding environment. **Electrical** ✓ Exposed or faulty electrical devices, such as circuit breakers, panels, cables, cords and hand tools, can pose a serious risk to workers. Overhead wires can be struck by metal devices, such as poles or ladders, and by vehicles with metal booms. Vehicles or ground metal objects brought into proximity with overhead wires can result in arcing between the wires and the object, without actual contact. Recommended actions include: ✓ Marking all energized electrical devices and lines with warning signs. ✓ Locking out (de-charging and leaving open with a controlled locking device)		

Issues/	Impact sources	Mitigation Measures	Responsibility	
		and tagging out (warning sign placed on the lock) devices during service or maintenance. ✓ Checking all electrical cords, cables, and hand power tools for frayed or exposed cords and following manufacturer recommendations for the maximum permitted operating voltage of the portable hand tools. ✓ Double insulation/grounding all electrical equipment used in environments that are, or may become, wet; using equipment with ground fault interrupter (GFI) protected circuits. ✓ Protecting power cords and extension cords against damage from traffic by shielding or suspending them above traffic areas. ✓ Conducting detailed identification and marking of all buried electrical wiring before any excavation work. **Eye Hazards** ✓ Solid particles from a wide variety of construction activities, and/or a liquid chemical spray may strike a worker in the eye, causing an eye injury or permanent blindness. Recommended measures include: ✓ Use of machine guards or splash shields and/or face and eye protection devices, such as safety glasses with side shields, goggles, and/or a full-face shield. ✓ Specific Standard Operating Procedures (SOPs) may be required for the use of sanding and grinding tools and/or when working around liquid chemicals. Frequent checks of these types of equipment prior to use to ensure mechanical integrity is also a good practice. Machine and equipment guarding will conform to standards published by organizations such as Canadian Standards Association (CSA), American National Standards Institute (ANSI) and International Organization for		

Issues/	Impact sources	Mitigation Measures	Responsibility	
		Standardization (ISO). **Welding/Hot Work** ✓ Welding creates an extremely bright and intense light that may seriously injure a worker's eyesight. In extreme cases, blindness may result. Additionally, welding may produce noxious fumes that, upon prolonged exposure, can cause serious chronic diseases. Recommended measures include: ✓ Provision of proper eye protection, such as welder goggles and/or a full-face eye shield, for all personnel involved in or assisting with welding operations. Additional methods may include the use of welding barrier screens around the specific workstation (a solid piece of light metal, canvas, or plywood designed to block welding light from others). Devices to extract and remove noxious fumes at the source may also be required. ✓ Special hot work and fire prevention precautions and SOPs will be implemented if welding or hot cutting is undertaken outside established welding workstations, including Hot Work Permits, stand-by fire extinguishers, stand-by fire watch, and maintaining the fire watch for up to one hour after welding or hot cutting has terminated. Special procedures are required for hot work on tanks or vessels that have contained flammable materials. **Vehicle Driving and Site Traffic** ✓ Poorly trained or inexperienced vehicle drivers have an increased risk of accidents with other vehicles, pedestrians, and equipment. Subproject vehicles and delivery vehicles, as well as private vehicles on-site, also represent potential collision scenarios. Subproject vehicle driving and site traffic safety practices include:		

Issues/	Impact sources	Mitigation Measures	Responsibility	
		✓ Training and licensing vehicle operators in the safe operation of specialized vehicles, such as forklifts, including safe loading/unloading and load limits. ✓ Ensuring drivers undergo medical surveillance. ✓ Ensuring moving equipment with restricted rear visibility is outfitted with audible back-up alarms. ✓ Establishing rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures (e.g., prohibiting operation of forklifts with forks in down position), and control of traffic patterns or direction. ✓ Restricting the circulation of delivery and private vehicles to defined routes and areas, giving preference to 'one-way' circulation, where appropriate. **Ergonomics, Repetitive Motion, Manual Handling** ✓ Injuries due to ergonomic factors, such as repetitive motion, overexertion, and manual handling, take prolonged and repeated exposures to develop, and typically require periods of weeks to months for recovery. These OHS problems must be minimized or eliminated to maintain a productive workplace. Controls may include: ✓ Facility and workstation design with 5th to 95th percentile operational and maintenance workers in mind. ✓ Use of mechanical assistance to eliminate or reduce exertions required to lift materials, hold tools and work objects, and require multi-person lifts if weights exceed thresholds. ✓ Selecting and designing tools that reduce force requirements and holding times and improve postures.		

Issues/	Impact sources	Mitigation Measures	Responsibility	
		✓ Providing user-adjustable workstations. ✓ Incorporating rest and stretch breaks into work processes and conducting job rotation. ✓ Implementing quality control and maintenance programs that reduce unnecessary forces and exertions. ✓ Taking into consideration additional special conditions, such as left-handed people. **Working at Heights** ✓ Fall prevention and protection measures must be implemented whenever a worker is exposed to the hazard of falling more than two meters, into operating machinery, into water or other liquid, into hazardous substances, or through an opening in a work surface. Fall prevention/protection measures may also be warranted on a case-specific basis when there are risks of falling from lesser heights. Fall prevention may include: ✓ Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area. ✓ Proper use of ladders and scaffolds by trained employees. ✓ Use of fall prevention devices, including safety belts and lanyard travel limiting devices to prevent access to fall hazard areas, or fall protection devices such as full body harnesses used in conjunction with shock-absorbing lanyards or self-retracting inertial fall arrest devices attached to a fixed anchor point or horizontal lifelines. ✓ Appropriate training in the use, serviceability, and integrity of the necessary PPE. ✓ Inclusion of rescue and/or recovery plans, and equipment to respond to		

Issues/	Impact sources	Mitigation Measures	Responsibility	
		workers after an arrested fall. **Fire and Explosions** ✓ Fires and/or explosions resulting from the ignition of flammable materials or gases can lead to loss of property as well as possible injury or fatalities to project workers. Prevention and control strategies include: ✓ Fuel storage areas and generators will have secondary containment in the form of concrete or brick masonry bunds. The volume of the containment area will be equal to 120% of the total volume of fuel stored. ✓ Storing flammables away from ignition sources and oxidizing materials. Further, the flammables storage area must be: ▪ Remote from entry and exit points into camps ▪ Away from facility ventilation intakes or vents ▪ Have natural or passive floor and ceiling level ventilation and explosion venting ▪ Use spark-proof fixtures ▪ Be equipped with fire extinguishing devices and self-closing doors, and constructed of materials made to withstand flame impingement for a moderate period ✓ Defining and labelling fire hazard areas to warn of special rules (e.g., prohibition on the use of smoking materials, cellular phones, or other potential spark-generating equipment). ✓ Providing specific worker training in the handling of flammable materials and in fire prevention or suppression. **Corrosive, oxidizing, and reactive chemicals** ✓ Corrosive, oxidizing, and reactive chemicals present similar hazards and		

Issues/	Impact sources	Mitigation Measures	Responsibility	
		require similar control measures as flammable materials. However, the added hazard of these chemicals is that inadvertent mixing or intermixing may cause serious adverse reactions. This can lead to the release of flammable or toxic materials and gases and may lead directly to fires and explosions. These types of substances have the additional hazard of causing significant personal injury upon direct contact, regardless of any intermixing issues. The following controls will be observed in the work environment when handling such chemicals: ✓ Corrosive, oxidizing and reactive chemicals will be segregated from flammable materials and from other chemicals of incompatible class (acids vs. bases, oxidizers vs. reducers, water sensitive vs. water based, etc.), stored in ventilated areas and in containers with appropriate secondary containment to minimize intermixing during spills. ✓ Workers who are required to handle corrosive, oxidizing, or reactive chemicals must be provided with specialized training and provided with and wear appropriate PPE (such as gloves, aprons, splash suits, and face shields or goggles). ✓ Where corrosive, oxidizing, or reactive chemicals are used, handled, or stored, qualified first aid must always be ensured. Appropriately equipped first-aid stations will be easily accessible throughout the place of work, and eye-washing stations and/or emergency showers will be provided close to all workstations where the recommended first-aid response is immediately flushing with water. **Biological Hazards** ✓ Biological agents (Bacteria, Viruses, Toxins, Fungi, and Parasites) represent a potential for illness or injury due to a single acute exposure or chronic		

Issues/	Impact sources	Mitigation Measures	Responsibility	
		repetitive exposure. Biological hazards can be prevented most effectively by implementing the following measures: ✓ The contractor will review and assess the known and suspected presence of biological agents at the place of work and implement appropriate safety measures, monitoring, training, and training verification programs. ✓ The project contractor must provide good working and sanitation conditions at the camp and work site. Disease surveillance will be carried out to identify any exposure to parasites, such as hookworm, ascaris, and various mites, chiggers, ticks and dengue. ✓ Measures to eliminate and control hazards from known and suspected biological agents at the place of work must be designed, implemented and maintained in close co-operation with the local health authorities and according to recognized international standards.		
Community Health and Safety - CHS	Risks associated with construction works, construction machinery, electrocution risk, vehicular traffic hazards, improper waste disposal, and exhaust emissions.	✓ The OCHS Management Plan will be strictly implemented ✓ The construction area will be barricaded to prevent unauthorized access ✓ Warning signs will be placed where appropriate/needed ✓ The construction camp will have septic tanks and soaking pits of adequate size. ✓ Camp will be at least 500 m from any groundwater wells used by the community. ✓ The construction camp will have an appropriate solid waste disposal mechanism. ✓ The construction camp and site office will have first-aid kits. ✓ The construction crew will be provided with awareness of transmissible	Contractor	PIMSC and PMU-HESCO

Issues/	Impact sources	Mitigation Measures	Responsibility	
		diseases (such as HIV / AIDS, hepatitis B and hepatitis C). ✓ The construction crew will be provided with mosquito nets and repellents for protection from mosquitoes. ✓ Guidelines for SEA/SH and violence against children (VAC) will be implemented. ✓ Liaison with the community will be maintained. In particular, the nearby communities will be informed before commencing the construction works, testing and commissioning of the system. Protective fencing will be used where appropriate/possible. Awareness-raising program will be implemented to educate the communities regarding the hazards associated with the grid station, transmission line, feeders and other electrical systems/equipment. Warning signs will be used at the appropriate locations.		
Influx of Labor	Risks associated with the influx of labor from other parts of the country,	✓ Code of conduct (CoC) for workers and employees will be enforced for the protection of local communities, gender-based violence, other social issues, flora and fauna and a ban on tree cutting and hunting. Any violation of the CoC would lead to strict punishment, including termination of employment. ✓ To avoid the influx of labor, local labor for skilled and unskilled categories will be preferred. ✓ Inclusion of CoC obligations and the applicable legislation in the contracts of all employees and workers, with the provision of sanctions and penalties in case of violations. ✓ Any employee who continues misconduct, carries out duties amateurishly or inattentively, fails to conform to provisions of the contract and CoC, or persists in any conduct which is harmful to safety, health, or the protection	Contractor	PIMSC and PMU-HESCO

Issues/	Impact sources	Mitigation Measures	Responsibility	
		of the environment will be terminated. ✓ Awareness among workers will be created on proper sanitation and hygiene practices to promote proper health. ✓ Good housekeeping practices will be maintained at subproject site(s). ✓ Adequate personal hygiene facilities will be provided in good condition with an adequate supply of clean water. ✓ Arrangements will be made to treat the affected workers on time to control the spread of vector-borne diseases. ✓ Workers and surrounding communities will be sensitized on awareness and prevention of HIV/AIDS and STIs through training, awareness campaigns and workshops. ✓ HIV/AIDS and STI screening is provided for site workers ✓ Counselling sessions will be held to make the workers aware of the risks of HIV/AIDS and STIs. ✓ The use of drugs and alcohol will not be allowed at the work/construction site. ✓ Carrying weapons into the workplace premises will be prohibited. ✓ Adequate security arrangements will be made at all construction sites and temporary facilities. ✓ The contractor will create awareness of the construction crew to sensitize them about the security situation in the project area, in coordination with private/public security agencies. ✓ Appropriate fencing, security checkpoints, gates and security guards will be provided at the construction site to ensure the security of equipment,		

Issues/	Impact sources	Mitigation Measures	Responsibility	
		machinery and materials, as well as to secure the safety of site staff. ✓ The Contractor will ensure that good relations are maintained with local communities and their leaders to help reduce the risk of vandalism and theft. ✓ To avoid conflicts with local people on employment matters, it is recommended that the contractor employ the locals in skilled, semi-skilled, and unskilled work. This will reduce pressure on resources such as residential and health facilities. ✓ The contractor will proactively manage the potential impacts from labor influx and potential cultural conflicts between local communities and workers, which include the following: ✓ The construction camp will be built in the designated area, within the grid station boundary wall, away from settlements. ✓ The Contractor's monthly training program will cover topics related to a respectful attitude while interacting with the local communities. ✓ World Bank Guidelines on the influx of labor will be used for further guidance.		
Gender Issues, including SEA/SH Risks	Presence of migrant labor	✓ The routes/places used by the women will be avoided as far as possible. If unavoidable, alternate routes should be identified for the communities, if required, especially along routes frequented by womenfolk, such as the route to the local well or water source. ✓ The campsite for construction will be away from the nearest community, as recommended earlier. ✓ The construction crew will avoid entering villages and settlements. ✓ Strict CoC will be observed by the construction crew. Local norms will be	Contractor	PIMSC and PMU-HESCO

Issues/	Impact sources	Mitigation Measures	Responsibility	
		respected. ✓ PIMSC will identify additional mitigation measures for the sensitive receptors as needed. ✓ Awareness among workers will be created on proper sanitation and hygiene practices, SEA/SH issues, privacy of women, and cultural appropriateness. ✓ GRM will have a separate mechanism (GRC) to handle SEA/SH cases. ✓ A SEA/SH service provider will be identified in the subproject area. ✓ Accountability and response framework will be prepared and implemented for SEA/SH cases. ✓ Safe spaces will be established/arranged for women in all temporary and permanent facilities. ✓ SEA/SH awareness will be considered during the recruitment of staff. ✓ Communities will be informed and consulted before commencing works inside or near the communities. ✓ WB guidelines on SEA/SH and Influx of Labor will be implemented.		
Child Labor	Employment of below-age workers	✓ The provisions of the Child Labor Act will be made part of the construction contracts. ✓ It will be ensured that no child labor is employed at any of the work sites or camp sites. ✓ The LMP prepared for EDEIP will be implemented.	Contractor	PIMSC and PMU-HESCO
Damage to Public Infrastructure	Subproject activities along the TL AOI; vehicles using	✓ Any damage caused by the subproject activities will be completely repaired. ✓ Damage to the existing infrastructure will be minimized if not avoided altogether through astute planning.	Contractor	PIMSC and PMU-HESCO

Issues/	Impact sources	Mitigation Measures	Responsibility	
	local roads	✓ All damaged infrastructure will be restored to original or better condition.		
Blocked Access	Construction activities, particularly transmission line works, and the off-road movement of vehicles	✓ Efforts will be made to avoid any impact on the local roads, routes, and access. ✓ In case of the blockage of the existing routes, alternate routes will be identified in consultation with the affected communities. ✓ The contractor will prepare and implement a traffic management plan to minimize impacts on the local routes. ✓ Community liaison will be maintained throughout the construction phase.	Contractor	PIMSC and PMU-HESCO
Procurement of Quarry Material	Environmental degradation and community disturbance from unregulated quarrying, noise, dust, and transportation of materials such as sand, gravel, and stones for construction.	✓ No new quarry sites will be developed under the project to avoid land degradation and biodiversity loss. ✓ Procure all quarry and borrow material from existing, government-approved sites with valid environmental clearances. ✓ Verify the supplier's environmental compliance documents before procurement. ✓ Include environmental clauses in procurement contracts requiring the suppliers to follow safe extraction practices. ✓ Monitor transportation of material to minimize dust, noise, and traffic disruptions. Restrict movement of heavy trucks during peak community hours and ensure proper vehicle maintenance. ✓ Implement load covering measures (e.g., tarpaulin sheets) to avoid spillage and dust generation during transport. ✓ Measures random site verifications of supplier locations for environmental compliance.	Contractor	PIMSC, PMU-HESCO

Issues/	Impact sources	Mitigation Measures	Responsibility	
Loss of Trees and Vegetation Cover of the Areas for Towers and Temporary Workspaces	Trees and vegetation growing in the Right of Way.	✓ Landholders will be paid compensation for their standing trees in accordance with prevailing market rates. The landholders will be allowed to salvage the wood of the affected trees (If any). ✓ The contractor's staff and labor will be strictly directed not to damage any vegetation, such as trees or bushes. ✓ To save the affected orchards (if any), the Transmission Line route will need to be changed. However, if unavoidable, the use of towers with maximum height will be resorted to. ✓ Clearing of green surface cover and cutting of trees during the construction of tower bases and during stringing should be minimized. ✓ A total of 117 trees (98 Conocarpus, 17 Acacia and 02 Eucalyptus trees). Compensatory planting of trees at a rate of 5 trees for each cut, cut/uprooted tree ✓ At completion, all organic debris and waste shall be removed.	Contractor	PMU/HESCO
Loss of Wild fauna	Pit excavation for tower erection and conductor stringing	✓ Rescue any trapped reptile or amphibian species	Contractor	PMU/HESCO
Damage to crops	TL works in cultivated fields	✓ Damage to the crops will be avoided during the transmission line works. ✓ Any damage caused by the construction activities or subproject vehicle/machinery movement will be compensated as per ARAP of the project. ✓ Liaison with the nearby communities will be maintained in this regard.	Contractor	PIMSC, PMU-HESCO

Issues/	Impact sources	Mitigation Measures	Responsibility	
		✓ The grievance redressal mechanism will be maintained on a continuous basis.		
Impacts on Sites of Historical, Cultural, Archaeological or Religious Significance	Construction activities	✓ In case of discovery of any sites or artifacts of historical, cultural, archeological or religious significance, the work will be stopped at that site. ✓ The provincial and federal archeological departments will be notified immediately, and their advice will be sought before resumption of the construction activities at such sites. ✓ The existing graveyards will not be damaged. The construction work close to the graveyards will be carried out after informing/consulting the relevant communities. ✓ Chance-find procedures which will be used during this Project are as follows: ✓ Stop the construction activities in the area of the chance find. ✓ Delineate the discovered site or area. ✓ Secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a nightguard will be present until the responsible local authorities and the relevant Department of Archaeology take over. ✓ Notify the supervisory Engineer, who in turn will notify the responsible local authorities and the relevant Department of Archaeology immediately (within 24 hours or less); ✓ Responsible local authorities and the relevant Department of Archaeology would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed by the		

Issues/	Impact sources	Mitigation Measures	Responsibility	
		archaeologists (within 72 hours). The significance and importance of the findings will be assessed according to the various criteria relevant to cultural heritage; those include the aesthetic, historical, scientific, research, social and economic values. ✓ Decisions on how to handle the finding will be taken by the local authorities and the relevant Department of Archaeology. This could include changes in the layout (such as when finding irremovable remains of cultural or archeological importance), conservation, preservation, restoration, and salvage; ✓ Implementation of the authority decision concerning the management of the finding will be communicated in writing by the relevant Department of Archaeology; and ✓ Construction work could resume only after permission is given by the local authorities and the relevant Department of Archaeology concerning the safeguards of the heritage.		
Operation and Maintenance Phase Impacts				
Soil and Water Contamination	Maintenance activities, disposal of transformer oils and other wastes	✓ The grid station will have appropriate solid waste collection and disposal arrangements. ✓ The grid station will have an appropriate sewage handling system. The grid station's sewage collection system will be connected to the municipality-operated sewerage system, if available. Otherwise, the grid station will have its own arrangements, such as septic tanks and soakage pits. ✓ Waste oils and chemicals will be disposed of in accordance with their respective Material Safety Data Sheet (MSDS). MSDS will be made available at the grid station and maintenance workshop.	Grid In-charge	HESCO

Issues/	Impact sources	Mitigation Measures	Responsibility	
		✓ Non-toxic recyclable waste (such as cardboard) will be given away for recycling. ✓ Toxic waste will be stored separately and incinerated at an appropriate double-chamber incinerator. ✓ The grid station will have channels and drainage pits to collect any leaked oil from the transformers in the grid station. This oil will be sent back to the workshop for recycling. ✓ Any soil contaminated by the oil/chemical spillage will be removed and disposed of appropriately in accordance with the MSDS of the spilled oil/chemical.		
OHS hazards	O&M activities on live equipment, working at heights	✓ HESCO will implement the Safety Code prepared by the National Electric Power Regulatory Authority (NEPRA) and its own safety manual. ✓ O&M staff will be provided with essential protective gear and equipment. ✓ O&M staff will be provided with safety training. Refresh courses will be arranged regularly. ✓ Firefighting equipment will be made available at the grid station. ✓ The Emergency Response Plan (ERP) will be made available at the grid station. Its salient points will be displayed at prominent places within the grid station. The O&M staff will be given training on the ERP. The Environmental and Social Unit (ESU) will review the ERP with respect to the environmental and social considerations and recommend changes if needed. The ERP will include a procedure to inform the nearby communities in case of a fire in the grid station. ✓ The communities near the grid station and transmission line will be educated on the risk of electrocution and how to avoid accidents.	Grid In-charge	HESCO

Issues/	Impact sources	Mitigation Measures	Responsibility	
		✓ Appropriate signage on safety precautions will be installed at the key locations.		
Public Health Concerns	Electrocution risk; EMF radiation; health concerns for the nearby population	✓ Separation of live parts and pubic property/other structures/trees will be maintained. ✓ Community liaison will be maintained to raise public awareness about electrocution risks. ✓ Solid waste and waste effluents from the grid station will be treated/ managed appropriately.	Grid In-charge	HESCO
Gender Mainstream	Gender mainstreaming needs to be carried out in HESCO	✓ Gender mainstreaming will be encouraged in HESCO. Employment opportunities should be created for women. A women-friendly work environment will be established within HESCO facilities (e.g., separate toilets, a system to address sexual harassment).	Grid In-charge	HESCO

6.5 E&S Monitoring

6.5.1 Compliance Monitoring

Environmental and Social staff of the Contractor are responsible for implementing the ESMP, while the environmental and social specialists of the PIMSC and PMU will be responsible for the overall monitoring of the ESMP implementation throughout the subproject implementation. Compliance monitoring comprises on-site inspection of the construction activities to verify that measures identified in this ESMP and that are included in the clauses for contractors are being implemented. The E&S Checklists prepared on the basis of the MMP given in Table **6.2** will be used for this purpose.

6.5.2 Effects Monitoring

A tentative monitoring plan to be implemented during the construction stage of the subproject to ensure the effectiveness of the mitigation measures is given in **Table 6-3**, along with the monitoring indicators and frequency. The PIMSC will finalize/revise it before the commencement of construction works.

Table 6-3: Environmental Monitoring Plan

Parameter	Means of Monitoring	Location	Frequency	Responsibility	
				Implementation	Supervision
Construction Phase					
Erosion	Visual inspection of erosion prevention measures and the occurrence of erosion	At Site	Monthly	Contractor	PIMSC, PMU
Wastewater discharges from worksites, batching plants, and campsites	Spot measurement for pH Visual inspection to ensure clear water leaving the site Sampling and analysis of	At Site (including worksite, batching, and camp discharges)	Weekly	Contractor	PIMSC, PMU

Parameter	Means of	Location	Frequency	Responsibility	
	wastewater discharges for the parameters given in SEQS				
Air Quality (dust)	Visual inspection	At site	Daily	Contractor	PIMSC, PMU
Ambient Air Quality	Air quality monitoring for 24 hours for the parameters specified in SEQS	At site	Quarterly	Contractor	PIMSC, PMU
Noise and vibration	24-hour noise monitoring (at/near construction site, campsite, offices, colonies, communities, quarry area, transportation routes)	At the site, particularly near sensitive receptors	Monthly	Contractor	PIMSC, PMU
Emissions from plant and equipment	Visual Inspection	All vehicles/equipment	Monthly	Contractor	PIMSC, PMU
Waste Management	Visual inspection of spoil disposal Visual inspection for the availability of dust bins at worksites and camps. Visual inspection for the collection and treatment of organic	At disposal sites At camp sites and work sites At camp site	Monthly	Contractor	PIMSC, PMU

Parameter	Means of	Location	Frequency	Responsibility	
	waste Visual inspection of the collection and treatment of recyclable and hazardous waste by the waste management contractor	At camp and work sites			
Spills from hydrocarbon and chemical storage	Visual inspection to check whether fuels are stored in contained facilities Availability of spill kits at the site Visual Inspection for leaks and spills	At fuel storage sites	Monthly	Contractor	PIMSC, PMU
Traffic Safety	Visual inspection for placement of traffic signs and traffic control personnel	Near the construction sites	Monthly	Contractor	PIMSC, PMU,
Local Roads	Visual inspection to ensure local roads are not damaged	local roads	Monthly	Contractor	PIMSC, PMU,
Cultural/religious and Sites	Visual observation for cultural sites	Along the local roads	Monthly	Contractor	PIMSC, PMU,
Surface Water	Water quality	At the nearest	Quarterly	Contractor	PIMSC, PMU

Parameter	**Means of**	**Location**	**Frequency**	**Responsibility**	
Quality	Analysis of the Irrigation Channels for drinking water parameters specified in SEQS	canals/water bodies			
Drinking water and sanitation	Water quality analysis for drinking water parameters specified in SEQS	At the work site and campsite	Quarterly	Contractor	PIMSC, PMU,
Safety of workers	Usage of Personal Protective Equipment: accident/incident record.	At worksite	Regular basis	Contractor	PIMSC, PMU,
Labor engagement and SEA/SH risks	Interaction with labor and review of GRM	At site	Monthly	Contractor	PIMSC, PMU
Reinstatement of Site	Visual Inspection	At site	After Completion of all Works	Contractor	PIMSC, PMU,
Operation Phase					
Inspection as per Standard Operating Procedures	Visual Inspection of environmental related issues	Grid and tower locations	Monthly	Operational staff	PMU
Bird collisions	Visual Inspection and interview with the nearby community	Tower locations	Weekly	Operational staff	PMU
EMF	Measurement	Near the	Biannual	Operational staff	PMU

Parameter	Means of	Location	Frequency	Responsibility	
	through appropriate equipment	residential areas along the TL Alignment			
Oil spills from transformers	Visual observations	Grid station	Daily	Operational staff	PMU

6.6 Gender Action Plan Outline

An outline of the Gender Action Plan (GAP) for the subproject is given in Table 6-4. This will be finalized before the mobilization of the contractor.

Table 6-4: Gender Action Plan Outline

S.No.	Activities	Targets	Responsibility
1	Conduct public awareness campaigns on subproject benefits and potential impacts, particularly on women and children.	● Project brochure in Urdu/Sindhi to be disseminated in villages/communities of the subproject area of influence and within one month of the start of the subproject, and orientation to women in face-to-face meetings.	PMU-HESCO PIMSC
2	Socially and gender-inclusive consultations	● Broad-based, socially and gender-inclusive participatory consultation workshop(s) for relevant stakeholders on GAP objectives, one for males and one for females. Women's representation will be ensured in consultations, participation, and decision-making forums so they can clearly express their views, needs, and preferences. Meetings will be held at locations and times that encourage women's participation, with women making up the majority of participants.	PMU, Project Director (PD), Social and Gender Staff of PMU; PIMSC
3	Enhance the	● Incentive programs will be designed	PMU, Project Director

S.No.	Activities	Targets	Responsibility
	capacity of HESCO and PMU to include a gender perspective in the EDEIP's subprojects.	for women to build their skills and support their career development. Social and Gender Specialist and female staff deployed in PMU and PIMSC to assist in GAP implementation and monitoring. ● Gender awareness and social inclusion training provided to PMU and management staff of HESCO for clarity in gender mainstreaming and social inclusion concepts, orientation on GAP targets, roles, and responsibilities, better planning, communication, coordination, implementation, documentation, monitoring and evaluation;	(PD), Social and Gender Staff of PMU; PIMSC
4	Include gender-disaggregated data in monitoring and evaluation and EDEIP progress reports.	● Developed a set of quantitative and qualitative sub-indicators of key indicators, and developed a system to consistently collect, retrieve and analyze the gender-disaggregated data of level of participation, immediate results of activities, benefits, and outcomes, of the EDEIP on women, men, boys, and girls (disaggregated by gender, income, marginalized and vulnerable groups)	PMU, Project Director (PD), Social and Gender Staff of PMU; PIMSC

6.7 Capacity Building and Training

Regular awareness-raising sessions will be held for workers on acceptable conduct, cultural sensitivity, gender equality, and community relations. Parallel outreach will be made to communities to build trust and provide information on the project, its workforce, and available complaint channels.

The proposed training plan is given in Table 6-5. At the construction site, PIMSC will take the lead in implementing the capacity building plan, though the contractors will also be responsible for conducting training for their own staff and workers. The various aspects that are covered under the capacity building will include general environmental and social awareness, key

environmental and social sensitivities of the area, key environmental and social impacts of the project, ESMP requirements, OHS aspects, and waste disposal.

Table 6-5: Environment and Social Training Plan

Contents	Participants	Trainer	Schedule
Environmental and social impacts of the subproject and ESMP requirements of the Contractor. World Bank Group Environmental Health and Safety Guidelines.	All the technical Staff of PMU, E&S, and the relevant technical staff of HESCO who are involved in the management of environmental and social issues associated with the routine operation and maintenance of the grid station.	Environment, Social and Health Safety (ESHS) staff of the PIMSC, and an external training agency that has a thorough knowledge of the WB ESSs and guidelines	During the initial stages of the subproject implementation. The training will be repeated every six months.
Environmental and Social issues associated with the ongoing construction works; Workers' health and safety	Site Engineers of the Contractor, PMU, and the PIMSC; E&S staff of the contractor	E&S staff of the PIMSC	Every month
Code of Conduct Occupational Health and Safety	Construction crew	Contractors E&S Staff	Before the start of the construction activities and during the construction activities (To be repeated as needed.)

6.8 Grievance Redress Mechanism (GRM)

6.8.1 Project GRM

A project-specific GRM for EDEIP has been established in HESCO to receive, evaluate, and facilitate the resolution of affected parties' concerns, complaints, and grievances about the E&S performance of the Project.

A three-tier GRM has been designed to provide a time-bound, early, transparent and fair resolution for Project Affected Persons (PAPs) and other stakeholders' grievances regarding E&S management of each subproject. All complaints received verbally or in writing will be

properly documented and recorded in the Complaint Management Register(s). In addition, an easy-to-access web-based system has been developed to receive the complaints.

Tier 1– Field Level

The first tier of GRM will be operationalized at the field level, which will offer the fastest and most accessible mechanism for the resolution of grievances at the local level. A local-level Grievance Redress Committee (GRC) will be formed for this purpose, which will be headed by the Health Safety, Environment & Social Management (HSE&SM) Manager, with membership of the Land Acquisition Collector (LAC) (if needed), contractors' representatives, consultants' representatives, and two members from the PAPs. The composition of Tier-1 GRC is given below.

1. Manager, (HSE&SM)
2. Representatives of PIMSC
3. Contractor's Representative
4. Two representatives from PAPs (including one woman, where possible).

Tier-1 Field Level GRC will resolve the complaints within 2 to 10 working days, depending on the nature of the grievance.

Tier 2 – PMU Level Grievance Redress Committee

The E&S staff in PMU will refer to the unresolved issues at tier-1 or grievances (with written documentation) to the second tier of GRM, the PMU level GRC.

The PMU level GRC has been established by HESCO, which consists of the following personnel:

1. Chief Engineer (Development), PMU, HESCO.
2. General Manager (Technical), HESCO.
3. Project Director (GSC), HESCO.
4. Manager (HSE&SM), HESCO.
5. In-charge PMDU, HESCO.
6. Representative of the Deputy Commissioner (DC) office (where relevant).
7. Representative of PIMSC.
8. Representative of the Contractor; and
9. Representatives of the respective project-affected people (on-call).

The PMU Level GRC will suggest corrective measures for field-level resolution and assign clear responsibilities for implementing its decision within 25 working days, depending on the nature of the grievance.

Tier 3 – Higher Administrative / Judicial Level

If a grievance cannot be resolved directly by the second tier of GRC or if complainant is

dissatisfied with the decision of GRC, the affected people can seek alternative redress through the Chief Executive Officer (CEO) or Board of Directors of DISCOs, district administration, the Secretary Energy (Power Division) or higher-level administrative authorities, the Pakistan Citizen Portal or the court of law, as appropriate.

6.8.2 GRM for Construction Workers

The GRM described above will address the grievances/complaints lodged by the project-affected persons and other local stakeholders. But according to the lessons learned in various project contexts, there is also a need to establish a separate GRM to deal exclusively with those complaints that involve workers employed by the contractors for construction activities. Such grievances may involve wage rates and unpaid overtime work; irregular and partial payments; lack/inadequacy of living accommodations; lack of clean drinking water and sanitation facilities; lack of medical care in emergencies; and lack of protection against SEA/SH risks by labor suppliers and supervisors.

The GRCs dealing with labor grievances/complaints will have members who are directly and indirectly associated with the construction works. The GRC will include a PMU official who is in charge at the worksite as the convener, the resident engineer of the PIMSC, a workers' representative, and the contractor's representative. The convener will designate an official to receive the complaints and ensure the complainant does not lose his job and is not intimidated into withdrawing the complaint before the formal hearing.

To ensure impartiality and transparency, hearings on complaints will be held in a non-threatening environment and will remain open to all other workers on the site. The GRC will record the (i) details of the complaints; (ii) reasons that led to acceptance or rejection of the individual cases, as well as the number of accepted and rejected cases; and (iii) decisions agreed with the complainants. PMU will keep records of all resolved and unresolved complaints and grievances and make them available for review as and when asked for by the World Bank and other interested entities/persons.

6.9 Reporting

HESCO, PIMSC and contractors will prepare periodic reports on the status of ESMP implementation, and these reports will be submitted to the World Bank and SEPA for their review and feedback. Details of these reports and their content are given in **Table 6.6**.

Table 6-6: ESMP Monitoring and Compliance Reports

S.No.	Title of Report	Contents of Report	Frequency	Report to be prepared by
1	ESHS Monitoring Report	The compliance status of the subproject with environmental and social mitigation and monitoring measures. Besides, the report also covers: environmental incidents; • health and safety incidents, • health and safety supervision: • Usage of PPE by workers • Worker accommodations • Training conducted, and workers participated • Workers' grievances • Community grievances • Chance-find (if any)	Monthly	Contractor
2	ESMP Monitoring Report	The compliance status of the overall subproject with ESMP requirements; non-compliances; Effects Monitoring Report; training provided; GRM data; summary of ESHS monthly reports; corrective actions determined; corrective actions taken; availability of E&S personnel at site.	Quarterly	PIMSC
3	Incident Reports	Incident investigation reports for all major incidents covering details of the incident, root cause analysis, and actions taken to address the future recurrence of this event.	Initial investigation report within 24 hours Detailed Investigation Report within ten days	Contractor; PIMSC

6.10 ESMP Cost Estimates

The total cost of the ESMP implementation is estimated to be about PKR **15.7** million. The cost estimates for various mitigation, monitoring and management plans proposed in the ESMP are presented in Table 6-7.

Table 6-7: ESMP Implementation Budget

Component	Activity	Unit	Quantity	Unit Cost (PKR)	Total Cost (PKR)
CESMP	Preparation of C-ESMP	Lumpsum	1	400,000	400,000
Capacity Building and Training	ESMP Training for Contractor and Workers (minimum quarterly, more as required)	Session	4	250,000	1,000,000
Effects Monitoring and Reporting	Air, Noise, and Water Quality Monitoring (Baseline & Quarterly)	quarterly	4	500,000	2,000,000
OHS	PPEs for Labor (Gloves, Helmets, Safety Shoes)	details in Table 6-8	-	2,362,500	2,360,500
	First Aid Kits and Safety Signage	Lot	5 lots	100,000	200,000
Fire Safety	Fire Extinguishers Fireballs, Fire Trolley Etc, and refilling Cost	Lumpsum	1 lot	1,500,000	1,500,000
Mitigation Measures	Dust Suppression (Water sprinkling)	Fortnightly	24	250,000	6,000,000
	Solid Waste Management (Bins, Disposal)	Lot	1	500,000	500,000
Grievance Redress Mechanism (GRM)	GRM Setup, Forms, Record Keeping	Lot	1	150,000	150,000
Tree Plantation	Compensatory planting of trees at a	Number	117 × 5 = 585	1,000	585,000

Component	Activity	Unit	Quantity	Unit Cost (PKR)	Total Cost (PKR)
	rate of 5 trees for each cut/uprooted tree				
Contingency	Unforeseen environmental/social issues	Lump Sum	-	1,000,000	1,000,000
Total Estimated ESMP Implementation Cost					**15,695,500**

Table 6-8Breakup of Personal Protective Equipment (PPE) Cost

Items	Unit Cost (PKR)	Qty	Subtotal (PKR)	Standard
A. Basic PPE				
Safety Helmet	2,000	200	400,000	EN 397 / ANSI Z89.1
High-Visibility Safety Vest	600	150	90,000	EN ISO 20471
Protective Gloves	500	150	75,000	EN 388
Safety Shoes (steel toe)	3,500	150	525,000	EN ISO 20345 / ASTM F2413
Dust Mask (N95 / FFP2)	300	2500	750,000	NIOSH N95 / EN 149 FFP2
Safety Goggles	600	150	90,000	EN 166
Ear Protection (plugs/muffs)	300	150	45,000	EN 352
Sub Total (A)			**1,975,000**	
B. Task-Specific Mandatory PPE				
Full Body Harness	5,000	70	350,000	EN 361
Welding Face Shield	1,500	25	375,00	EN 166 + EN 170
Sub Total (B)			**387,500**	
Total (A+B)			**2,362,500**	

7 Stakeholder Consultations

This Chapter covers the process and outcomes of the consultations carried out with various stakeholder groups for the preparation of the ESIA. This chapter also includes a framework for the consultations to be conducted during subproject implementation. Additionally, disclosure requirements for the ESIA are also described at the end of the chapter.

7.1 Stakeholder Engagement Plan

As described in **Section 1.6**, an SEP has been prepared to describe the objectives, process and outcome of the stakeholder engagement already carried out during the EDEIP preparation and to be carried out during the EDEIP implementation – in accordance with the WB ESS 10. The key aspects of the SEP are summarized below.

The overall objective of the SEP is to define a program for stakeholder engagement, including public information disclosure and consultation, throughout the entire project cycle. The SEP outlines the ways in which the project team will communicate with stakeholders and includes a mechanism by which people can raise concerns, provide feedback, or make complaints about the project and any activities related to the project. The involvement of the local population is essential to the success of the project in order to ensure smooth collaboration between project staff and local communities and to minimize and mitigate environmental and social risks related to the proposed activities.

The stakeholder engagement and consultation activities for the proposed subproject have been carried out in accordance with the guidelines provided in the SEP. These activities are described in the following sections.

7.2 Objectives of Consultations

Both national and provincial environmental regulations and the World Bank's ESF, specifically ESS-10, mandate that meaningful consultations should be conducted with stakeholders as part of the ESIA process. Methodology for carrying out consultations has been devised to meet these legal and policy requirements and to fulfil the engagement commitments outlined in the SEP of EDEIP. An inclusive, gender-responsive, and transparency-driven approach has been adopted to conduct consultations. The consultations aimed to achieve the following objectives:

- Inform affected communities and stakeholders about the proposed subproject, its components, and potential environmental and social impacts in an accessible and culturally appropriate manner.
- Solicit views, concerns, and feedback from local communities, including women, vulnerable groups, and informal land users, regarding potential risks associated with the subproject.
- Obtain and incorporate local knowledge and priorities into the ESIA and ESMP, ensuring context-specific and community-informed mitigation strategies.

- Promote participation, transparency, and accountability by providing a platform for two-way communication between HESCO and stakeholders; and
- Support the design and implementation of the EDEIP's Grievance Redress Mechanism (GRM), ensuring that it is accessible, responsive, and inclusive.

7.3 Stakeholder Identification and Analysis

The SEP prepared for the EDEIP defines three groups of stakeholders: (i) affected parties, (ii) interested parties, and (iii) vulnerable groups. The affected parties for the proposed subproject include individuals, groups or other entities within the subproject's AoI who are impacted or likely to be impacted directly or indirectly, positively or adversely, by the proposed subproject activities. The interested parties are the individuals/groups who may have an interest in the subproject. They include individuals or groups whose interests may be affected by the subproject and who have the potential to influence the subproject's outcomes in any way. Vulnerable groups include people who may be disproportionately impacted by the subproject or further disadvantaged as compared with any other groups due to their vulnerable status and who may require special engagement efforts to ensure their equal representation in the consultation and decision-making process associated with the subproject. This group may include elderly citizens, disabled citizens, women, ethnic and religious minorities, and the poor. **Table 7.1** identifies various categories of stakeholders for the proposed subproject. Consultations have been carried out with these categories of stakeholders of the proposed subproject.

Table 7-1: Stakeholder Categories for Proposed Subproject

Affected Parties	Interested Parties	Vulnerable Groups
Nearby communities within the AoIs of the subproject, including the inhabitants of the staff colony inside GS.	• EPA Sindh • Social Welfare Department Sindh • Revenue Department Sanghar and Khipro • Settlement & Survey Department Sindh • Sindh Irrigation and Drainage Authority, Hyderabad • Agriculture Department • Hyderabad Electric Supply Company • Government Degree College, Khipro • National Highway Authority, Jamshoro • Non-Government Organizations (NGO) and Civil Society	Children, women, the elderly and poor households residing within the AoIs of the subproject

Affected Parties	Interested Parties	Vulnerable Groups
	Organizations (CSOs).	

7.4 Consultation Process

Consultations were carried out with all three categories of stakeholders listed in **Table 7.1**. The consultations with the local communities (affected parties, including vulnerable groups) were carried out through village meetings and focus group discussions (FGDs). Separate meetings were carried out with the women of the area (vulnerable groups). Consultations with the departments and other organizations (interested parties) were conducted through separate one-to-one meetings.

7.4.1 Community Consultations

Extensive community consultations were carried out in the nearby subproject locations to ensure inclusive participation of communities in the ESIA process. The consultations included sessions with residents, landowners, shopkeepers, women representatives, laborers, and vulnerable groups residing in the subproject's AOI. Overall, 26 community consultation sessions were held (17 with men and 9 with women), wherein 207 persons (137 men and 70 women) participated. The attendance sheet of participants is placed at **Annexure-3**. The details of community consultation sessions are presented in Table 7-2. The locations of community consultations sessions are shown in Figure 7.1.

Table 7-2 Details of Consultation Sessions with the Community

Sr. No.	Date	Location of Consultations	Number of Participants	Respondents
Consultation with Men				
1	31/12/2025	Village (Goth) Gajan/Hayat Wasan	12	Local Community in TL AoI
2	31/12/2025	Village (Goth) Haji Islam Bughti	11	Local Community in TL AoI
3	31/12/2025	Village (Goth) Haji Wali Muhammad	7	Local Community in TL AoI
4	31/12/2025	Village (Goth) Ali Akber Sher	4	Local Community in TL AoI
5	01/01/2026	Village (Goth) Khair Muhammad Junejo	8	Local Community in TL AoI
6	01/01/2026	Village (Goth) Mir M.	5	Local Community in TL AoI

Sr. No.	Date	Location of Consultations	Number of Participants	Respondents
		Manjhotho		
7	16/12/2025	Village (Goth) Haji Gulam Mustafa Rajer	7	Local Community in TL AoI
8	15-12-2025	Village (Goth) Ali Hassan Narejo	5	Local Community in TL AoI
9	15/12/2025	Village (Goth) Mureed Akbar Sangrasi	5	Local Community in TL AoI
10	02/01/2026	Village (Goth) Ismail Samo	9	Local Community in TL AoI
11	03/01/2026	Village (Goth) Haji Khamiso Rajer	12	Local Community in TL AoI
12	03/01/2026	Village (Goth) Goth Nial Din	4	Local Community in TL AoI
13	03/01/2026	Village (Goth) Dani Parto Pahor	11	Local Community in TL AoI
14	03/01/2026	Village (Goth) Haji M. Bux Kuber	8	Local Community in TL AoI
15	25/05/2025	Wahid City	9	Local Community in the Grid Station AoI
16	25/05/2025	Dr. Herchand rai Village	8	Local Community in the Grid Station AoI
17	25-05-202	Christian Colony	12	Local Community in the Grid Station AoI
Sub Total			**137**	
Consultation With Women				
18	31-12-2025	Village (Goth) Fatah Junijo/ Islam Bughti	8	Local Women in the TL AoI
19	01-01-2026	Village (Goth) Somaro	7	Local Women in the TL AoI
20	02-01-2026	Village (Goth) Haji Khamiso Rajar	7	Local Women in the TL AoI
21	02-01-2026	Village (Goth)	11	Local Women in the TL AoI

Sr. No.	Date	Location of Consultations	Number of Participants	Respondents
		Soharo Khaskhily		
22	03-01-2026	Village (Goth) Goth Nial Din	10	Local Women in the TL AoI
23	25-05-2026	Wahid City	7	Local Women in the Grid Station AoI
24	25-05-2026	Dr. Herchanand Villlage	8	Local Women in the Grid Station AoI
25	25-05-2026	Christian Colony	7	Local Women in the Grid Station AoI
26	25-05-2026	Staff Colony	5	Women in the Khipro Grid Station Staff Colony
Sub Total			**70**	
Total			**207**	

During the stakeholder consultations, the salient features of the proposed subproject, including the conversion of the existing 66 kV Khipro Grid Station to 132 kV and the construction of the associated 34.5 Km transmission line, were explained to the participants. The social team also described the anticipated E&S impacts during the construction and operation phases, including potential impacts on agricultural land, crops, community safety, noise, dust, traffic, and local infrastructure. In addition, the proposed mitigation and management measures outlined in the ESMP were presented to ensure that stakeholders had a clear understanding of both the potential benefits and risks of the subproject. Following these discussions, community members expressed support for the subproject, recognizing the need for a reliable electricity supply, improved voltage stability, and reduced load shedding. These improvements are expected to benefit households, agriculture, education, healthcare services, and small businesses in the area. Participants raised concerns regarding local employment opportunities during construction, the safety of nearby residents, protection of agricultural land and water resources, and temporary disturbances such as noise, dust, and traffic congestion. Women participants highlighted the importance of uninterrupted electricity for household activities, children's education, and access to healthcare services. Overall, the consultations reflected a positive community attitude toward the subproject, provided that the identified mitigation measures are effectively implemented through the ESMP. Details of community consultations are presented in Table 7.3, while Table 7.4 provides information on consultations conducted with women. Consultation photographs are attached as Annexure-6.

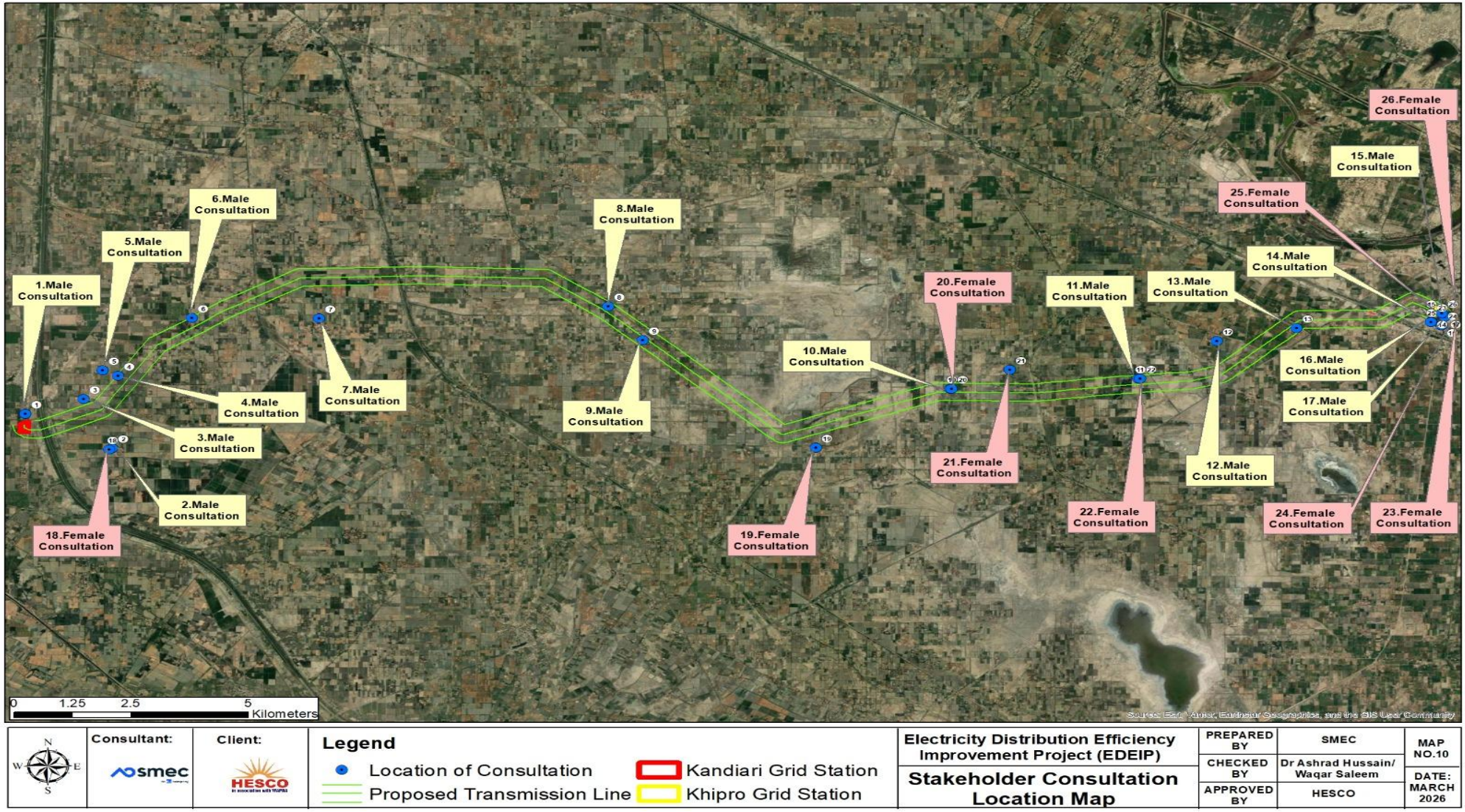

Figure 7-1 Location of Community Consultations Sessions

Table 7-3 Summary of Community Consultation with Men

Sr. No.	Concerns of the Locals	Response	Proposed Action	Responsibility
1	The local community requested the provision of skilled and unskilled employment opportunities during project implementation.	Priority for hiring labor will be given to the locals under the subproject guidelines to involve them in the project.	HESCO will ensure that contractors follow the code of conduct and local hiring policies.These commitments are included in the ESMP, which requires contractors to implement the CoC, prioritize local employment opportunities.	HESCO, PIMSC Contractor
2	PAPs expressed concern regarding the permanent loss of land and restrictions on its future use due to the installation of transmission line towers on their agricultural land.	The project team explained that the land required for tower foundations will be compensated in accordance with the approved ARAP	Affected land under towers, along with crops, will be compensated as per the ARAP/WB Policy.	HESCO
3	Due to the erection of conductors, dust and noise near their homes are a concern for the locals.	The community was assured that comprehensive mitigation measures for fugitive dust and construction noise are explicitly integrated into the project's ESMP (specifically within the Pollution Prevention and Traffic Management Plans).	Strictly execute site-specific dust suppression (watering) and noise control measures (restricted working hours near homes) as provided in the ESMP. Maintain the operationality of the project GRM to swiftly resolve any community complaints.	HESCO, PIMSC Social/Environment Experts

Sr. No.	Concerns of the Locals	Response	Proposed Action	Responsibility
4	Community members do not know where to file concerns.	A GRM has already been established and is in place.	GRM will be operationalized throughout the subproject implementation	HESCO, PIMSC and Contractor
5	Community members expressed concerns that the installation of transmission line towers within cultivated agricultural land could result in damage to standing crops, temporary disruption of farming activities, and potential loss of agricultural productivity.	Compensation for crop losses, temporary impacts on agricultural activities, and any applicable land value diminution associated with tower installation will be provided in accordance with the provisions of the approved ARAP and applicable compensation framework.	ARAPs will be implemented for appropriate compensation.	HESCO, PIMSC,
6	There is a fear that tower installations in the middle of fields will decrease the resale and investment value of land.	Maximum effort will be made to address this concern and compensation for land value loss will be included in the ARAP.	ARAPs will be implemented for appropriate compensation	HESCO
7	Towers and trenches may pose safety hazards.	The community was informed that strict safety protocols are mandated under the ESMP's Community Health and Safety Plan. These include mandatory hard barricading of active trenches, bilingual warning signage, and community safety awareness sessions prior to excavation.	Enforce the Community Health and Safety provisions of the ESMP. Ensure the Contractor installs robust physical barricades around all open pits/trenches, deploys reflecting night-signs, and conducts documented community safety briefings.	HESCO, PIMSC,

Sr. No.	Concerns of the Locals	Response	Proposed Action	Responsibility
8	The local community showed concerns that the contractors should be bound to ensure environmental and social compliance during construction activities.	It was explained that GRM has already been established to address the complaints of the PAHs, who will have complete access to it.	GRM will remain operational throughout the subproject cycle. A complete mechanism for addressing grievances is provided in ESIA and ARAP.	HESCO, PIMSC, &Contractor
9	Machinery and materials may block access routes.	The community was assured that under the project's ESMP provisions, the Contractor is contractually required to maintain unhindered public mobility by deploying clear signage and providing safe, alternative temporary access routes.	Enforce the Traffic Management and Community Access provisions of the ESMP. The Contractor must submit a site-specific traffic movement plan, install highly visible safety signs, and maintain the existing GRM to immediately resolve any access-related grievances.	HESCO, PIMSC, Contractor
10	How will the rates of crops and average yields be determined?	The average yields and rate of crops will be market-reflective and will be finalized with the involvement of relevant government departments.	HESCO will pay compensation as per the approved ARAP.	HESCO& Contractor

Sr. No.	Concerns of the Locals	Response	Proposed Action	Responsibility
11	Construction activities may block access to schools, religious places, and clinics.	The community was assured that specific provisions are embedded within the ESMP to protect access to sensitive institutional receptors. The Contractor is required to maintain safe, unhindered, and continuous access to these facilities at all times.	Enforce the Community Access and Traffic Management provisions of the ESMP. Require the Contractor to coordinate construction schedules around peak hours (e.g., school timings, Friday prayers), install safe pedestrian walkways with hard barricades, and utilize the operational GRM for immediate dispute resolution.	HESCO, PIMSC, and Contractor
12	High-voltage lines near residential areas are a major worry.	All safety measures will be taken to address the safety risks. Public awareness sessions on safety will be conducted.	Design of the subproject will ensure that all safety codes are implemented. Community awareness trainings will also be conducted.	HESCO, PIMSC, Contractor
13	Households fear that compensation payments may be delayed indefinitely.	Compensation payments will be paid before the start of construction works	ARAP will be fully implemented.	HESCO, PIMSC

Table 7-4: Summary of Consultations with Women

Sr. No.	Concerns Raised by Women Participants	Response	Proposed Action	Responsibility
1	Women highlighted that frequent power outages affect household activities, children's studies, the operation of fans during extreme summer temperatures, and access to healthcare services.	It was explained that the subproject aims to improve the reliability and stability of electricity supply in the area, thereby reducing outages and voltage fluctuations.	The subproject will be implemented as planned, and an improved power supply will be ensured through the operation of the upgraded grid station and associated transmission line.	HESCO
2	Women expressed concern regarding dust generated during construction, which may affect household cleanliness and cause discomfort, particularly for children and elderly family members.	It was explained that dust generation will be minimized through appropriate construction management practices.	ESMP includes measures such as regular water sprinkling, covering of construction materials, and monitoring of dust emissions to minimize impacts on nearby communities.	Contractor, HESCO, and PIMSC
3	Women were concerned about noise from construction activities that could disturb households, schools, and daily routines.	Construction activities will be planned to minimize disturbance to nearby residents.	ESMP includes measures such as restricting noisy activities to daytime hours, maintaining equipment properly, and monitoring noise levels during construction.	Contractor, HESCO, and PIMSC
4	Women requested that local residents be given preference for employment opportunities during construction to support household	It was explained that local labor will be employed where feasible and based on required skills and qualifications.	ESMP includes provisions encouraging contractors to provide employment opportunities to	Contractor and HESCO

	incomes.		local communities to the extent possible.	
5	Women expressed concerns regarding the safety of children near construction areas and the movement of construction vehicles.	ESIA team explained that safety measures would be implemented to protect community members throughout the construction period.	ESMP includes measures such as the installation of warning signs, barricades, controlled access to work sites, traffic management measures, and community safety awareness sessions.	Contractor, HESCO, and PIMSC
6	Women emphasized the need for timely information regarding construction schedules and temporary disruptions so that households can plan their daily activities accordingly.	It was explained that communities will be informed in advance of construction activities and any temporary disruptions.	ESMP and SEP include provisions for continuous stakeholder engagement, information disclosure, and operation of a Grievance Redress Mechanism (GRM) throughout project implementation.	HESCO, Contractor, and PIMSC

7.4.2 Departmental Consultations

Consultations were conducted with key relevant line departments and local institutions in the Sanghar district. These include Sindh Environmental Protection Agency, Social Welfare Department, Settlement and Survey Department, Revenue Department, Sanghar and Khipro, and Agriculture Department. Additionally, consultations were held with Sindh Agricultural and Forestry Workers Coordinating Organization and Sindh Rural Support Organization to incorporate the perspectives of civil society and Non-Governmental Organizations.

Specific concerns raised by departments included proper land acquisition and compensation processes, minimization of impacts on agricultural land and irrigation channels, tree plantation within and around the substation sites to offset any loss of vegetation, and ensuring dust, noise, and traffic management during construction. Departments also emphasized the need for local employment opportunities, safety measures for workers and nearby communities, and timely

coordination with local authorities before initiating construction activities. A summary of consultations with these stakeholders is given in Table 7-5.

Table 7-5: Summary of Departmental Consultations

Sr. No.	Stakeholder	Concerns and Suggestions	Response
1	Ali Muhammad Deputy Director Sindh Environmental Protection Agency	Deputy Director emphasized the importance of maintaining environmental standards for the proposed TL subproject during construction. He emphasized the following points. **1.** Maintain clean air, soil, and water quality. **2.** Compensation for the affected crops should be given at the market rate to the PAPs. **3.** During construction, job opportunities should be provided for the locals, and HESCO and Consultants should ensure compliance with the Construction Environmental and Social Management Plan (C-ESMP) by the contractor.	It was communicated to the Deputy Director that E&S considerations will be fully integrated into the subproject planning and implementation process through the following targeted measures: **1.** Regarding environmental quality**:** Specific parameters for air, soil, and water quality safeguarding are comprehensively covered under the mitigation and monitoring frameworks of this ESIA. 2. Regarding crop compensation: Compensation for all affected crops will be evaluated at true current market rates and provided to project-affected persons (PAPs) strictly as per the approved abbreviated resettlement action plan (ARAP). 3. Regarding local employment: Priority will be strictly given to the employment of unskilled and semi-skilled labor sourced from the local community to maximize local economic benefits. 4. Regarding framework enforcement: HESCO, through its Project Management Unit (PMU) and project implementation and management support

Sr. No.	Stakeholder	Concerns and Suggestions	Response
			consultants (PIMSC), will maintain strict, continuous oversight to ensure full field execution and compliance with the C-ESMP by the contractor.
2	Noor Muhammad Assistant Director Social Welfare Department, Sanghar	**1.** The alignment should avoid densely populated areas as far as practicable to minimize impacts on residential structures, community infrastructure and reduce displacement risks. **2.** Public safety must be ensured during construction, particularly for children and vulnerable groups. **3.** Address potential impacts on agricultural livelihoods due to temporary land use restrictions within the Right of Way (ROW). **4.** Ensure timely and transparent compensation to affected households to prevent grievances and social unrest. **5.** Strengthen the Grievance Redress Mechanism (GRM) to ensure accessible, fair, and timely resolution of complaints.	**1.** Regarding alignment and displacement: The 132 kV transmission line alignment has been finalized after rigorous technical and social assessments specifically to bypass densely populated areas as far as feasible. No physical displacement of residential structures or community infrastructure is expected. **2.** Regarding public and community safety: The contractor is strictly required to implement robust site safety protocols, including clear warning signage, physical barricading around active construction zones, and community safety awareness to protect children and vulnerable groups. 3 & 4. Regarding livelihood impacts and timely compensation**:** Any temporary impacts on crops, trees, or agricultural assets within the ROW will be compensated at full replacement cost. In strict accordance with the approved Abbreviated Resettlement Action Plan (ARAP) and World Bank ESS5, all compensation disbursements will be completed transparently prior to

Sr. No.	Stakeholder	Concerns and Suggestions	Response
			the commencement of civil works. **5.** Regarding grievance resolution**:** A multi-tier Grievance Redress Mechanism (GRM) has been established and will remain fully functional, culturally appropriate, and easily accessible throughout the subproject lifecycle to resolve any field complaints fairly and without delay.
3	Waheed Bugti Mukhtiarkar Revenue Department Sanghar and Khipro	**1.** Ensure accurate verification of land ownership and utilize updated revenue records to avoid legal or civil disputes during compensation disbursement for land and crops falling within the ROW. **2.** Compensation rates must accurately reflect prevailing market values to prevent grievances and dissatisfaction from affected landowners.	**1.** Regarding record verification and dispute prevention: The project team confirmed that all compensation processing will be strictly based on legally verified revenue records. Close, continuous coordination will be maintained with the concerned district revenue staff to ensure absolute transparency, meticulous documentation, and the timely resolution of any ownership-related issues or title discrepancies. 2. Regarding market-based rates and timing: It was verified that compensation for all affected assets, crops, and trees will be determined in strict accordance with approved valuation procedures, applicable land acquisition laws, and the provisions of the Abbreviated Resettlement Action Plan (ARAP). Furthermore, all payments will be fully disbursed to the verified landowners before the commencement of any civil or

Sr. No.	Stakeholder	Concerns and Suggestions	Response
			structural works in the affected transmission line sections.
4	Mr. Arsalan Gul Assistant Director Agriculture Department Sanghar	**1.** Address the high possibility of disputes arising from jointly owned or inherited land falling within the Right of Way (ROW). **2.** HESCO should implement explicit soil conservation measures during construction to minimize impacts on nearby agricultural areas	It was : 1. Regarding joint ownership and inheritance disputes: It was clarified that all compensation will be disbursed strictly based on officially verified land ownership records. In complex cases of joint or inherited ownership, disbursements will be split and paid in exact accordance with district revenue laws and documented legal shares. The project's multi-tier Grievance Redress Mechanism (GRM) will also be fully operational to handle and fast-track any related title complaints. 2. Regarding soil conservation measures**:** The team confirmed that potential impacts on agricultural topsoil are thoroughly assessed in Chapter 5, and explicit, actionable soil conservation protocols—including the stockpiling and reinstatement of fertile topsoil, strict compaction controls, erosion prevention, and proper machine maintenance to prevent fuel spills—have been fully integrated into the impact assessment, mitigation matrix, and the final Construction Environmental and Social Management Plan (C-ESMP) for mandatory contractor implementation
5	Rozo Dhani		The project team assured that

Sr. No.	Stakeholder	Concerns and Suggestions	Response
	Community Organization	The Rozo Dhani Community Organization raised concerns that temporary loss of crops and livelihood assets within the transmission line ROW could adversely affect vulnerable households, particularly women-headed families and low-income farmers.	all affected households will receive compensation for crop losses at replacement cost. However, during construction, if found any vulnerable groups, including women-headed households and low-income farmers, will receive additional assistance and livelihood restoration support in accordance with the approved ARAP and WB Policy.
6	Ms. Shanbana Samijo Project coordinator Rural Development Foundation , Sanghar	**1.** Ensure transparent project-related information sharing with the local population throughout the subproject lifecycle. **2.** Maintain active, meaningful community participation during all phases of project implementation.	1. Regarding transparent information sharing: The project team confirmed that comprehensive project information, social safeguards, and environmental disclosures will be made publicly available at the Project Management Unit (PMU) office, local HESCO offices, and on the official corporate website. Additionally, non-technical project summaries and brochure materials translated into local languages will be distributed across the subproject area. 2. Regarding active community participation: It was assured that meaningful, ongoing consultations will be actively conducted at the village level throughout the construction and operational phases. These sessions will ensure that local residents remain fully informed of scheduling, safety protocols, and the channels available to them. Furthermore, the localized Grievance Redress

Sr. No.	Stakeholder	Concerns and Suggestions	Response
			Mechanism (GRM) will remain fully staffed, functional, and accessible to transparently resolve any community concerns in a timely manner.
7	Mehrab Laghari Manager Sindh Rural Support Organization, Jamshoro	**1.** Mitigate potential adverse impacts on rural livelihoods, particularly for small-scale farmers and low-income households whose agricultural activities may be temporarily affected within the Right of Way (ROW). **2.** Prioritize continuous community awareness and active local participation to prevent the spread of misinformation and eliminate grievances at the village level.	1. Regarding rural livelihood protection: The project team assured that all affected households have been thoroughly mapped through the detailed census and socioeconomic survey. To offset temporary disruptions, full compensation for all crop losses, damaged trees, and associated agricultural impacts will be calculated at current market replacement values. These funds will be disbursed transparently to eligible small farmers and low-income households in strict accordance with the approved Abbreviated Resettlement Action Plan (ARAP) prior to the start of construction. 2. Regarding community awareness and transparency: The Social Expert confirmed that a robust stakeholder engagement plan is in place. Regular, culturally appropriate consultation sessions will be held directly within the local villages to share clear timelines and entitlement policies, thereby counteracting misinformation. Furthermore, project details will be publicly disclosed, and the multi-tier

Sr. No.	Stakeholder	Concerns and Suggestions	Response
			Grievance Redress Mechanism (GRM) will remain fully operational and accessible to all community members to guarantee a transparent, fair, and rapid resolution of any field concerns.
8	Ghulam Hussain Mustafa Regional Manager Sindh Agricultural and Forestry Workers Coordinating Organization	**1.** Potential temporary loss of agricultural productivity due to the installation of towers and land use restrictions within the ROW, particularly affecting small and medium farmers dependent on seasonal crops. **2.** Risks of secondary crop damage, degradation of soil fertility, and disruption of local irrigation channels caused by the movement of heavy machinery and the storage of construction materials.	1. Regarding agricultural productivity and livelihood compensation: It was explained that comprehensive crop compensation will be paid to all affected farmers to offset seasonal losses. In accordance with the approved ARAP, compensation will be calculated for one full year at current market rates based on the highest average crop yield over the past three years, or as officially assessed by the District Agriculture Department. All entitlement disbursements will be fully completed prior to the commencement of any civil works in the affected transmission line sections. 2. Regarding soil fertility, machinery movement, and irrigation safeguards: The team confirmed that these specific physical impacts are comprehensively covered under the project's Environmental and Social Management Plan (ESMP). The contractor will be strictly bound to follow designated access tracks to prevent

Sr. No.	Stakeholder	Concerns and Suggestions	Response
			widespread soil compaction, stockpile and reinstate fertile topsoil, restore any accidentally damaged irrigation channels immediately to their original condition, and avoid placing material storage yards near active agricultural fields or natural drainage lines.
9	Mr. Muhammad Suleman Director Survey and Settlement Department, Hyderabad	**1.** Ensure absolute accuracy in land ownership records and precise demarcation of the ROW for the 132 kV Kandiari to Khipro Transmission Line to prevent outdated or disputed records from causing community grievances, compensation delays, or legal complications during project implementation. **2.** Address and mitigate potential adverse impacts on local agricultural productivity and critical irrigation infrastructure within the ROW, particularly across the fertile areas of Khipro Taluka.	1. Regarding cadastral verification and dispute prevention: It was clarified that a comprehensive cadastral verification and joint field measurement exercise will be executed in direct coordination with the provincial Revenue and Survey Departments. Fully updated land records will be secured before finalising any compensation packages. Any identified discrepancies or title disputes will be transparently resolved via proactive consultations with the affected landowners, and all compensation processing will strictly comply with provincial regulations and World Bank safeguard standards to guarantee fairness. 2. Regarding agricultural and irrigation safeguards in Khipro Taluka: The project team explained that tower spotting has been optimized specifically to bypass or minimize footprint impacts on highly cultivated lands and active irrigation channels. Any temporary

Sr. No.	Stakeholder	Concerns and Suggestions	Response
			physical disruptions occurring during the construction phase will be fully restored to their pre-project condition by the contractor. Furthermore, fair compensation for crop losses and temporary land use restrictions will be distributed based on approved market rates, supported by ongoing institutional coordination with the Irrigation and Agriculture Departments.
10	Dr. Ali Asghar Mahesar General Manager (Research & Development) Sindh irrigation and drainage authority	1. Expressed strict concern regarding the placement of transmission line towers, stating that no towers should be erected directly on or dangerously close to canal embankments, dykes, or active flood protection bunds to prevent structural weakening or erosion.	1. It was clarified that the routing of the 132-kV transmission line actively avoids canal embankments, and a safe setback distance/buffer zone will be maintained from all irrigation infrastructure.
11	Nadeem Tareen, Director, NHA National Highway Authority	1. Concern over potential traffic congestion, damage to the highway shoulders, or safety hazards caused by slow-moving construction cranes, trailers, and dumper trucks turning onto or off the national highway near the project site**.**	1. A comprehensive Traffic Management Plan (TMP) will be enforced as part of the contractor's site management. Mitigation measures include the deployment of trained flagmen, clear reflective diversion signage, and scheduling heavy machinery transport outside of peak commuter hours. Any accidental damage to highway shoulders or infrastructure during construction will be fully restored to its original

Sr. No.	Stakeholder	Concerns and Suggestions	Response
			condition by the contractor.
12	Ghulam Nabi Siyal Regional Director, Labor Department, Qasimabad, Hyderabad	1. Concerns were expressed regarding occupational health and safety, particularly in relation to electrical installations and high-risk construction operations involving heavy machinery. 2.The Regional Director stressed the importance of ensuring fair wages for workers and strict adherence to legal working hours in accordance with applicable labor laws.	1. The contractor will implement an Occupational Health and Safety (OHS) Management Plan to ensure safe working conditions. All workers will be provided with appropriate personal protective equipment (PPE), safety training, and access to first-aid facilities. All construction activities will comply with applicable labor safety regulations and recognize the best international practices. 2.All workers will be remunerated in accordance with government-notified wage rates, and working hours will be strictly aligned with applicable labor laws. Any overtime work, where necessary, will be compensated as per legal provisions.
13	Noor Muhammad Hingrjo Chief Librarian (BPS -19) Government Degree College, Khipro	1. Highlighted that severe power outages and low voltage during hot seasons make classrooms unbearable for students, leading to heat exhaustion, poor concentration, and lower attendance.	1. It was explained that the core objective of the 132-kV Khipro subproject is to eliminate local power deficits. The addition of the new 20/26 MVA transformer will stabilize line voltage and significantly reduce load shedding across the local grid, directly improving the classroom environment, cooling facilities,

Sr. No.	Stakeholder	Concerns and Suggestions	Response
			and overall learning conditions for students.
14	Dhani Bux Kundar, Executive Engineer, Civil Department, HESCO	HESCO executive engineer emphasized the need to ensure strict implementation of the ESMP during all phases of project implementation. The team highlighted the following concerns: 1. Control dust, noise, and air emissions during construction activities. 2. Ensure proper management of construction waste and hazardous materials. 3. Prevent contamination of agricultural land and water resources. 4. Conduct regular environmental monitoring and reporting throughout the project cycle.	The E&S team acknowledged the recommendations and confirmed that all contractors will be contractually bound to implement the approved ESMP. Dust suppression, noise control, waste management, and pollution prevention measures have been incorporated into the ESIA. Regular environmental monitoring will be carried out by the Contractor, Construction Supervision Consultant, and HESCO PMU, with corrective actions implemented where necessary.
		He also highlighted the importance of ensuring effective implementation of social safeguards and stakeholder engagement activities. He said that PMU should follow the following points: 1. Ensure timely payment of compensation before commencement of works. 2. Maintain continuous engagement with local communities throughout project implementation. 3. Strengthen awareness regarding the GRM.	It was explained that all compensation and assistance measures will be implemented in accordance with the approved ARAP and World Bank ESS5 requirements. Community consultations will continue throughout project implementation under the SEP. The GRM will remain accessible and widely publicized in local communities.

7.5 Future Consultations

Stakeholder engagement and consultations are ongoing activities and will continue to be carried out during the subproject construction and O&M phases, in accordance with the SEP. An indicative framework is presented in Table 7.6, listing these consultations; it will be finalized before commencing the construction activities/site mobilization.

Table 7-6: Consultation Framework

Description	Target Stakeholders	Timing	Responsibility
Stakeholder consultations as part of the preparation of each subproject-specific E&S instrument, including ESMP and ESIA	Affected communities; Secondary stakeholder	During the preparation of ESIA/ESMP/ARAP	PIMSC/HESCO
Public awareness sessions to share the ESMP, ESIA and GRM with the communities and other stakeholders. • Location: various places in the subproject area	Communities within the subproject area, the general public, and line departments/ agencies.	During the preparation of ESIA/ESMP, to be continued thereafter	PIMSC/HESCO
Consultations regarding GRM • Location: various places in the subproject area	Communities at/around the subproject area	Before the commencement of subproject activities.	PIMSC/HESCO
• Consultations regarding GRM operation • Location: various places in the subproject area	PMU staff, consultants, relevant line departments, and communities.	Subproject Implementation Stage	PIMSC/HESCO
• Informal consultations and discussions. • Location: various places in the project	Communities at/around the subproject area	Subproject Implementation Stage	PIMSC/ HESCO; contractor

Description	Target Stakeholders	Timing	Responsibility
area			
• Consultations with the communities during internal monitoring • Location: various places in the subproject area	Communities at/around the subproject area	Construction Stage	PIMSC/HESCO
• Consultations with the Communities during the Independent Monitoring (if required) • Location: various places in the project area	Communities at/around the subproject area	Construction Stage	Independent monitors
Consultation workshops to review ESIA/ESMP/RP implementation, any outstanding issues and grievances, views and concerns of communities, and actions needed to address them. • Location: site offices in the project area.	Communities at/around the subproject area; relevant line department; relevant NGOs	Six-monthly during the implementation phase	PIMSC/HESCO

7.6 Information Disclosure

The present ESIA and its executive summary in the local language (Sindhi and Urdu) will be disclosed on the HESCO website. These documents will be placed at the HESCO office, the contractor's site office and the worksites.