GOVERNMENT OF PAKISTAN

MINISTRY OF WATER AND POWER

Tarbela 5th Extension Hydropower Project

ENVIRONMENTAL AND SOCIAL ASSESSMENT

February 2016

Water and Power Development Authority (WAPDA)

National Transmission & Despatch Company (NTDC)

Table of Contents

List of Tables

List of Figures

List of Acronyms

ADB	Asian Development Bank
ADI	Area of Direct Impact
AIS	Air Insulated Switchgear
AIS	Alien Invasive Species
AM	Angle Marker
AoI	Area of Influence
APHA	American Public Health Association
APLIC	Avian Power Line Interaction Committee
BAP	Biodiversity Action Plan
BCM	Billion Cubic Metres
BDL	Below Detection Limit
BH	Bore Hole
BHU	Basic Health Unit
BMP	Blast Management Plan
BOD	Biological Oxygen Demand
BoQ	Bill of Quantities
BP	Bank Procedure
CBD	United Nations Convention on Biological Diversity
CDAP	Community Development Assistance Program
CCGT	Combined-Cycle Gas Turbine
C-ESMU	Contractor's Environmental and Social Management Unit
CEAP	Construction Environmental Action Plan
CIA	Cumulative Impact Assessment
CITES	Convention on International Trade of Endangered Species of Wild Fauna and Flora
CLO	Community Liaison Officer
CMS	Convention on the Conservation of Migratory Species of Wild Animals
CO	Carbon Monoxide
CSS	Customer Service Selection
CTMP	Construction Traffic Management Plan
DCO	District Coordination Officer
DHP	Dasu Hydropower Project
DW	Dug Well
ESIC	Environmental and Social Impact Cell
EBMP	Ecological/Biodiversity Management Plan
ECA	Employment of Child Act (1991)
ECP	Environmental Code of Practice
E-ESMU	Engineer's Environmental and Social Management Unit
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMF	Electromagnetic Fields
EPC	Engineer Procure Construct

EPRP	Emergency Preparedness and Response Plan
EPRP	Emergency Preparedness and Response Plan
ERP	Tarbela Dam Emergency Response Plan
ESA	Environmental and Social Assessment
ESHS	Environmental, Social Health and Safety
ESMP	Environmental and Social Management Plan
ESMU	Environmental and Social Management Unit
EWC	European Waste Catalogue
FESCO	Faisalabad Electric Supply Company
FFC	Federal Flood Commission
FRAEA	Filing, Review and Approval of Environmental Assessments (1997)
FSL	Full Service Level
GBHP	Ghazi Barotha Hydropower Project
GBTI	Ghazi Brotha Tarqiati Idara
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GIIP	Good International Industry Practice
GIS	Gas Insulated Switchgear
GMRC	Glacier monitoring and Research Center
GoP	Government of Pakistan
GPS	Global Positioning System
GT	Grand Trunk
GTBI	Ghazi Barotha Tarqiati Idara
H&S	Health and Safety
Ha	Hectare
HPP	Hydro Power Plant
HRRP	Habitat Removal and Restoration Plan
HRT	Headrace Tunnel
HSE	Health and Safety Executive
IAQM	Institute of Air Quality Management
IBA	Important Bird Areas
IBWS	Indus Basin Water System
ICNIRP	International Commission on Non-Ionising Radiation Protection
ICUN	International Union for Conservation of Nature and Natural Resources
IEE	Initial Environmental Examination
IESCO	Islamabad Electric Supply Company
IFC	International Finance Corporation
ILO	International Labour Organisation
IPCC	Intergovernmental Panel on Climate Change
IRR	Internal Rate of Return
IRSA	The Indus River System Authority

ISSG	Invasive Species Specialist Group
IUCN	International Union for Conservation of Nature and Natural Resources
KBA	Key Biodiversity Areas
KP-EPA	Khyber Pakhtunkhwa Environmental Protection Agency
KPEPC	Khyber Pakhtunkhwa Environment Protection Council
KPEQS	Khyber Pakhtunkhwa Environmental Quality Standards
KPI	Key Performance Indicators
kV	Kilovolts
LGA	Local Government Act
LLO	Low Level Outlets
M1	Motorway 1
MAF	Million Acre Feet
Masl	Metres above sea level
MDE	Maximum Design Earthquake
Mm^3	Million metres cubed
MML	Mott MacDonald Limited
MMP	Mott MacDonald Pakistan (Private) Limited
MOL	Minimum Operating Level
MoWP	Ministry of Water and Power
MSDS	Material Safety Data Sheets
MSW	Municipal Solid Waste
MW	Megawatts
NARC	National Agricultural Research Centre
NCRs	Non Compliance Reports
NCS	National Conservation Strategy
N-ESMU	NTDC PMU's Environmental and Social Management Unit
NEP	National Environmental Policy
NEQS	National Environmental Quality Standards
NGO	Non-governmental Organisation
NGVS	No Guideline Value Set
NO2	Nitrogen Dioxide
NOC	No Objection Certificate
NOx	Nitrogen Oxides
NRP	National Resettlement Policy
NTDC	National Transmission and Dispatch Company
OBE	Operational Basis Earthquake
OBIA	Object Based Image Analysis
OE	Owner's Engineer
OESMP	Operational Environmental and Social management Plan
OHS	Occupational Health and Safety
OP	Operational Policy
OPL	Official Poverty Line
PAD	Project Appraisal Document

Pak-EPA	Pakistan Environment Protection Agency
PAP's	Project Affected Persons
PCRWR	Pakistan Council of Research in Water Resources
PEPA	Pakistan Environmental Protection Act 1997
PM10	Respirable particulate matter 10
PM2.5	Respirable particulate matter 2.5
PPE	Personal Protective Equipment
PPV	Peak Particle Velocity
PRER	Guidelines for the Preparation and Review of Environmental Reports
PSQCA	Pakistan Standard Quality Control Authority
QC	Quality Control
RAMSAR	Wetlands of International Importance
RAP	Resettlement Action Plan
RCC	Resettlement Claim Commissioners
RESU	Regional Environment Sector Unit
ROW	Right of Way
S.R.O	Statutory Notifications
SCA	Sensitive and Critical Areas
SCARP	Monitoring Organization
SDPI	Sustainable Development Policy Institute
SEP	Stakeholder Engagement Plans
SIA	Social Impact Assessment
SIMF	Social Impact Assessment Framework
SO2	Sulphur Dioxide
SPM	Suspended particulate matter
SSESA	Sectoral environmental and social assessment
SSG	Species Survival Commission
SUPARCO	Pakistan Space and Upper Atmosphere Research Commission
SWMP	Site Waste Management Plan
T4CJV	Tarbela 4th Extension Consultants Joint Venture
T4HP	Tarbela 4th extension hydropower project
T5	Existing irrigation Tunnel 5
TDP	Tarbela Dam Project
TESCO	Tribal Areas Electric Supply Company
TMP	Traffic Management Plan
TRT	Tailrace Tunnel
TW	Tube Well
TWL	Tail Water Level
UIB	Upper Indus Basin
VEC	Valued Environmental and Social Component
W-ESMU	WAPDA PMU's Environmental and Social Management Unit
WAPDA	Pakistan Water and Power Development Authority
WB	World Bank

WCAP	Water Capacity Building Project
WEC	WAPDA Environment Cell
WHO	World Health Organisation
WWF	World Wildlife Fund for Nature

1 Introduction

The Pakistan Water and Power Development Authority (WAPDA) and National Transmission and Dispatch Company (NTDC) with funding from the World Bank (WB) plan to undertake Tarbela 5th Extension Hydropower Project (T5HP) by developing an extension to the power generating capacity of the Tarbela Dam. The additional capacity will be achieved by converting the 5th irrigation tunnel of the Tarbela Dam for hydropower generation. WAPDA and NTDC have undertaken an environmental and social assessment (ESA) of the Project in accordance with World Bank Operational Policies and Pakistan regulations. The present ESA report documents the process and outcome of this assessment.

Included in the scope of the ESA are the temporary and permanent works and infrastructure required to construct and operate the primary power generation infrastructure (located in the vicinity of the Tarbela Dam), and the associated facilities that will be required to evacuate the generated power to the grid including a transmission line and a grid station.

1.1 Background

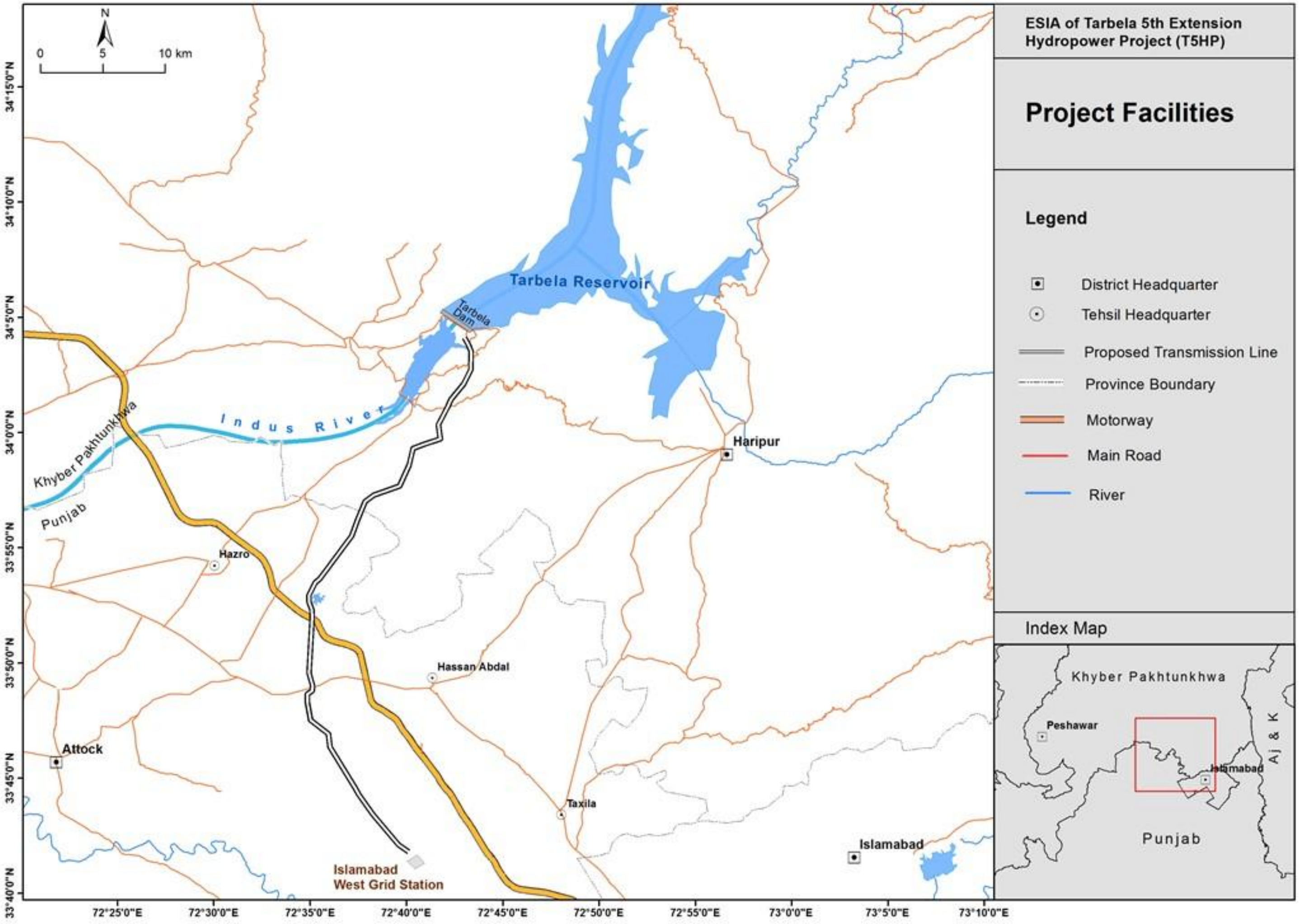
The Tarbela Dam is one of the largest earth-fill dam constructions in the world. The dam is situated on the Indus River in the province of Khyber Pakhtunkhwa (KP) at a distance of about 70 kilometers (km) NW of Islamabad and about 50 km upstream of the city of Attock (see **Figure 1.1**). The reservoir behind the dam is almost 100 km long and measures 243 km^2 when completely filled. The live storage capacity of the reservoir was initially 11.9 billion m^3 (about 9.65 million acre-feet or MAF), but this has been reduced due to siltation during 35 years of operation to 6.8 billion m^3 (about 5.51 MAF). The Tarbela Dam is 2,743 m long, 143 m high above the river bed and has two spillways cutting through the left bank and discharging into a side valley.

At the right bank there are four tunnels, each of about 900 m length as bypass for irrigation releases and/or power generation. Tunnel 5 used for irrigation releases is situated at the left bank. In three of the four tunnels on the right bank the water can be used for both irrigation and for power generation. Tunnels 4 and 5 were originally designed for irrigation supply.

The Tarbela Dam Project (TDP) was developed during the seventies of the last century in the framework of the Indus Basin Water Master Plan. Initially the main purpose of TDP was to supply irrigation water to the densely populated agricultural areas in Punjab and Sindh provinces. Then, starting in the mid-eighties power generation capacity was added in three subsequent hydro-electrical project extensions, installing a total of 3,478 mega-watts (MW) generating capacity on respectively Tunnel 1 (four turbines), Tunnel 2 (six turbines) and Tunnel 3 (four turbines).

Currently, WAPDA is implementing the Tarbela 4th Extension Hydropower Project (T4HP) by converting the 4th tunnel for hydropower generation. The proposed T5HP intends to utilize the existing 5th tunnel for power generation.

Figure 1.1:T5HP Location Map



1.2 The Proposed Project

The proposed project (T5HP) would support the scaling up of power generation capacity by adding 1,410 MW to an existing tunnel number 5 (T5) of Tarbela Dam on Indus River. The T5 is presently being used to release water for irrigation only when the reservoir level is below the minimum spillway operating level and water releases from the existing power units is not adequate. With T5HP power house installed, the T5 (and overall TDP) would continue to carry out the same function and in addition water released from spillway would be diverted through the tunnel 5 and only remaining water would be passed over the spillway. This would maximize use of the existing TDP facilities and provide the critically needed power for the country. It will generate approximately additional 1,800 GWh of electricity utilizing the same water flows at a very low cost compared to alternative generation from thermal or other hydropower projects, that is because all other infrastructure such as dam and tunnel are already constructed. Most importantly the gestation period of the project is short (39 months from the start of construction); this would help alleviate the severe black outs and highly costly self-generation.

The primary components of the T5HP Project are:

- Power Generation Component
    - Raised Intake
    - Powerhouse
    - Tailrace channel
    - Switchyard
- Power Evacuation Component
    - Transmission lines (500-kV) from Project switchyard to Islamabad West Grid Station, whichlocated about 30 km northwest of Islamabad
    - Islamabad West Grid station (765 and 500 kV).

The power generation facilities at TDP (intake, powerhouse, tailrace and switchyard) will be implemented by WAPDA whereas power evacuation facilities (transmission line and grid station) will be implemented by NTDC.

Another important advantage in development of T5HP is that power generation part of the project will be free of resettlement and litigation problems, which are often major causes of delay in hydro-electric projects. Environmental and social issues are relatively minor, since most of the infrastructure is already in place. Basic infrastructure and other facilities like offices, labor camps and residential accommodation are largely available and only have to be renovated and possibly expanded against modest cost. The installation of additional generating capacity will not influence the irrigation release capacity of the dam.

1.3 The Environmental and Social Assessment

Potential adverse effects of the T5HP project are described in the present Environmental and Social Assessment (ESA) report. Possible mitigating measures to offset, reduce or compensate these impacts are included in the Environmental and Social Management Plan (ESMP). The power generation element of the project will be implemented on the left bank of the Indus River in a limited area concentrated around the inlet and outlet of tunnel 5 of the Tarbela Dam. The proposed transmission line for power evacuation will be about 50 km long and will mostly follow alignment of existing transmission lines.

Direct and indirect impacts of the project will mainly occur in the immediate surrounding (few km) of the power generation facility and along the transmission line corridor with the exception of some borrow areas and quarries for construction materials situated at larger distance. To understand the impacts of proposed developments, an area of 5 km upstream and 10 km downstream of the dam has been studied during the ESA. In addition, about 500 m wide corridor along the proposed transmission line route has been taken as the study area for the present ESA. Most negative environmental and social impacts of the project will be experienced during the period of construction, and will mostly be temporary and reversible in nature.

Negative impacts during operation and maintenance of the project will be very limited. The project is also not expected to contribute to any cumulative impacts since operational regime of Tarbela will not change by the T5HP. However, the positive impacts of the Project will be very substantial due to production of clean and cheap low-carbon hydro power. This is especially true when compared with alternative means of generating electricity through thermal power stations (coal, oil, gas fired). The direct adverse social impacts of the project are also expected to be relatively minor. Most of these impacts will occur during construction and are associated with the contractor's operations and the interaction of the work force with the local communities.

The terms of reference for the ESA study is given in **Annex 1**. purpose of this ESA is to present the main aspects of the environmental and social assessment process, and to define the key management, mitigation and enhancement measures for predicted impacts. The environmental and social assessment process outlined in this document aims to satisfy the following objectives:

- To comply with the requirements of provincial Environmental Protection Acts as well as WB standards for undertaking an ESA for Category A projects
- To identify and assess environmental and social impacts (including labour, health, safety and security), both adverse and beneficial in the Project's area of influence
- To avoid, or where avoidance is not possible, minimize, mitigate or compensate for adverse impacts on workers, affected communities, and the environment
- To ensure that affected communities are appropriately engaged on issues that could potentially affect them
- To promote improved social and environmental performance through the effective use of natural resources, social networks and management systems.

1.4 Project ESA Study Area

The ESA study area comprises an Area of Direct Impact (ADI) and an Area of Influence (AoI):

- ADI: The ADI for the Project is defined as the location of all constructionand spoil disposal areas, including workers camp and batch plant areas, plus a 1km buffer (**Figure 1.2**), and also the right of way of power evacuation route and grid station site to account for any direct impacts during installation of new conductors, foundation strengthening, and also O&M activities.
- AOI: The AoI of the project covers an area about 5km upstream, 10km downstream of the dam and 2km on each side of the Indus River (right and left banks), and also the length of the power evacuation route plus a 500m buffer (**Figures 1.3** and **1.4**).

Figure 1.2:Area of Direct Impact – Power Generation Facilities

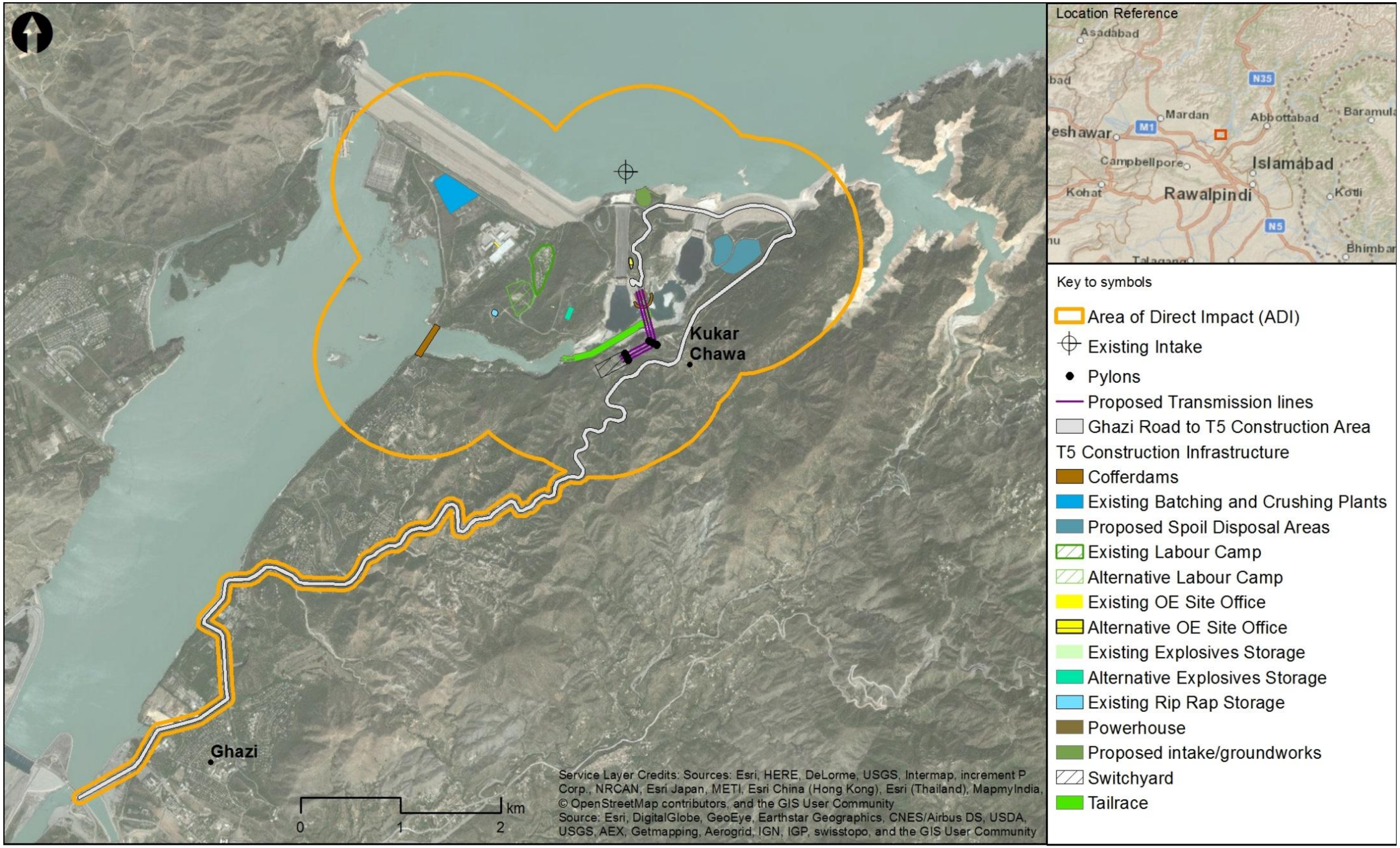


Figure 1.3:Area of Influence - Power Generation Facilities

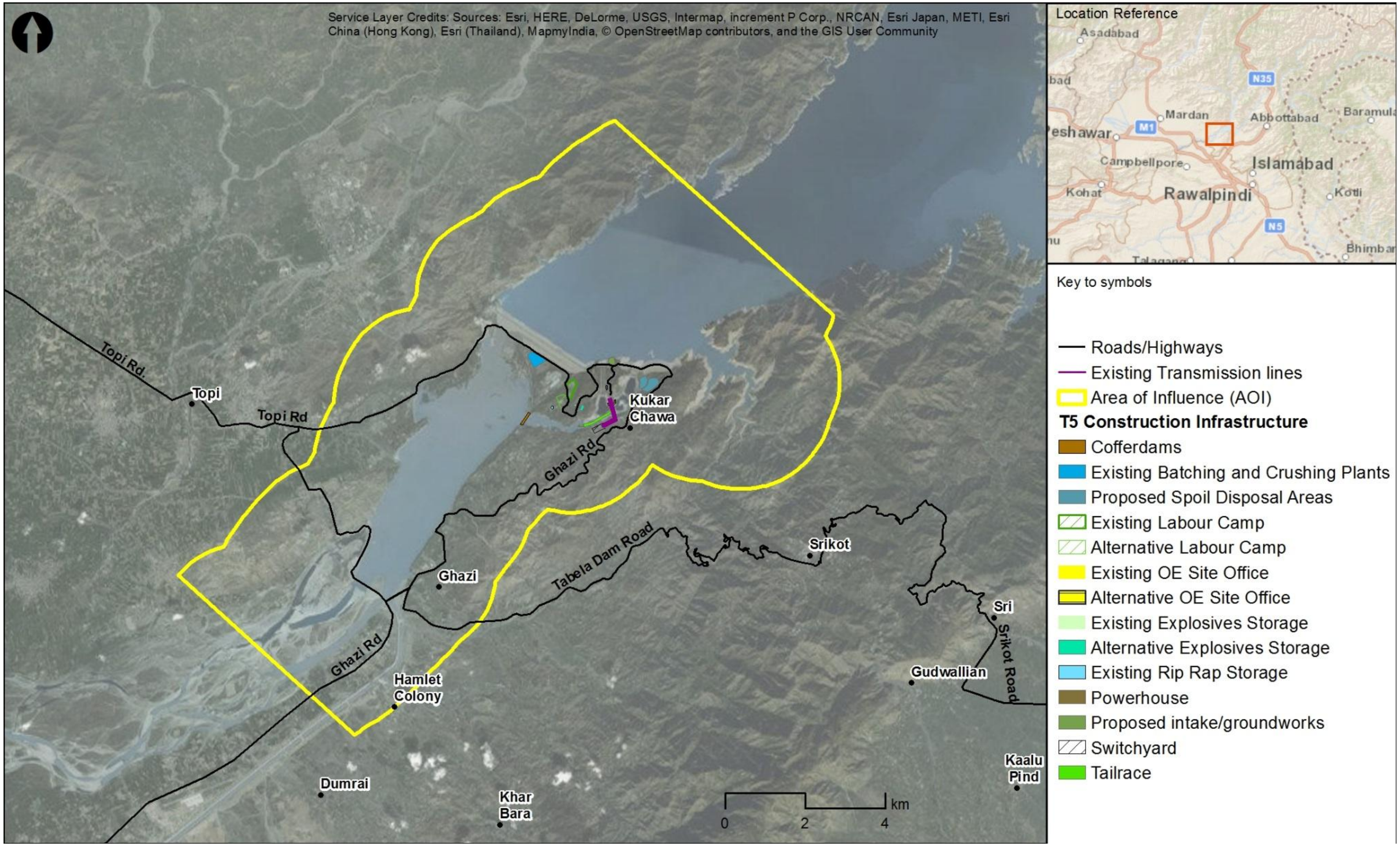
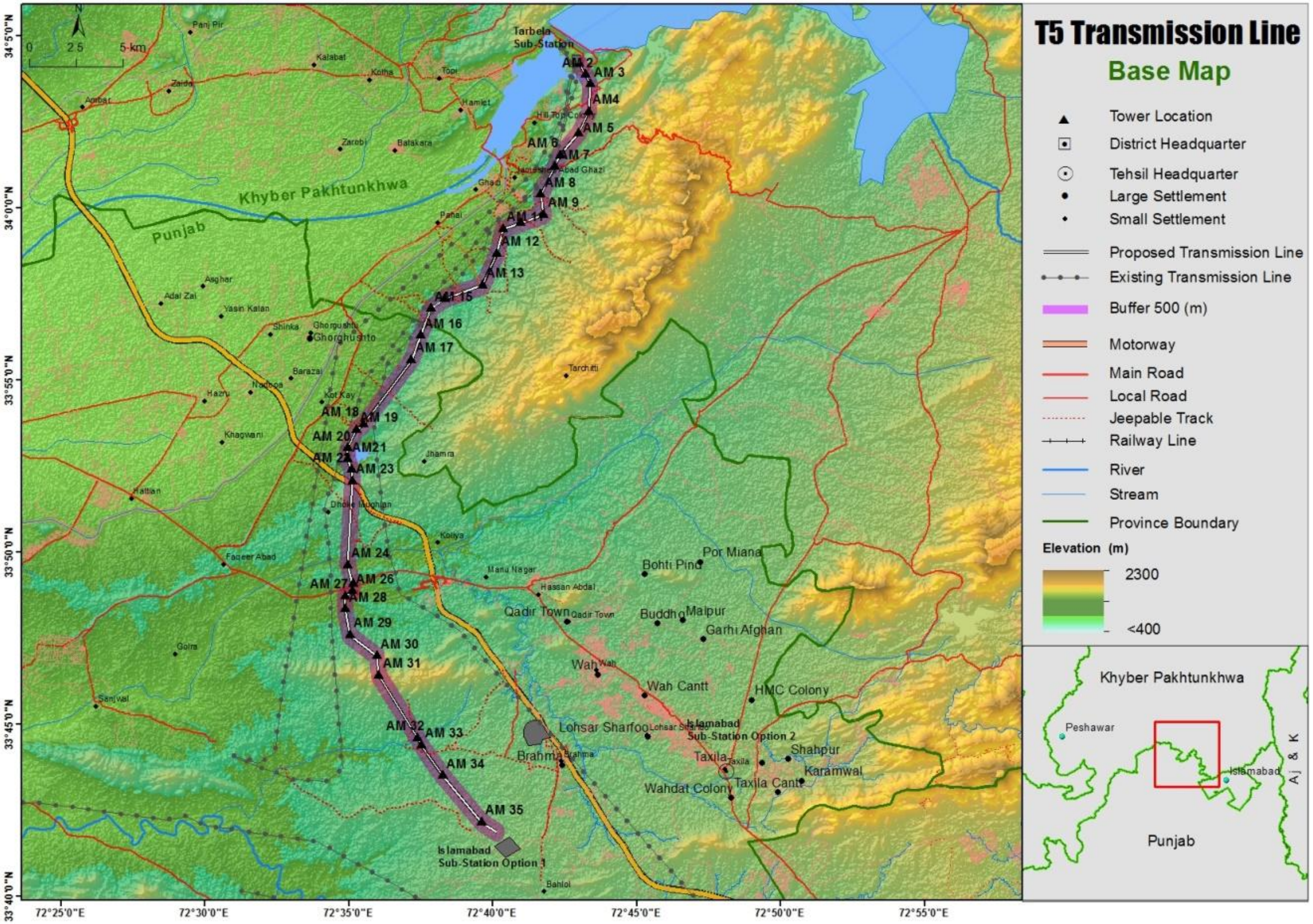


Figure 1.4:Area of Influence –Power Evacuation Facilities



1.5 Composition of Study Team

WAPDA engaged a team of independent consultants – Dr. Venkata Nukala (team leader), Mr. Abdul Hameed (social) and Mr. Mohammad Ali Durrani (Environment) – to assess the environmental as well as social impacts of the project, to prepare the environmental and social management plan, and to compile the main ESA report as well as the Summary ESA report. In addition, Mr. Ayaz Asif (environment), Dr. Ali Nawaz (ecology), and Prof. Zahid Beg Mirza (birds) were also engaged for this ESA. The environmental and social staff of Project Management Unit (PMU) of Dasu Transmission Line Project - Mr. Muhammad Atif Raza (environment), Mr. Fawad Ahmed (social) and Ms. Misbah Amanat (environment) – have also participated in field studies.

The baseline data collection, project description compilation, stakeholder consultations, and initial impact assessment was carried out by a team led by Mr. Azmat Beg (environment) with core support from Mr. Ihsan-ul-Haq Farooqi and Ms. Marielle Rowan (sociology), and Mr. Mr. Omer Rasheed, and Mr. Mark Barnard (environment). Ecology surveys were carried out by Dr. Zaheer-ud-din Khan (Flora), Dr. Abdul Aleem Chaudhry (Fauna) and Prof. Dr. Muhammad Ashraf and Dr. Ali Hussain (aquatic ecology). Noise, air quality and water quality surveys were carried out by personnel from the Pakistan Space and Upper Atmosphere Research Commission (SUPARCO); Mr. Ishtiaq Ahmad (air quality), Mr. Farooq Majeed (noise) and Mr. Mumtaz Hussain (water quality).

1.6 Document Structure

Chapter 2 reviews the prevailing WB policies and national regulatory requirements relevant to environmental assessment. Chapter 3 presents a simplified description of the project, its various components and other salient information relevant for environmental assessment. Analysis of alternatives considered during project planning and design are described in Chapter 4. Description of the baseline environmental conditions is presented in Chapter 5. Risks from climate change and earthquakes are described in Chapter 6.Potential environmental and social issues from the Project implementation as well as the appropriate mitigation measures to address these negative impacts have been discussed in Chapter 7. Potential social impacts and mitigation measures are discussed in Chapter 8.Cumulative impact assessment of T5HP along with other existing future planned projects on upstream and downstream of Tarbela are discussed in Chapter 9. Chapter 10 presents the outline of the environmental and social management plan (ESMP) for power generation component, and Chapter 11 presents ESMP for power evacuation facilities. Finally, Chapter 12 describes the consultations that have been carried out with the stakeholders.

2 Policy, Legal and Administrative Framework

This chapter summarizes relevant local and national Pakistani legislation and international and financing obligations relevant to the ESA and environmental and social management of the Project. It also provides the institutional framework for the management of the Project over its lifecycle.

2.1 Pakistani Legislation

2.1.1 Overview

Pakistan has in place a policy and legislative framework for the protection of the environment and social issues which the Government of Pakistan (GoP) is continuing to develop. This section is structured around the legislative hierarchy. An overview of relevant national level policy is presented, followed by separate discussion of national and regional environmental and social legislation applicable to the Project and supporting guidance documents. National and regional regulatory authorities with mandate to oversee implementation of and compliance with, environmental and social legislation are introduced at the end of the section.

2.1.2 Constitution

Whilst the constitution of the Islamic Republic of Pakistan (as modified up to the February 2012) is silent on the topic of environmental protection, it does support the "promotion of social justice and eradication of social evils" (paragraph 37) and requires that the state makes "provision for securing just and humane conditions of work, ensuring that children's and women are not employed in vocations unsuited to their age or sex, and for maternity benefits for women in employment" (Paragraph 37(e)).

2.1.3 National Hydropower Programme

Overview

WAPDA is mandated to coordinate and give a unified direction to the development of schemes in Water and Power Sectors. The primary development role of WAPDA is now focusing on hydropower development and water sector projects to support the national economy and poverty alleviation. The National Hydropower Programme has been developed to deliver this aim.

Vision 2025

WADPA's Vision 2025 program promises to develop 65 million acre feet (MAF) of additional water storage capacity in the Indus Basin and add at least 37,770 megawatts (MW) of hydropower generation capacity to the national grid by 2025. A major challenge to realizing Vision 25 is how to develop a hydropower program of this magnitude while meeting growing expectations from donors and society alike, to incorporate sustainability into projects and maintain a broad spectrum of environmental and social values.

Strategic Sectoral Environmental and Social Assessment

The Strategic Sectoral Environmental and Social Assessment (SSESA) of the Indus Basin (SMEC, 2014) was commissioned to examine the challenges in meeting Vision 25 and presents a suite of 40 recommendations to increase the efficiency and efficacy of the existing processes and to optimize the overall environmental and social performance of the hydropower program on a basin-wide scale. The recommendations represent a paradigm shift away from a traditional project-based engineering approach to a more holistic systemic approach. HPP planning at the basin-wide scale, integrating potential social and environmental issues across multiple projects and the entire Indus Basin is advocated.

2.1.4 Environmental and Social Policy Framework

Environmental and social policies guiding the legislative framework in Pakistan are summarized in **Table 2.1**.

Table 2.1:National policies relevant to the Project

Policy name (year)	**Content Summary**
National Conservation Strategy (1992)	The Pakistan National Conservation Strategy (NCS) is the principal policy document for environmental issues in the country and was developed and approved by the Government of Pakistan on March 01, 1992. The NCS deals with 14 core areas: • Maintaining soils in cropland • Increasing irrigation efficiency • Protecting watersheds • Supporting forestry and plantations • Restoring rangelands and improving livestock • Protecting water bodies and sustaining fisheries • Conserving biodiversity • Increasing energy efficiency • Developing and deploying material for renewable energy • Preventing/abating pollution • Managing urban wastes • Supporting institutions for common resources • Integrating population and environmental programs • Preserving cultural heritage.
National Environmental Policy (NEP) (2005)	The NEP was implemented in 2005 to provide an overarching framework for addressing Pakistan's environmental issues. It provides directions for addressing sectorial issues and provides a means for promoting conservation and environmental protection in water, air and waste management, forestry, and transport. The NEP aims to promote protection of the environment, the honouring of international obligations, sustainable management of resources and economic growth.
National Water Policy 2002 (NWP)	Objectives of the NWP include, amongst others, efficient management and conservation of existing water resources, optimal development of potential water resources and improved flood control and protective measures.
National Forest Policy 2010 (NFP)	The NFP establishes the policy framework for the restoration, development, conservation and sustainable management of forests and allied natural resources. It seeks to ensure the sustainability of ecosystem functions, services and benefits for present and future generations.
National Resettlement	Resettlement and compensation rights of people affected by development projects are presently covered by the Pakistan Land

Policy (NRP) (drafted 2002; not adopted to date)	Acquisition Act which dates from 1894. The NRP is being developed to update Pakistan's policy on resettlement and compensation and bring it into line with international standards. The aims of the NRP include: To ensure the consistent treatment of resettlement issues throughout Pakistan To ensure project affected persons (APs) are appropriately compensated for lost assets and income To provide development opportunities to all vulnerable groups To ensure that APs share the social and economic benefits of projects. The NRP will be supplemented by the Project Implementation and Resettlement of Affected Persons Ordinance (PIRAPO) which is to be enacted by provincial and local governments. However, the draft NRP specifies that the PIRAPO shall be supplementary to rather than a replacement for, the Land Acquisition Act and other established laws relevant to land acquisition and resettlement.
National Climate Change Policy, 2012	In September, 2012 Government of Pakistan launched its National Climate Change Policy. Environmental assessment is integrated in the preamble of the policy. The policy commits for taking appropriate measures for mitigation and adaptation to climate change through tools of environmental assessment.

2.1.5 Environmental Legislation

Khyber Pakhtunkhwa Environmental Protection Act2014 and Punjab Environmental Protection Act 1997 (Amended 2012)

The Khyber Pakhtunkhwa Environmental Protection Act 2014 (KPEPA 2014) and Punjab Environmental Protection Act of 1997 (Amended 2012) are the provincial versions of the Pakistan Environmental Protection Act, 1997 (PEPA) relevant to the Project. Responsibility for PEPA was transferred from the Ministry of Environment to the provincial governments by an amendment to the PEPA in 2012. The provincial versions continue to remain materially the same as the PEPA except where governmental bodies are referred.

The following key features of the provincial Acts have a direct bearing on the Project:

- Section 11 (Prohibition of Certain Discharges or Emissions) states that "Subject to the provisions of this Act and the rules and regulations made there under, no person shall discharge or emit, or allow the discharge or emission of, any effluent or waste or air pollutant or noise in an amount, concentration or level which is in excess of the Environmental Quality Standards".
- Section 12-I (Initial Environmental Examination and Environmental Impact Assessment) requires that "No proponent of a project shall commence construction or operation unless he has filed with the Federal Agency an IEE or, where the project is likely to cause an adverse environmental effect, an EIA, and has obtained from the Federal Agency approval in respect thereof."
- Section 12-2b (Review of IEE and EIA): The Pakhtunkhwa Environmental Protection Agency shall review the EIA report and accord its approval subject to such conditions as it may deem fit to impose, or require that the EIA be re-submitted after such modifications as may be stipulated or rejected, the project as being contrary to environmental objectives.

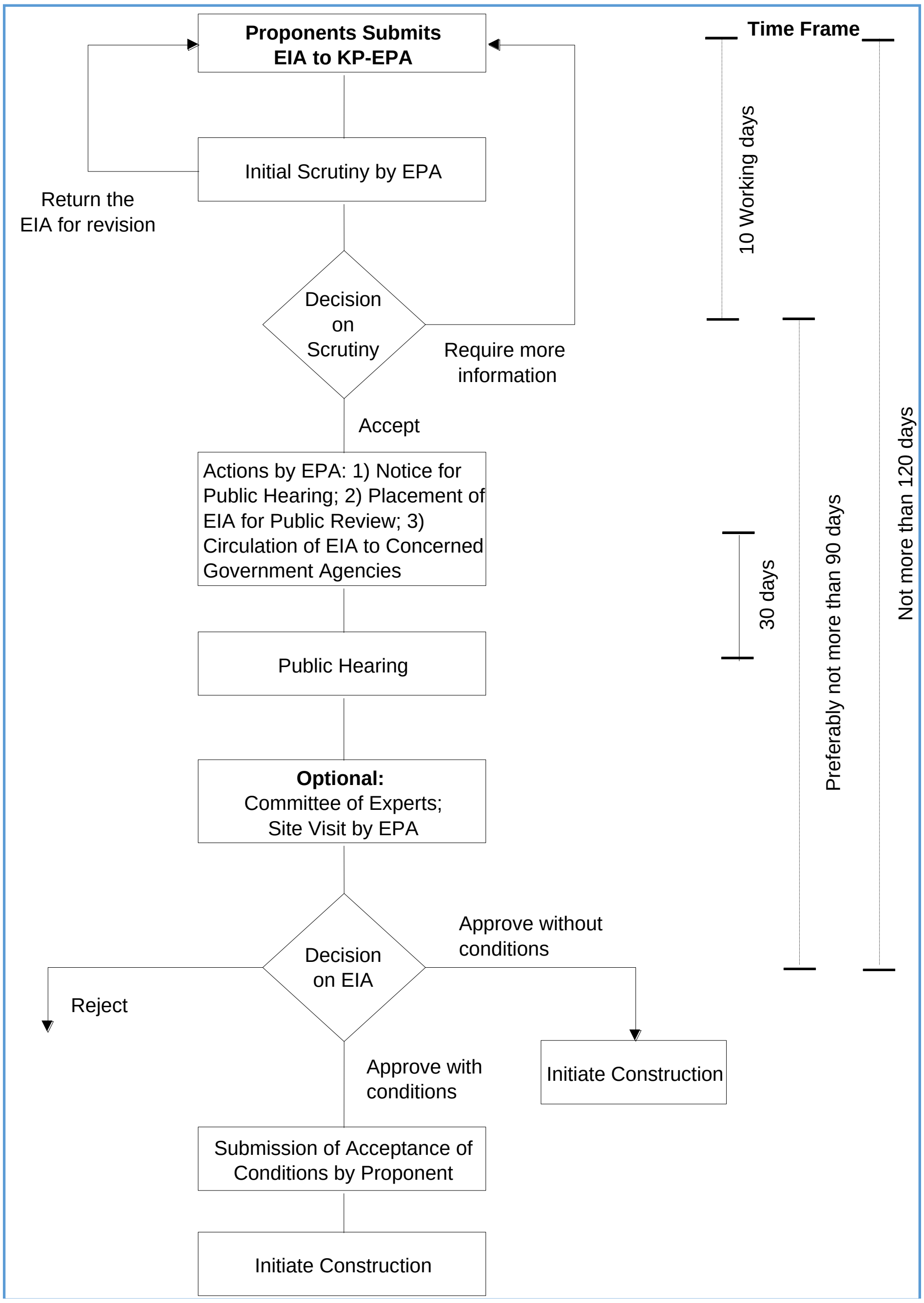
- Section 14 (Handling of Hazardous Substances) requires that "Subject to the provisions of this Act, no person shall generate, collect, consign, transport, treat, dispose of, store, handle, or import any hazardous substance except (a) under a license issued by the EPA and in such manner as may be prescribed; or (b) in accordance with the provisions of any other law for the time being in force, or of any international treaty, convention, protocol, code, standard, agreement, or other Instrument to which Pakistan is a party." Enforcement of this clause requires the EPA to issue regulations regarding licensing procedures and to define 'hazardous substance.'
- Section 15 (Regulation of Motor Vehicles): Subject to provision of this clause of the Act and the rules and regulations made there under, no person shall operate a motor vehicle from which air pollutants or noise are being emitted in an amount, concentration or level which is in excess of the EQS, or where the applicable standards established under clause (g) of subsection (1) of Section-6 of the Act.
- Section 17 (Penalties): Whoever contravenes or fails to comply with the provisions of section 11, 12, 13, or section 16 or any order issued there under shall be punishable with fine which may extend to one million rupees, and in the case of a continuing contravention or failure, with an additional fine which may extend to one hundred thousand rupees for every day during which such contravention or failure continues: Provided that if contravention of the provisions of section 11 also constitutes contravention of the provisions of section 15, such contravention shall be punishable under sub-section (2) only.
- Section 18 (Offences by Bodies Corporate): Where any contravention of this Act has been committed by a body corporate, and it is proved that such offence has been committed with the consent or connivance or, is attributed to any negligence on the part of, any director, partner, manager, secretary or other officer of the body corporate, such director, partner, manager, secretary or other officer of the body corporate, shall be deemed guilty of such contravention along with the body corporate and shall be punished accordingly.

PAKISTAN ENVIRONMENTAL PROTECTION AGENCY (REVIEW OF IEE AND EIA) REGULATIONS, 2000

The IEE/EIA Regulations 2000 establish the framework for the preparation, submission, and review of the IEE and EIA. The regulations categorize development projects for IEE and EIA into two schedules (Schedules I and II). Schedule I includes projects where the range of environmental issues is comparatively narrow and the issues can be understood and managed through less extensive analysis. Schedule II covers major projects that have the potential to affect a large number of people in addition to generating potentially significant adverse environmental impacts. Preparation of a complete EIA is required for Schedule II projects. Under the IEE/EIA Regulations 2000, hydropower projects with a generation capacity more than 50 MW fall into Schedule II. The Project is therefore classified as a Schedule II project.

National guidelines for undertaking EIA in accordance with the IEE/EIA Regulations 2000 include the Policy and Procedures for Filing, Review and Approval of Environmental Assessments, 1997 (the FRAEA Guidelines) and Guidelines for the Preparation and Review of Environmental Reports, 1997 (the PRER Guidelines) (refer to Section 0 for additional details). The EIA approval process in Pakistan as described in the FRAEA and PRER Guidelines is illustrated in**Figure 2.1**.

Figure 2.1: EIA review and approval process in Pakistan



Source: Mott MacDonald Pakistan

Secondary and complimentary environmental legislation

An overview of secondary and complimentary environmental legislation relevant to the Project is presented in **Table** 2.2.

Table 2.2:Secondary and complimentary environmental legislation

Legislation / Guideline Name (Year of Issuance)	**Brief Description**
National Environmental Quality Standards 2012	Powers for regulating Environmental Quality Standards (EQS) transferred from the national government to the provincial governments in 2012. The EQS are materially the same as the National EQS (NEQS) that were established in 1993 and were subject to amendment in 2000, 2009 and 2010. EQS relevant to the Project include: • Municipal and liquid industrial effluents (32 parameters) • Industrial gaseous emissions (18 parameters) • Motor vehicle exhaust and noise (used and new vehicles) • Ambient air quality (9 parameters) • Drinking water quality (32 parameters) • Noise (four zones during day and night).
Environmental Tribunal Rules (the ET Rules)	Under Section 21 of the provincial Act (Environmental Tribunals) have been established to deal with cases of violation or of failure to comply with the provisions of EPA. According to the ET Rules, a tribunal is required to make every effort to dispose of a complaint or an appeal or other proceeding within 60 days of its filing.
Forest Act (1927) and Forest (Amendment) Act (2010)	The Forest Act of 1927 establishes the right of GoP to designate areas of reserved forest, village forest and protected forest. GoP is enabled to acquire such areas in order to prohibit or restrict the public use of such resources or other activities within them. It has been confirmed in consultation with the Forest Department of Haripur that no such areas are present within the Project Area of Influence (AOI).
Khyber Pakhtunkhwa Wildlife Protection, Preservation, Conservation and Management Act (1975) (the KP Wildlife Act) and Punjab Wildlife (Protection, Preservation, Conservation and Management) Act, 1974	The provincial Wildlife Acts have been established to provide direct protection to the provinces' wildlife resources and indirect protection to other natural resources. Wildlife is categorised by degree of protection, i.e. animals that may be hunted on a permit or special license, and species that are protected and cannot be hunted under any circumstances. Restrictions are also established for hunting and trade in animals, trophies, or meat. Categories of wildlife protected areas are also formalised and include National Parks, Wildlife Sanctuaries, and Game Reserves. The Project will need to be undertaken in accordance with these Wildlife Acts. Although no protected areas are present in the Project AOI species captured in the scope of the legislation are present and include Grey Partridge (*Grey francolin)* and Black Partridge *(Black Francolin)*, the hunting and poaching of which is prohibited.
Protection of Trees and Brushwood Act (1949)	The Protection of Trees and Brushwood Act of 1949 prohibits the cutting or lopping of trees along roads and canals planted by the Forest Department unless prior permission of the Forest Department is obtained.

Antiquity Act (1975)	The Antiquities Act of 1975 ensures the protection of cultural resources in Pakistan. The act is designed to protect defined "antiquities" from destruction, theft, negligence, unlawful excavation, trade and export. Antiquities have been defined in the Act as ancient products of human activity, historical sites, or sites of anthropological or cultural interest and national monuments. The law prohibits new construction in the proximity of a protected antiquity and empowers GoP to prohibit excavation in any area which may contain articles of archaeological significance. The guideline procedure for Environment Assessment recommended by the KP-EPA reads as follows: "If the proponent or the consultant identifies an archaeological site that appears to be of importance but the site is not listed they should discuss the site with the relevant conservation authority". "The relevant conservation authority should inform the Responsible Authority of their assessment of the significance of the likely impact of the proposed development early in the process, in order for the Responsible Authority to determine the level of documentation required. The KP-EPA will then be in a position to review the level of reporting required in the light of advice from the Archaeology Department".

Environmental guidelines

A number of guidance documents have been published by GoP and the KP-EPA that set out more detail on how environment policy and legislation are expected to be implemented in practice. Environmental guidance documents relevant to the Project are listed in **Table 2.3**.

Table 2.3:Environmental guidelines

Legislation / Guideline Name (Year of Issuance)	**Brief Description**
Policy and Procedures for the Filing, Review and Approval of Environmental Assessments (1997) (FRAEA Guidelines)	The FRAEA Guidelines define the policy context and the administrative procedures that govern the environmental assessment process, from the project prefeasibility stage to the approval of the environmental report. Requirements for the preparation of an Environmental Management Plan (EMP) are also covered. An EMP is defined as a "document designed to ensure that the commitments in the Environmental Report, subsequent review reports, and Environmental Approval conditions are fully implemented" and is "usually finalised during or following detailed design of the proposal, after Environmental Approval of the development application".
Guidelines for the Preparation and Review of Environmental	The PRER guidelines address project proponents, and specify the: • Nature of the information to be included in environmental reports

Reports (1997) (PRER Guidelines)	• Need to incorporate suitable mitigation measures into every stage of project implementation • Requirement to specify monitoring procedures • Terms of reference (ToR) for the reports to be prepared by the project proponents.
Guidelines for Public Consultation (1997)	The Guidelines for Public Consultation cover approaches and techniques for effective public consultation. An effective consultation strategy is considered to be one that captures the views of all major stakeholders, allowing for the incorporation of concerns in the impact assessment.
Guidelines for Sensitive and Critical Areas (1997) (the SCA Guidelines)	The SCA Guidelines establish environmental assessment procedures (including formal checklists) that are to be followed by projects that are located within or near to officially protected areas in Pakistan. Officially protected areas include those designated to protect critical ecosystems such as biosphere reserves, national parks, wildlife sanctuaries and preserves, and archaeological sites.
EIA Guidelines for Large Scale Hydropower in Pakistan 2014 (the Hydropower Guidelines)	The Hydropower Guidelines were prepared jointly by the GoP (under the "National Impact Assessment Program"), IUCN and Netherlands Commission for Environmental Assessment setting out best practice to be adopted. The guidance provides checklists, sample reports and Terms of Reference (ToR) for consultants.

2.1.6 Social Legislation

Labor laws

Labor laws in Pakistan are governed by many legislative tools. Principal labor rights are provided by the constitution of Pakistan. In addition to constitutional rights, acts and ordinances have been enforced time to time for limiting working hours, minimum working age, and conditions of employment.

Of the 24 labor-related laws that existed in 2014 in Pakistan[1], those set out in **Table 2.4** relate directly to the International Labor Organization's (ILO's) core labor standards.

Table 2.4:Labour related laws related directly to the ILO core labour standards

Legislation / Guideline Name (Year of Issuance)	**Brief Description**
Employment of Children Act (1991)	Article 11(3) of the Constitution of Pakistan prohibits employment of children below the age of 14 years in any factory, mines or any other hazardous employment. In accordance with this Article, the Employment of Child Act (ECA) 1991 disallows child labor in the country. The ECA defines a child to mean a person who has not completed his/her fourteenth years of age. The ECA states that no child shall be employed or permitted to work in any occupation set forth in the ECA (such as transport sector, railways, construction, and ports)

[1] GSP Plus Status of Compliance with Labour Standards, by Hafiz A Pasha, November 2014. Accessed 29 April 2015 at http://library.fes.de/pdf-files/bueros/pakistan/11046.pdf

	or in any workshop wherein any of the processes defined in the Act is carried out. The processes defined in the Act include carpet weaving, beeri (type of cigarette) making, cement manufacturing, textile, construction and others).
KP Bonded Labor System (Abolition) Act (1995) and Punjab Bonded Labor System (Abolition) Act (2012)	The Bonded Labor System (Abolition) Acts seek to eradicate bonded labor practices prevailing in the respective provinces. The Acts define the `Bonded Labor System' as a system of forced, or partly forced, labor under which a debtor enters, or is presumed to have entered into an agreement with the creditor to the effect that: - in consideration of an advance obtained by him or by any of the members of his family (whether or not such advance is evidenced by any document) and in consideration of the interest, if any, due on such advance, or - in pursuance of any customary or social obligation, or - for any economic consideration received by him or by any member of his family.
KP/Punjab Minimum Wages for Unskilled Workers Ordinances (1969)	The ordinances state that every employer shall be responsible for the payment of minimum wages required to be paid under the ordinances to all unskilled workers employed, either directly or through a contractor, in his commercial or industrial establishment: - Provided that where an employer provides housing accommodation to a worker, he may deduct from the wages of such a worker, an amount not exceeding that in the ordinance; and - where the employer provides a worker with transport to and from the place of work, he may deduct from the wages of such a worker an amount not exceeding that specified in the ordinance.
KP/Punjab Industrial Relations Acts (2010)	These Acts seek to regulate formation of trade unions, regulation and improvement of relations between employers and workmen and the avoidance and settlement of any differences or disputes arising between them and ancillary matters.

There are no laws covering equal remuneration for male and female workers undertaking work of equal value and removal of discrimination in respect of employment and occupation.

The Factories Act of 1934 addresses the health, safety and welfare of workers, disposal of solid wastes and effluents, handling and disposal of toxic and hazardous materials, and damage to private and public property. As construction activity is classified as ‘industry’, these regulations will be applicable to the Project, especially for construction contractors.

Pakistan has ratified the ILO conventions for the core labor standards including:

- Freedom of association and collective bargaining (conventions 87 and 98)
- Elimination of forced and compulsory labour (conventions 29 and 105)

- Elimination of discrimination in respect of employment and occupation (conventions 100 and 111)
- Abolition of child labour (conventions 138 and 182).

Pakistan also ratified the United Nations (UN) Convention on the Rights of the Child in 1990 but is not yet subscribed to the UN Convention of the Protection of the Rights of all Migrant Workers and Members of their Families.

Land Acquisition

The Land Acquisition Act 1894 provides for the acquisition of private properties for public purposes including development projects in Pakistan. It comprises 55 sections dealing with area notifications, survey, acquisition, compensation, apportionment awards, disputes resolutions, penalties and exemptions.

Land for Islamabad West grid station will be acquired in accordance with this Act.Other sectorial legislation relevant to the Project is summarized in **Table 2.6**.

Table 2.5:Sectorial legislation relevant to the Project

Key Sections of LAA	Salient Features of the LAA 1894
Section 4	Publication of preliminary notification and power for conducting survey.
Section 5	Formal notification of land needed for a public purpose. Section 5a covering the need for enquiry of the concerns or grievances of the affected people related to land prices.
Section 6	The Government makes a more formal declaration of intent to acquire land.
Section 7	The Land Commissioner shall direct the Land Acquisition Collector (LAC) to take order the acquisition of the land.
Section 8	The LAC has then to direct that the land acquired to be physically marked out, measured and planned.
Section 9	The LAC gives notice to all PAPs that the Government intends to take possession of the land and if they have any claims for compensation then these claims are to be made to him at an appointed time.
Section 10	Delegates power to the LAC to record statements of the PAPs in the area of land to be acquired or any part thereof as co-proprietor, sub-proprietor, mortgage, and tenant or otherwise.
Section 11	Enables the Collector to make enquiries into the measurements, value and claim and then to issue the final “award”. The award includes the land’s marked area and the valuation of compensation.
Section 11 A (applicable in KPK)	Enables the Collector to acquire land through private negotiations upon request of Head of the acquiring department. Upon receipt of any such request the collector is empowered to constitute/notify a committee for assessment of market value of land and verification of title of ownership. On agreement by Head of Acquiring Department, with negotiated market value determined by the committee, the collector shall then direct parties to execute sale deed in favor of acquiring department on stamp paper.
Section 11 B (applicable in	Provides time limit of six months to complete land acquisition process from the date of notification under Section-4.

Key Sections of LAA	Salient Features of the LAA 1894
KPK)	
Section 16	When the LAC has made an award under Section 11, he will then take possession and the land shall thereupon vest absolutely in the Government, free from all encumbrances.
Section 18	In case of dissatisfaction with the award, PAPs may request the LAC to refer the case onward to the court for a decision. This does not affect the Government taking possession of land.
Section 23	The award of compensation to the title holders for acquired land is determined at i) its market value of land, ii) loss of standing crops, trees and structures, iii) any damage sustained at the time of possession, iv) injurious affect to other property (moveable or immoveable) or his earnings, v) expanses incidental to compelled relocation of the residence or business and vi diminution of the profits between the time of publication of Section 6 and the time of taking possession plus 15% premium in view of the compulsory nature of the acquisition for public purposes.
Section 28	Relates to the determination of compensation values and interest premium for land acquisition.
Section 31	Section 31 provides that the LAC can, instead of awarding cash compensation in respect of any land, make any arrangement with a person having an interest in such land, including the grant of other lands in exchange.
Section 48A (LAA-1986)	If within a period of one year from the date of publication of declaration under section 6 in respect of any land, the Collector has not made an award under section 11 in respect to such land, the owner of the land shall, unless he has been to a material extent responsible for the delay be entitled to receive compensation for the damage suffered by him in consequence of the delay.

2.1.7 Other Sectorial Legislation

Other sectorial legislation relevant to the Project is summarized in **Table 2.6**.

Table 2.6:Sectorial legislation relevant to the Project

Legislation Name	Brief Description
Motor Vehicle Ordinance (1965) and Rules (1969)	The ordinance deals with the licensing requirement for driving; powers of licensing authority, Regional Transport Authority and those of Court vis-à-vis disqualification for license and registration requirements to control road transport; compensations for the death of or injury to a passenger of public carrier; powers of Road Transport Corporation; traffic rules, power to limit speed, weight, use of vehicles; power to erect traffic signs; specific duties of drivers in case of accident and powers of police officers to check and penalize traffic offenders. All vehicles used during construction/operation of the Project, by WAPDA, Consultants and the Contractor will be subject to this

	Motor Vehicle Ordinance 1965 and rules 1969.
Highway Safety Ordinance Act (2000)	This Ordinance includes provisions for licensing and registration of vehicles and construction equipment; maintenance of road vehicles; traffic control offences, penalties and procedures; and the establishment of a police force for motorways and national highways to regulate and control the traffic as well as keep the highways clear of encroachments.
Pakistan Penal Code (1860)	The Pakistan Penal Code deals with offences where public or private property and/or human lives are affected due to the intentional or accidental misconduct of an individual or body of people. In the context of the environment, the Penal Code empowers local authorities to control noise, toxic emissions and disposal of effluents.
Pakistan Explosives Act (1894)	The Pakistan Explosive Act of 1884 provides regulations for the handling, transportation and use of explosives during quarrying, blasting and other purposes. The quarrying of stone for rip rap or concrete aggregates may need blasting at the quarry site. In this event these regulations will be applicable for this project.
Regulation of Mines and Oil Fields/ Mineral Development Act (1948)	This legislation provides regulatory procedures for the quarrying and mining of construction material on public as well as private lands.
National Power Policy 2013	The policy aims to build a power generation capacity that can meet Pakistan's energy needs in a sustainable manner. It further envisages creating a cutting edge transmission network, minimising financial losses across the system and aligning the ministries involved in the energy sector and improve governance.

2.2 International Treaties and Conventions

Pakistan is a signatory to a number of international environment and social related treaties, conventions, declarations and protocols. The following are the relevant international treaties and conventions to which Pakistan is a party:

- Convention on the Conservation of Migratory Species of Wild Animals
- Convention on Wetlands of International Importance
- Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal
- Convention concerning the Protection of World Culture and Natural Heritage
- Convention on the International Trade in Endangered Species
- International plant protection convention
- International Covenant on Economic, Social and Cultural Rights
- International LabourOrganisation's (ILO) Core Labour Standards on
    - Freedom of association (convention 87)
    - Elimination of forced and compulsory labour (conventions 29 and 105)
    - Elimination of discrimination in respect of employment and occupation (conventions 100 and 111)
    - Abolition of child labour (conventions 138 and 182)
- Kyoto Protocol to the Convention United Nations Framework on Climate Change
- Stockholm Convention on Persistent Organic Pollutants

- United Nations Convention on Biological Diversity
- United Nations Convention on the Rights of the Child
- United Nations Framework Convention on Climate Change.

2.3 Environment Regulatory Authorities

A number of national and provincial governmental agencies perform functions relevant to the Project. These agencies and their relationship to the Project are discussed below.

Provincial Environmental Protection Agencies

Since the project area falls in KP and Punjab provinces, their respective EPAs are the relevant environmental regulatory authorities. The provincial EPAs are responsible for environmental regulation and implementing GoP environmental policies in their respective provinces. As part of their roles, provincial EPAs are responsible for reviewing EIA documentation for compliance with provincial EIA requirements and procedures and, using their district based staff, also monitors the implementation of EMPs.

Statutory functions of the provincial EPAs are to:

- Administer and implement Environmental Protection Act, its rules and regulations
- Review IEE/EIA, preparation of procedures and guidelines
- Prepare, revise and enforce EQS (industries, municipalities, vehicular emission)
- Establish and maintain laboratories, certification of laboratories for conducting tests and analysis
- Assist local Councils, Authorities and / or Government Agencies in execution of projects
- Establish a system of surveys, monitoring, examination and inspection to combat pollution
- Conduct training for Government functionaries and industrial management
- Provide information and education to the public on environmental issues
- Publish the Annual State of the Environment report
- Undertake surveys and qualitative and quantitative analysis of data on air, soil and water quality, and industrial, municipal and traffic emissions
- Take measures to promote environment related Research and Development (R&D) activities.

Khyber Pakhtunkhwa Forestry, Environment and Wildlife Department

This is the parent department housing the KP-EPA in addition to the Forestry and Wildlife functions in the province. This is the focal agency at the province level for policy, legislation, plans, strategies, and programs with regard to environmental protection, forestry, and wildlife management.

Punjab Environment Protection Department

This is the parent Department of the Punjab-EPA and its functions are essentially same as that of the environmental protection agency described earlier.

Punjab Forestry, Wildlife, and Fisheries Department

This Department houses three distinct functions described below.

Forest

- Preparation and implementation of policies and programs in forestry sector. Implementation of Forestry Laws and rules.
- Protection, conservation, development and management of renewable natural resources, particularly forests and range lands in the province.
- Sustainable management of forest for production of timber, firewood and other non-timber produce and services.
- Demarcation and protection of Forest lands against encroachment.
- Raising of nurseries and plantations.
- Provide extension services for mass awareness and conduct research and training for capacity building.

Wildlife

- Protection, conservation, preservation and management of wildlife.
- Management of protected areas, wildlife parks, safaris and zoos.
- Public and private participation through trophy hunting, private breeding farms & hunting associations.

Fisheries

- Extension services/fish farming/aquaculture development.
- Conservation, management and development of natural resources.
- Production of fish seed under controlled conditions.
- Research &Training activities.
- Introduction of new technologies for enhancing fish production.

Ministry of Climate Change

The Environment Division of the Ministry of Climate Change at federal level is the focal agency for national policy, legislation, plans, strategies and programs with regard to disaster management and climate change including environmental protection and preservation. The division also deals with other countries, international agencies and forums for coordination, monitoring and implementation of environmental agreements. Policies set by the Ministry of Climate Change will influence the design and operation of the project.

2.4 World Bank

2.4.1 Overview and Categorization

The World Bank requires environmental and social screening of projects to determine the appropriate extent and type of environmental and social assessment needed. The World Bank classifies proposed projects into categories depending on the type, location, sensitivity, and scale of the project, as well as the nature and magnitude of its potential adverse social and environmental impacts.

In consideration of the likely impacts of the Project and in discussion with the World Bank, it is concluded that the Project falls into Category A[1] due to its association with the existing Tarbela dam infrastructure. It therefore requires a detailed environmental and social assessment (ESA) and development and implementation of an environmental and social management plan (ESMP).

[1]Projects expected to have significant adverse social and/or environmental impacts that are diverse, irreversible or unprecedented

Social legacy issues associated with the construction of the original Tarbela dam have been addressed in full as part of the development of the Tarbela 4th extension project and are not considered further as part of the present scope of work.

2.4.2 World Bank Social and Environmental, Health and Safety Guidelines

The World Bank's Policy on Access to Information and the World Bank Group's Environmental, Health, and Safety (EHS) Guidelines are applicable to the Project. In particular, Contractors will be required to implement the General EHS Guidelines (April 2007[2]), the EHS Guidelines for Electric Power Transmission and Distribution (April 2007[3]) and the EHS Guidelines for Construction Materials Extraction (April 2007) under the ESMP as enforced through the Project contracts.

The World Bank has also produced environmental and social publications relevant to project financing. Those relevant to the Project are:

- Environmental Assessment Sourcebook, Volume I: Policies, Procedures, and Cross-Sectoral Issues (1991)
- Environmental Assessment Sourcebook, Volume II: Sectoral Guidelines. Technical Paper 140. (1991)
- Social Analysis Sourcebook.

2.5 World Bank Safeguard Policies and Requirements

Overview

Developers seeking financing from the World Bank are required to comply with the applicable environmental and social safeguards, Operational Policies (OPs) and Bank Procedures (BPs). A summary of the key objectives of the relevant safeguards policies considered for the Project is provided in the sub-sections below.

OP 4.01 Environmental Assessment

Provides the framework for World Bank environmental safeguard policies and defines the project screening and categorization in order to determine the level of ESA required. For Category A projects the policy requires public consultation and disclosure to be undertaken as part of the ESA process. The Policy sets out requirements to comply and report on implementation of any environmental management plans.

OP 4.04 Natural Habitats

OP 4.04 outlines the World Bank policy on biodiversity conservation taking into account ecosystem services and natural resource management and use by project affected people. Projects must assess potential impacts on biodiversity. The policy strictly limits circumstances under which conversion or degradation of natural habitats can occur and prohibits projects which are likely to result in significant loss of critical natural habitats.

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[2] World Bank Group EHS Guidelines are reproduced in Annex C and are also available at: http://www.ifc.org/wps/wcm/connect/554e8d80488658e4b76af76a6515bb18/Final%2B-%2BGeneral%2BEHS%2BGuidelines.pdf?MOD=AJPERES

[3] These are under revision and the ESA team will monitor draft documents to anticipate any future requirements that may be applicable.

OP 4.09 Pest Management

Aims to minimize and manage the environmental and health risks associated with pesticide use and promote and support safe, effective, and environmentally sound pest management.

OP 4.10 Indigenous Peoples

OP4.10 requires that any development project must fully respect the dignity, human rights, economies, and cultures of Indigenous Peoples.

OP 4.11 Physical Cultural Resources

Seeks to preserve physical cultural resources and avoid their destruction or damage. It encompasses resources of archaeological, paleontological, historical, architectural and religious (including grave yards and burial sites), aesthetic, or other cultural significance.

OP 4.12 Involuntary Resettlement

OP 4.12 establishes requirements of the World Bank for managing involuntary resettlement. Involuntary resettlement should be avoided where possible. Where the acquisition of land or other assets is necessary, the policy sets out requirements for participation in resettlement planning, mandates compensation for assets at replacement cost, and expects to see that incomes and standards of living of affected persons are improved or at least restored to what they were prior to displacement.

OP 4.36 Forests

OP 4.36 sets out the World Bank objectives for reducing deforestation, enhancing the environmental contribution of forested areas, promoting afforestation, reducing poverty, and encouraging economic development.

OP 4.37 Safety of Dams

OP 4.37 requires competent design and construction supervision to implement dam safety measures through the project cycle. The policy applies to projects that depend on the safe functioning of existing dams (such as the Project) as well as to projects that involve construction of new dams. The policy also recommends measures to strengthen the institutional, legislative, and regulatory frameworks for dam safety programs.

OP 7.50 Projects on International Waterways

Requires notification to other riparian of planned projects that could affect water quality or quantity, sufficiently far in advance to allow them to review the plans and raise any concerns or objections.

OP 7.60 Projects in Disputed Areas

The World Bank will only finance projects in disputed areas when either there is no objection from the other claimant to the disputed area, or when the special circumstances of the case support financing notwithstanding the objection.

BP 17.50 Public Disclosure of Information

BP 17.50 sets out the World Bank policy on disclosure of information. It is a mandatory procedure to be followed by the borrower and Bank and supports public access to information on environmental and social aspects of projects.

2.5.1 Applicable World Bank Policies

The applicability of environmental and social safeguard policies of the World Bank is provided below in **Table 2.7** along with comment as to whether or not they are triggered by the Project.

Table 2.7: World Bank Operational Policies and relevance to the project.

WB Operational Policies (OP)	Policy	Triggered		Justification
		Yes	No	
Environmental Assessment	OP/BP/GP 4.01	✓		Triggered. As the Project falls into Category A, a full assessment has to be carried out. It is the basis of this ESA
Natural Habitats	OP/BP 4.04		✓	Not triggered as the Project will not adversely impact natural habitats or protected areas. Totalai Game Reserve, located 20-25 km from Tarbela, is the nearest protected area.
Pest Management	OP 4.09		✓	Not triggered. The Project is a power sector project and there is no construction, operation or maintenance activities that require the use of pesticide. This includes maintaining of the Right of Way (RoW) beneath the power evacuation lines. NTDC does not use pesticides to maintain RoW.
Indigenous Peoples	OP 4.10		✓	Not triggered. There are no distinct, vulnerable, social and cultural groups in the Project AOI which could qualify as "indigenous" and trigger this Policy.
Physical Cultural Resources	OP 4.11		✓	No known areas of cultural heritage will be impacted by the Project. Procedures will be in place to deal appropriately with any chance finds.
Involuntary Resettlement	OP/BP 4.12	✓		No land acquisition will be required for setting up the power generation and associated facilities since the entire TDP area is owned by WAPDA. For setting up the Islamabad West Grid Station (up to which the power evacuation transmission line will be built as part of the T5HP), about 150 acres of land will need to be acquired for which a resettlement action plan (RAP) has been prepared. For the construction of TL, some land may be required and crop damage is likely to occur for which a Land Acquisition and Resettlement Policy Framework (LARF) is prepared. A RAP will be prepared once the design and exact alignment of the TL has been finalized.
Forests	OP/BP 4.36		✓	There will be no disruption to forests as a result of the Project.

Safety of Dams	OP/BP 4.37	✓		The dam safety policy is triggered since the construction works are implemented on a large dam including associated infrastructure situated upstream of a densely populated area. A robust dam safety and instrumentation system is already in place at Tarbela Dam. As part of T4HP, the following existing Tarbela documents linked to maintaining dam safety have been reviewed by the design consultant and also by an Independent Panel of Experts: Plan for construction supervision and quality assurance. Instrumentation plan for the Dam Safety and Monitoring Program of the World Bank Project Appraisal Document (PAD). Operation and maintenance (O&M) plan Tarbela Dam Emergency Response Plan (ERP).
Projects on International Waterways	OP/BP/GP 7.50	✓		Triggered. The Project is located on an international waterway.
Projects in Disputed Areas	OP/BP/GP 7.60		✓	Not triggered. The Project is not located in or near any disputed area.
Access to Information	BP 17.50	✓		Triggered. Consultations with various stakeholders including affected communities were carried out during EIA study. The ESA documents will be disclosed in WAPDA and NTDC websites. The Executive Summary of ESA will be translated into Urdu and will be disclosed in WAPDA and NTDC websites, and also will be made available to local communities. Public consultations will be carried out in early January to disclose the ESA reports to general public.

2.6 Compliance Status with Pakistani and World Bank Policies

The present compliance status of the project with Pakistani legislation and World Bank safeguard policies is indicated in **Table 2.8**.

Table 2.8: Compliance of Project with GoP Legislation and WB Safeguard Policies

	Legislation / Policy	Actions Taken to Comply
Government of Pakistan (GoP)	Pakistan Environmental Protection Actand provincial EPA acts	WAPDA will submit application for environmental clearance of the projects along with ESA report to KP-EPA and Punjab EPA.
	EIA guidelines for Power Projects	Provide safety measures and information on emergency preparedness
	International	Verification of protected sites, Red List and

	treaties	protection of vulnerable habitats in all environmental screenings and assessments under the project. Inclusion of relevant mitigation measures in each EMP for each subproject/activity.
	Disclosure of projects	The draft ESA and ARF reports have been disclosed on WAPDA and NTDC websites. Public consultations were held to disclose the project information and ESA and to solicit stakeholder feedback.
World Bank	Early screening and Scoping	Scoping consultations were held during December 2014 for power generation facilities; and during November 2015 for power generation facilities.
	Participatory approach	Consultation meetings and focus group discussions are held throughout the project area during ESA preparation.
	Integrate environmental and social assessment	Natural environment, public health, and social aspects are integrated in planning documents.
	Risk assessment	Health and safety risks for population and workers are identified in the ESA, and management measures will be included in tender documents.
	Climate Change and floods	Impact of increased snow-melt and climate change and effect on Indus floods studied. Adaptation measures were considering for design of power house.
	Cumulative impact assessment	Cumulative impact assessment has been conducted as part of the ESA to cover the impacts from all components of the Project and other related developments in the Project area.
	Alternatives	Alternatives considered included: “without project” case; Alternatives to project (thermal generation and other hydropower projects); 9 combination of alternatives for T5HP layout and design; 3 alternatives for transmission line routing; and 3 alternatives for siting of 500 kV grid station.
	Pollution	Baseline survey of environmental quality has been carried out. Environmental standards of GoP and World Bank will be complied. Environmental Code of Practices (ECPs) will be included in contractors’ bidding documents
	Physical and Cultural Resources	Chance find procedure included in contract documents
	Gender	Gender consultations carried out during ESA.
	Public Health	Public Health aspects addressed in mitigation measures.
	Consultation and	Stakeholder consultation meetings, focus group

	Information Disclosure	discussions and formal public consultations were held. Public consultations were held on 31st December at Tarbela and on 1st January at grid station site. ESA, LARF, RAP and the Executive Summary will be disclosed in WAPDA and NTDC websites; and will be sent to World Bank InfoShop. Executive Summary will also be translated in to Urdu and will be disclosed in WAPDA and NTDC websites.

3 Project Description

3.1 Overview

The Project consists of retrofitting a hydropower plant with a capacity of 1,410MW onto the irrigation tunnel five (T5) of Tarbela Dam and laying a new 500-kV transmission line for power evacuation from the new powerhouse. The Project aims to maximize the hydropower potential of this significant multipurpose storage reservoir scheme and provide WAPDA with greater flexibility with regard to power generation and irrigation supply to meet critical power shortages in Pakistan.

The Chapter is organized in two parts: power generation facilities; and power evacuation facilities.

3.2 Power Generation

3.2.1 Location

The Tarbela Dam is located on the Indus River in Khyber Pakhtunkhwa approximately 50km northwest of Islamabad (refer to **Figure 1.1**). The west side of the dam is located within the Swabi District, and the eastern side which includes the Project site is within the Haripur District.

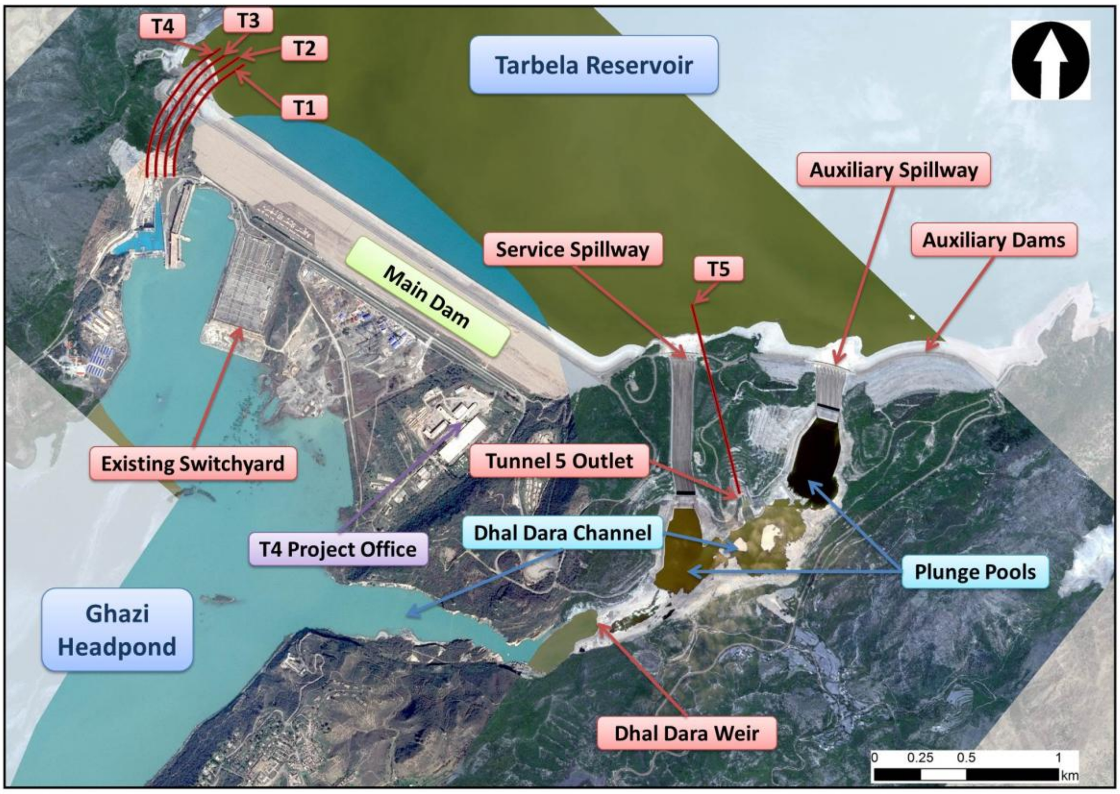
To support delivery of equipment and personnel to site there will be upgrades to existing access roads, creation of new permanent access roads and possibly some temporary access roads. WAPDA already has very good road infrastructure for easy access to site from Ghazi. From the M1 motorway to Ghazi a 20km national highway exists and the road is currently being widened by the local government.

The dam is an earth and rock-filled embankment spanning 2,743m across the Indus River with a maximum height of 143m. Two spillways cut through the left bank and discharge into a side valley, known as the Dal Dara channel. The main spillway has a discharge capacity of approximately 18,400m^3/s and an auxiliary spillway has a 23,780m^3/s capacity. There are two auxiliary embankment dams 713m and 293m long that raise natural low level ridges in the left bank valley. A group of three tunnels (T1 to T3), each approximately 900m long, is situated within the right abutment rock and is used for power generation. Tunnel T4, also on the right bank and originally used for irrigation releases only is currently being converted to power generation (the Tarbela 4th Extension Hydropower Project or T4HP).

The Project site is situated on the left bank of Indus within the Haripur District and is proposed to retrofit a hydropower plant to the existing T5, which has historically been used to supply water for irrigation and has been in operation since April 1976. It is primarily used to release water when irrigation demands are greater than the release capacity of the current power generating facilities. The T5 was designed to allow water to be released for irrigation purposes when the reservoir level was below the minimum spillway operating level. It was not originally designed to be used for power generation. **Figure 3.1** presents an aerial overview of the existing Tarbela Dam and its components.

The Tarbela reservoir extends 97km and has a surface area of 243km^2. The Tarbela Reservoir is becoming filled with sediments as nearly 200 million metric tons of material enter each year. The initial gross storage capacity has been reduced by sedimentation over the years and in 2007 the gross and live storage capacity were 9.95 billion cubic meters (BCM) and 8.44 BCM respectively. The catchment area for the reservoir extends to over 169,600km^2. The main sources of reservoir inflows are snow melt plus limited inflows from monsoon rains.

Figure 3.1: General layout of existing facilities



Source: Feasibility Study of T5HP

T5 is situated close to the left bank between the main and auxiliary spillways (see Figure 3.2). It presently discharges via flip buckets into the Dal Dara channel, which connects the spillways to the main Indus channel (Ghazi Head Pond). A photograph showing the T5 low level outlet (LLO) in relation to the main and auxiliary spillways is presented in **Figure** 3.2**.**

Figure 3.2:View from downstream looking at T5 outlet between the service and auxiliary spillways

3.2.2 Project History and Timeframe

Tarbela was conceived in the 1960s and commissioned in the early 1970s and its primary function was to store water for irrigation purposes. This remains its main purpose today. Completed in 1976 with commencement of power generation the following year, the original dam is the second largest embankment dam constructed in the world. Along with the Mangla Dam Project on the Jhelum River, the project has formed the foundation upon which Pakistan's irrigation is based, and they are the only storage dams in Pakistan.

The Tarbela was originally designed to provide water storage for irrigation as well as generate hydro power from the irrigation releases with 3,478MW installed on Tunnels 1, 2 and 3 that pass through the right abutment of the dam. Tunnel 4 is currently being converted to hydropower and is under construction; as a result, a further 1,410MW generating capacity is currently being built on tunnel T4. The proposal for T5 will add a further 1,410MW resulting in a total generating capacity of 6,298 MW; see **Table 3.1** for summary.

Table 3.1:Installed and pending generating capacity at Tarbela

Power station	No. of units	Unit no's	Unit capacity (MW)	Installed capacity (MW)
Tunnel 1	4	1-4	175	700
Tunnel 2	6	5-10	175	1,050
Tunnel 3	4	11-14	432	1,728
Tunnel 4 (under construction)	3	15-17	470	1,410
Interim Total (without Project)	17	-	-	**4,888**
T5 (provisional)	3	18-20	470	1,410
Total (with Project)	20	-	-	**6,298**

Irrigation demand remains the primary purpose of Tarbela and with over 60% of Pakistan's population still employed in the agricultural sector, this remains a dominant need. If the Project is to go ahead as smoothly as possible the irrigation release capabilities of the scheme must not be put at risk. It is therefore envisaged that the discharge capabilities of T5 will remain unaffected until T4HP is commissioned, expected to be before the end of the high flow season in 2017. Some of the construction work could continue in parallel with that for the T4HP, but the final connection to T5 will only be made once the release capacity of T4 has been restored, probably in late 2017.

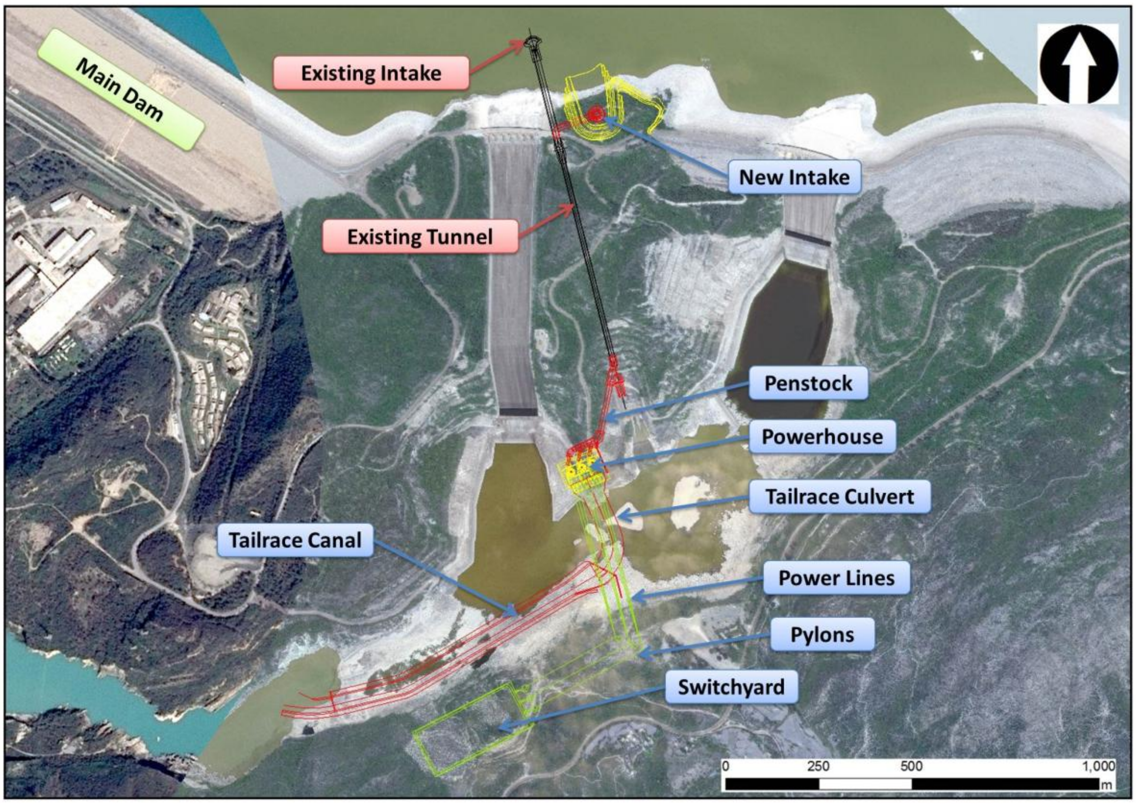
3.2.3 Project Components and Layout

The Project involves modifying T5 so that the majority of irrigation releases can be used for electrical generation. The Project also aims to utilize flows that would otherwise have been passed through the spillway and instead divert these through T5 for power generation. The Project powerhouse will connect to the downstream end of T5. The existing low level outlet (LLO) structure which releases water at the end of the waterway will be connected to a new penstock to maintain water release capacity in situations when power cannot be generated. A new raised intake within the reservoir will also be provided and this will connect to the existing tunnel just upstream of the main gates. A tailrace culvert and tailrace canal will carry the water from the powerhouse to a lower discharge level in the Dal Dara channel below the Dal Dara Weir. A new switchyard will be constructed on the opposite bank of the Dal Dara channel to the Powerhouse and an overhead connection made to the Powerhouse. The Project is split between the hydropower generation plant and the power evacuation facilities which include the switchyard and transmission lines.

There is no land acquisition foreseen for the Project as all construction activities will take place on the existing Tarbela site owned by WAPDA. Buildings to support permanent operations are already established within a reasonable distance of the powerhouse. These include facilities such as offices, workers' accommodation (if using the existing workers' accommodation standards will need to be improved) and a maintenance workshop.

Each of the key project components are also illustrated in **Figure 3.3**below whereas **Table** 3.2presents more detailed description of each of the project components.

Figure 3.3:Key Project Components



Source: Feasibility Study of T5HP

Table 3.2: Description of key Project components

Component	Explanation	Project detail
Main Dam and reservoir (existing)	A typical dam is a wall of solid, impermeable material built across a river to retain water to satisfy a water demand. Building a dam across a river results in the	The existing Tarbela Dam is one of the largest earth and rock filled embankment dams in the world. The reservoir has a surface area of 247km^2 and a gross and live storage capacity of approximately 9.95 BMC and 8.44 BCM respectively.

Component	Explanation	Project detail
	creation of a body of water behind the dam. The size and shape of the reservoir are dictated by the surrounding topography and height of the dam.	
Raised intake of T5 (proposed)	Intakes are situated behind a dam or weir which is used to create enough water storage to allow the intake channel/pipe to have sufficient water and head before entering the headrace/transfer tunnel. Depending on the intake design, construction may require a coffer dam to be built to protect the construction area.	Due to the increasing sedimentation of the Tarbela Reservoir, the Project included for the potential raising of the T5 intake to ensure scheme operation well into the future. The raised intake will involve excavation of the right abutment and the construction of a vertical shaft to connect to the upstream end of the tunnel. The modified intake structures will be hydraulically designed to divert the flow of water into the new shafts which will be connected down to the existing tunnels.
Irrigation Tunnel 5 (existing)	Irrigation tunnel used to release waters from the reservoir during periods when the reservoir level is below the minimum spillway operating level.	Apart from the intake modifications discussed above, no significant changes are expected to be made to Tunnel 5. Some modification will be made towards the end of the existing tunnel to connect to a new penstock. In order to create enough space for the tunnel connection, expansion section, bend and connections to the existing LLO, it will be necessary to make the connection to the existing tunnel about 30m upstream of the current portal location. To create this space, the existing cut slope will be excavated from the top down to its base and then supported to expose the end section of the T5 tunnel.
Plunge Pools (existing)	Area of deep water immediately below spillways which is used to dissipate the energy of the water coming down the spillway to avoid damage and erosion	There are three existing plunge pools at the Project site one at the bottom of each of the spillways and finally one at the base of the LLO. During the construction of the powerhouse and tailrace culvert, these pools will be dewatered to allow

Component	Explanation	Project detail
	downstream	excavation works to take place by pumping water out over the Dal Dara weir. Works will take place during dry season for the tailrace. A coffer dam will protect the power house site during the monsoon season.
Spillway (existing)	Reservoir schemes incorporate a spillway system which allows large flows of water to safely bypass the dam in the event of a flood or during closure/maintenance of the powerhouse	There are two spillways in close proximity to the site which act as auxiliary
Dal Dara channel (existing)	Manmade structure to convey water, may include engineered embankments and straightening and widening of natural river bend	The Dal Dara channel conveys spillway and T5 LLO discharges to the Ghazi Barotha headpond. The channel will be excavated in parts for installation of the tailrace culvert and canals described below.
Dal Dara weir (existing)	A low level dam built across a river to raise the level of water upstream on plunge pool or regulate its flow.	The weir maintains water levels within the channel and spillway plunge pools to protect the plunge pool structures during spill discharge. The proposed tailrace canal will structurally tie into the Dal Dara weir.
Penstock and bifurcation to LLO and Power House (proposed)	Water from the intake is channeled into the penstock which then accelerates the water and delivers it to the powerhouse.	The Project will require water from the existing irrigation tunnel T5 to be brought to a new powerhouse. This will be achieved by modifying the existing tunnel to connect to a new penstock and manifold. In this arrangement, the existing Low Level Outlet (LLO) structure can be retained through use of twin connections to the penstock through a bifurcation which will connect to the exiting LLO and the powerhouse. This configuration allows water to be released through the LLO in the event of powerhouse outages and thus continue to provide irrigation flows as required.

Component	Explanation	Project detail
Power House (proposed)	The powerhouse contains the turbines and generators for the production of electrical power as well as ancillary equipment. The structure can be located either above ground or underground.	A new surface powerhouse will be constructed on the right bank of the Dal Dara channel. The powerhouse will incorporate three 470MW Francis turbine generators and all necessary offices and maintenance facilities. As the powerhouse will be subject to significantly raised tailwater levels when the spillways are passing major floods the powerhouse will be designed to be waterproof to a higher level than is usual at Tarbela. The powerhouse will be a reinforced concrete structure; penstocks will enter from the manifold at the rear of the powerhouse.
Tailrace culvert (proposed)	The tailrace is the outlet of the powerhouse, returning waters back to the river once the water has been through the turbines.	To allow the turbines to access the lower water level of the Ghazi headpond the turbine discharges will feed into a culvert and canal that will discharge downstream of the Dal Darra Weir. The proposed culvert across the Dal Dara channel comprises a 360m long reinforced concrete structure which will be buried beneath the current channel bed. The culvert will be set low enough to maintain full culvert flow under all flow conditions and also for the structure to be set safely below the invert of the Dal Dara channel.
Tailrace canal (proposed)	Same as above.	To discharge the water from the culvert to the Ghazi-Barotha head pond, a 40m base width, 710m long canal along the left bank has been proposed. These facilities will be within the existing water course and will be designed such that they do not significantly affect the flow regime from the spillways. Upstream of the Dal Dara weir the canal will be separated from the Dal Dara channel by a dividing wall. The dividing wall will be mass concrete founded on rock with the depth to foundation determined to ensure adequate bearing capacity. At very high

Component	Explanation	Project detail
		releases over the spillways the channel side wall will be overtopped such that the full width of the channel is available. The combined tailrace culvert and canal configuration will provide a total increase in energy generation of 220GWh per year in addition to other benefits such as additional peaking energy, operational flexibility and better management of sediment in the area of the powerhouse.
Switchyard (proposed)	To export the electricity generated at the powerhouse, it will have to be stepped up (increased in voltage) using a transformer and switchyard.	In order to export the power from the new powerhouse, a new switchyard on the other (right) side of Dal Dara channel south of the service spillway plunge pool with 500kV overhead lines will be constructed. The switchyard civil components will comprise construction of a switchyard relay building, extending utility services, construction of the guard house, construction of foundations for transformers, switchgear and other switchyard equipment; installation of earthing system, laying of the surface and underground drainage and disposal systems in the switchyard area, and construction of switchyard security wall, barbed wire fence or chain link fence.
Connection between powerhouse and switchyard (proposed)	Power will need to be evacuated from the powerhouse to the switchyard then on to the wider national grid. A 500kV transmission line will connect the powerhouse to the switchyard.	The connection will require take-off masts at the downstream side of the powerhouse to provide terminating points for the 500kV overhead lines. A crossing span will carry the 3 circuits across the Dal Dara channel, connecting to a short section of overhead line before terminating on gantries at the 500kV substation.
Connection between switchyard and national grid (proposed)	Power will be evacuated from the switchyard to the national grid via 500kV transmission lines.	This connection will provide two circuits from the new 500kV switchyard within the TDP premises to the proposed Islamabad West grid station near Islamabad.

3.2.4 Technical Specification

The technical specifications of the design option selected at the pre-feasibility study phase for design optimization, and as assessed in this ESA, are summarized in **Table 3.3**.

Table 3.3: Summary of the salient features of the recommended option

Name	Quantity
Number of Turbines	3
Turbine Type	Vertical Francis
Gross head max. (FSL to min. TWL)	135.4 m
Gross head min. (MOL to max. TWL)	71.9 m
Design head	110
Turbine Efficiency at rated head	approx. 96%
Design Unit Discharge	462 m^3/s
Design Scheme Discharge	1385 m^3/s
Rated Output each turbine	470 MW
Synchronous Speed	107.14 rpm
Minimum Suction Head	3.5 m
Runner Inlet Diameter	approx. 8 m

3.2.5 Temporary, Related and Auxiliary Infrastructure

Implementation of the Project will require the development of temporary, related and auxiliary supporting infrastructure. Supporting facilities are proposed to be constructed in the locations illustrated in **Figure 3.4**. Details of the construction requirements related to the temporary infrastructure are provided in the sections below. Development of adequate infrastructure is a pre-requisite for timely implementation of the Project, particularly in view of the very tight implementation schedule of 39 months for the project.

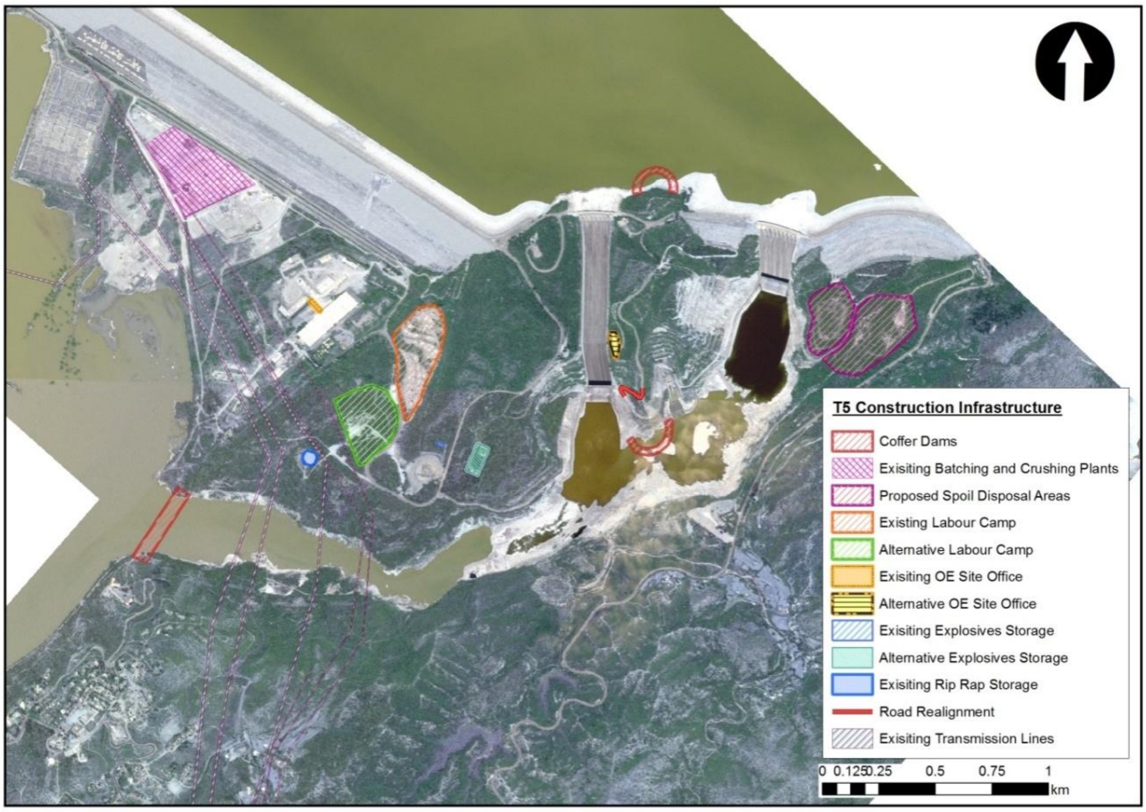
As the Project would be expected to start before completion of the T4HP it would be necessary to augment some of the existing facilities, although it is likely that there will be some scope for sharing between the two projects.

The following infrastructure facilities will be required for early construction of the Project:

- Construction camp for office and construction personnel
- Access roads to various work sites, camps, offices, spoil disposal areas, and quarries.
- Quarries and materials storage
- Batching plant. A batching plant for the fast construction of a large surface power station will require the construction of a large batching plant. One is already operating at Tarbela for the T4HP and it took about one year to put this into service. It would be sensible to use as much of this facility as possible for the Project
- Spoil disposal areas

- Explosive magazine
- Construction power supply.

Figure 3.4:Proposed or Potential Locations of Construction Infrastructure



Source: Feasibility Study Report of T5HP

3.2.6 Construction Activities and Program

This Section sets out the construction activities and techniques that are likely to be employed to facilitate the implementation of each major component of the Project. **Table 3.4** describes the typical construction activities required to construct a hydropower scheme such as this Project.

Table 3.4: Typical hydropower scheme construction activities

Activity	Description
Land acquisition (for temporary and permanent Project structures)	All land required for the construction and operation of the project is already owned by WAPDA and part of the existing Tarbela Project. There are no people living on the land required for the various project components, however some areas were used previously for grazing livestock. Since the areas around the construction sites in Tarbela are now restricted for general public and their livestock, no impacts are expected on the livestock grazing.
Site enabling works	Site access roads are already well established providing access to the wider Tarbela project and T5 project area. A new permanent road will be constructed at the powerhouse location to replace a section of existing road that will be demolished to allow construction of the penstock. New permanent access roads will also be required for the canal and switchyard. The locations of these are to be determined.Roads will be constructed on WAPDA owned land.

	Necessary storage areas, material assembling areas, construction accommodation, water and power supply systems will utilize existing facilities of T4HP as far as possible or be installed on site.
	To meet the construction schedule it is proposed to utilise the existing T4HP aggregate processing and batching plant required for the production of concrete to support construction works. Aggregate processing plants will be used to break up rock and excavated materials for reuse during construction (as aggregate) or for disposal at the spoil disposal sites.
Site preparation works	This will include vegetation clearance in the flowing areas: The proposed raised intake area adjacent to the service spillway gates The area between the service spillway and T5 LLOs where the powerhouse and penstock will be located The proposed switchyard area and minor clearing for installation the six towers of the transmission line connecting the powerhouse and switchyard on the left bank of Dal Dara channel The proposed spoil disposal area on the left bank of the auxiliary spillway plunge pool Potentially in the proposed alternative location for the contractor camp No herbicides will be used for vegetation clearance. Most of the vegetation comprises bushes and shrubs; trees will only be cut to the extent required Intrusive works will be undertaken in accordance with archaeological chance find procedures.
Demolition	Demolition of 30m lengths of the T5 tunnel upstream of the existing gate and LLO structures will be required for connection of the proposed raised intake and penstock respectively. Approximately 500m of existing road and some concrete and fill material in the area between the existing LLO and service spillway will be demolished for construction of the penstock and powerhouse, and the left hand side section of the Dal Dara weir will need to be demolished to permit installation of the downstream end of the proposed tailrace canal.
Earthwork excavation	Excavations will be required at the raised intake, for the penstock, powerhouse and within the Dal Dara channel for the tailrace culvert and canal. During excavation, drilling and blasting will be required to break the hard rock areas. Archeological chance find procedures will be followed.
Coffer Dams	Coffer dams will be required at the proposed raised intake and powerhouse to allow deep excavation to occur in these locations without inundation. A third coffer dam will be required at the mouth of the Dal Dara channel in order to allow the construction of the final downstream length of the proposed tailrace canal.
Dewatering	Dewatering of three areas using pumps will be required at certain times during the construction period; the area enclosed by the raised intake coffer dam, the area between the auxiliary spillway plunge pool and Dal Dara weir and lastly the area downstream of Dal Dara weir. The timing of dewatering activities is explained further below in Section 3.2.7.
Foundations	The foundations of the various project components will need to be adequately prepared. Grouting may be required to secure the raised intake, penstock and powerhouse foundations.
Construction of the main project components	The majority of the components will be made of reinforced or mass concrete, including the raised intake inlet structure, the lining of the raised intake shaft and tunnel, the powerhouse structure, the tailrace culvert, the

	tailrace canal lining, the tailrace dividing wall and various tower and switchgear foundations at the switchyard and connection between the powerhouse and switchyard. Significant steel components include the penstock, with sections being welded together in-situ, and transmission line towers and switchyard switchgear. During construction, concrete mix will be randomly tested by taking samples from the construction site to check the strength of the concrete. Thermal tests would be carried out to assure that the temperature of the concrete is as required during pouring and settling time.
Electro-mechanical works and switchyard	The turbines and generators and all their ancillary equipment will be imported and installed within the powerhouse. The electricity generated in the powerhouse will be transported to a switchyard installed on the left bank of the Dal Dara channel, directly south of the proposed powerhouse location, via an overhead line mounted on the downstream powerhouse wall. They would cross the Dal Dara channel in a single span and be transformed into a vertical arrangement to turn to the west on individual towers.
Completion work	At completion, the area will be cleared and tidied up. Disturbed land that has been used temporarily will be reinstated to its previous condition. Any site security fences will be retained throughout the dismantling process.

3.2.7 Construction Phasing

The spillways and T5 low level outlet need to be able to continue to operate throughout the construction phase with minimal impacts from the T5 hydropower project. During the high flow season, the reservoir level is typically high and the T5 LLO and spillways may be required to operate to control the reservoir level discharging to the Dal Dara channel where water flows over the Dal Dara weir and into the Ghazi-Barotha headpond. During the low flow season, the reservoir level lowers as inflows are relatively low and irrigation water is released through T1 to T4, and water will not be discharged from the spillways or T5.

During the high flow season, work will need to cease at the intake and tailrace as both construction areas will become inundated with water from the reservoir and Dal Dara channel respectively. Work at the powerhouse and lower penstock will continue throughout the high flow seasons as the powerhouse excavation will be isolated from the flows in Dal Dara channel by a coffer dam. Work at the penstock and other areas will also continue throughout the high flow season as they are not located in areas subject to inundation from high reservoir levels or flows in Dal Dara channel.

Relatively small volumes of water that are anticipated to seep into the powerhouse, intake and tailrace excavations will need to be continually pumped out. The intake and tailrace work areas will have to be dewatered periodically after each high flow season. The length of channel downstream of Dal Dara weir will only need to be dewatered once towards the end of the construction works (scheduled to occur in the 2018-2019 low flow season) for the connection of the tailrace canal to the Dal Dara weir and Ghazi-Barotha headpond.

3.2.8 Interruption to T4HP

The T4 extension project is scheduled for commissioning in June 2017, therefore the scheduled period of overlap is from March 2016 until June 2017 inclusive; a period of 16 months. By March 2016, all excavation works and the majority of concrete works for the T4 project are scheduled to have been completed.

During the period of overlap, the main construction activities of the T5 project will be site establishment, excavation, dewatering and construction of coffer dams (i.e. activities 2, 3, 7, 8 and 9 from Table 3.2). The T4 and T5 project components and work sites do not overlap so no major conflicts are expected in the course of construction work. An increase in construction traffic is anticipated in some areas, for example at the dam crest access road, but the existing roads in these areas are not being altered and have sufficient capacity for the increased traffic load.

To meet the demanding schedule of the T5 project, T4 facilities such as the batching plant and contractor camps will be utilized as much as possible. There is therefore potential for conflict associated with single facilities being used for both projects simultaneously. However, there are plenty of potential alternative facility locations within Tarbela which could be used by the T5 civil contractor if required. Sites for the various facilities as shown in **Figure 3.4**will be provided to the chosen contractor who will then be responsible for establishing appropriate facilities in coordination with WAPDA and the T4 civil works contractor.

3.2.9 Interruption to Existing Services

Construction of the Project involves the connection of a new raised intake to the existing Tunnel 5 at the upstream end and connection of the Project penstock to the T5 tunnel directly upstream of the existing low level outlets (LLO).

The construction of these connections will require tunnel T5 to be inoperable from when the tunnel is first broken into until close to commissioning, a planned period of approximately 20 months. This period is scheduled to occur between October 2017 and May 2019. Historically, irrigation flows are typically only released from T5 during the high flow season from May to July. As such the T5 tunnel would only be inoperable for one high flow season, and during this period the water will be released from other tunnels and there will be no impact on the irrigation releases.

T4HP is scheduled for commissioning in May 2017 and connection of the new raised intake on Tunnel 3 is scheduled to commence in late 2019 after commissioning of the Project. T1 and T2 are currently operable and will continue to be so throughout the T4 and T5 construction periods. Therefore, in the period during which T5 is scheduled to be inoperable, all other tunnels will be able to release discharges for irrigation. The combined capacity of T1 to T4 is expected to easily meet irrigation release requirements for the 2018 high flow season.

3.2.10 Construction Approach

The construction approach and procurement strategy to be employed by the Project will be driven by the short timeframe within which to develop and commission the Project. The procurement strategy is yet to be finalized however it is likely to follow a similar mechanism to the T4 project and follow standard World Bank procedures including pre-qualification and competitive bidding stages. Two construction contracts would be let by WAPDA, one covering civil works (an ad-measure or rates based contract) and the other covering electromechanical works, with both contracts adopting standard World Bank formats. Detailed design of civil works would be undertaken by an independent engineer and of electromechanical works by the chosen electromechanical contractor. An Owner’s Engineer (OE) will be employed by WAPDA during the construction phase.

Both skilled and semi-skilled construction workers will be required throughout the project. It is estimated that, during construction, the project will generate employment of about 320 person years for skilled labor and 1,600 person years for unskilled labor. Approximately 1,400 workers will be required at the peak of construction. It is anticipated that most of the skilled workers and non-skilled labor will be recruited locally, with many laborers continuing on from working on the T4HP Project. A mix of expatriate and national skilled laborers, technicians, and supervisors will be employed. Construction activities are likely to take place 24 hours a day, seven days a week to meet the timeframes required. This is likely to consisting of shift working comprised of three shifts of eight hours. It will be the responsibility of the contractor to determine arrangements to meet the program that also comply with international labor standards.

Given that there are limited local inhabitants living close to the project site, it is expected that activities will take place on a 24hour basis, although efforts will be made to limit noisy activities such as blasting or piling during the day.

3.2.11 Temporary and permanent land requirements

For construction of the project, land will be required for roads, main project components such as penstock, powerhouse, tail race, switchyard in addition to land for construction camp for office and construction workers, batching plant, spoil disposal areas and job facility sites. All the land required is already owned by WAPDA and there are no people living in the area. Some of the areas are used for grazing of cattle and goats and wild pigs also live there. The construction works will cause some disruption but the long term impacts will be minimum.

3.2.12 Construction Camps

It is planned that the existing T4 extension office building will be used for the T5 project by WAPDA and the Owners Engineer. In addition, an existing building located between the T5 tunnel and the service spillway is available for use as a camp office, although the building will require renovation. These two buildings will provide all the facilities required for Project management. Security at Tarbela is generally provided at the perimeter of the site and for the T4HP there is limited additional security at the office. This position is continually under review and WAPDA will provide security for these facilities as necessary.

The Contractors' will need their own offices and associated facilities. It is anticipated that the civil and M&E contractors would have separate camps containing both offices and accommodation for their staff. The civil contractor is expected to employ many more laborers and unskilled staff than the M&E contractor and will require a larger camp. For T4HP about 1,800 people have been employed and a similar number of construction workers are expected to be employed for the Project.

Most of the unskilled workers have been recruited from the local community and they have a preference for living in their family homes and using transport provided to travel to site on a daily basis. Whilst this might suit the individuals, for contractor it would be drawback since he needs to arrange the transport. The take-up of the accommodation on site for the T4HP Project has been less than expected and this to preference of local workers to travel on daily basis.

Two options are being considered at present with regards to accommodation of construction workers for the Project, i) refurbishment of existing accommodation to an acceptable standard and ii) development of a new construction worker camp on the right bank of the Dal Dara channel, approximately 1km downstream of Dal Dara weir. The proposed area is almost flat and only clearing and grubbing is required and in shown as the green hatched area in **Figure 3.4**. The area is easily accessed from both the T5 and T4 office locations. In addition, there is also potential for land on right side of the service spillway to be levelled for use as a labor camp.

The labor requirements of the M&E contractor are much smaller than those for the civil contractor. They could either be accommodated within the civil camp or the M&E contractor could build their own facilities at site identified above.

3.2.13 Access Roads

There are several access roads within in Tarbela area to access different components of the dam. Similarly, to access T5 tunnel site and spillways, there is a roadfrom the main entrance of Tarbela office. The access road to T5 is located on the right to left bank over the crest of the main dam, spillways and auxiliary dams. There is an existing small road that connects to this main road near the T5 intake and leads to the T5 LLO and further down the auxiliary and service spillways. A second branch of this road joins the access road towards the proposed contractor's camp location. With the construction of the T5HP powerhouse, a portion of this road will be relocated upstream of the T5 LLO as shown in **Figure 3.4**.

During the dry season (when the spillways aren't operating) access will also be possible from an existing access road that runs along the edge of the Dal Dara channel. It will also be possible to construct access roads across the channel when the spillways are not operating.

To facilitate speedy excavation and concreting in the deep seated powerhouse, a cofferdam with an access road on its crest is proposed to be constructed around the powerhouse. For the tailrace option with the culvert and canal tailrace, a coffer dam with access road may also be placed at the outlet of Dal Dara Channel in line with previous practice.

Table 3.5 presents key access roads and routes that will be required during project construction phase. Refer to Figure 2.5 for location of new lengths of new temporary and permanent road at intake and powerhouse respectively.

Table 3.5:Key access roads within in dam area to be used in construction

Route*	Road status	Existing road length (km)	New road length (km)
Access to Tarbela site1	Existing	Various	0.0
Intake to spoil disposal area2	Existing / new (temporary)	3.1	0.1
Powerhouse / penstock to spoil disposal area (low flow season)	Existing	1.7	0.0
Powerhouse / penstock to spoil disposal area (high flow season)	Existing / new (permanent)	3.7	0.4
Tailrace to switchyard2	New (permanent)	0.0	TBD, approx. 0.5
Tailrace to spoil area2	Existing	1.7	0.0
Batching plant to powerhouse / penstock (low flow season)	Existing	3.5	0.0
Batching plant to powerhouse / penstock (high flow season)	Existing / new (permanent)	5.2	0.4

Batching plant to tailrace2	Existing	3.5	0.0
Batching plant to intake2	Existing / new (temporary)	4.1	0.1

[1] Route will be the same for both seasons. [2] Route will generally not be required during the high flow season

Construction planning will ultimately be carried out by the contractor according to site conditions after award of the works. Hence final layout of the road will be decided by the contractor based on its preferred methodology and location of the various construction facilities. All access roads would be constructed in accordance with the Environmental and Social Management and Monitoring Plan.

3.2.14 Construction Materials

Aggregate materials required for the project will be recycled from Project or T4HP excavation activities as far as practicable, and if required supplemented by rocks extracted from the Indus River bed. A full list of coarse aggregate sources identified for the Project is provided below:

- Project excavations
- T4HP stockpiles
- The Indus River bed in the vicinity of the Project
- Commercial quarries at Qibla-Bandi and Lawrencepur.

A quarry area for fine aggregate (sand) has been identified on the left bank of the Dal Dara channel just downstream of the proposed switchyard area (**Figure 3.4**). The quality of the sand will be reviewed after investigation results have become available. The quality of the sand will be reviewed after investigation results have become available. As an alternative, sand from Qibla-Bandi and Lawrencepur, some 20-30km downstream of Ghazi town on the left side of the Indus valley can be used. These well-established commercial quarries can provide good sources of riverine sand that can help to provide more workable concrete than in possible from crushed rock.

It is intended that the T4HP batching plant will be maintained for the Project and this should have the capacity to provide the majority of concrete requirements. If an additional batching plant is required a number of acceptable locations exist close to the proposed new facilities. A breakdown of anticipated quantities of key materials for major infrastructure is provided in **Table 3.6**.

Table 3.6:Details of Major Quantities

	Description	Concrete (m^3)	Steel (metric ton)	Coarse Aggregate (m^3)	Fine Aggregate (m^3)
1	Intake	28000	3200	22000	15000
2	Penstock	146500	13200	115000	77000
3	Power house	347000	26000	271000	181000
4	Tailrace	190000	7000	149000	99000
5	Switchyard	3000	100	3000	2000
	Total	**714500**	**49500**	**560000**	**374000**

3.2.15 Demolition and Excavation

Demolition of the following structures is required to adapt the existing Tarbela structures to accommodate development of the hydropower plant:

- A portion of approximately 30m in length of the existing T5 tunnel between the existing intake and the gate structure for a new tunnel connection from the proposed raised intake.
- The final 29m length of the T5 tunnel along with the first 46m of the LLO structure, including the existing bifurcation for connection to penstock and new bifurcations leading to the existing LLO structure.
- Approximately 500m of existing road in the area between the existing LLO and service spillway which is within the footprint of the powerhouse and penstock excavations.
- Concrete and fill material over an area of approximately 3,000m2 on the left bank of the service spillway which is within the footprint of the powerhouse excavation.
- The left side section of the Dal Dara weir will need to be demolished to permit installation of the end of the downstream end of the proposed tailrace canal.

Steel will be separated from the excavated material on site and given to WAPDA for resale. The remainder of material will be disposed of in the designated spoil areas.

In the course of its work, the contractor may encounter asbestos in existing buildings and structures. The ESMP will specify methods of identification, removal and disposal of asbestos according to international best practice measures to be followed by the contractor.

A cofferdam will be constructed to allow excavation for the powerhouse below river level regardless of seasonal operation of the T5 LLO and the spillways. Additional dry-season coffer dams will be constructed across Dal Dara channel, allowing the Dal Dara channel to be drained, which will give full access across and along the channel.

The following are key project components which require significant excavations and the approximate excavation volumes:

- Raised Intake: 1.34 million m^3
- Penstock and LLO: 450,000m^3
- Power house: 650,000m^3
- Tailrace culvert: 350,000 m^3
- Tailrace canal : 1.18 million m^3

Excavation methods employed will vary depending on the schedule requirements and conditions encountered during construction. The following methods are likely to be employed:

- Drilling and blasting
- Breaking up boulders so they are suitable for transport using rock breakers
- High capacity excavators loading dump trucks to transport spoil

3.2.16 Spoil and Waste Management

Construction of the project involves generation of spoil from various work sites for which disposal areas at appropriate locations in line with the topographic conditions will be required. Areas identified thus far are marked on **Figure 3.4**. It is estimated that the total excavated volume will be approximately 4.5 million m^3. The spoil quantity expected to be generated from various work sites will be finalized during the next stage of works and will influence the final spoil disposal locations. However, it should be noted that it has been determined that more than sufficient space has been identified around the immediate project area to locate spoil sites. Given that spoil will be disposed of within close proximity to the project excavations, despite a significant number of truck movements, the transport spoil materials are not anticipated to impact any existing road users or other sensitive receptors.

Part of the excavated spoil material will be reused to raise the elevation of the proposed T5 switchyard footprint. To build the ground level up to an elevation of 400masl (meters above sea level), will require fill volume of 440,000m^3. The fill material for the switchyard will originate from material excavated for the proposed adjacent tailrace canal. Where materials cannot be reused suitable spoil disposal sites will be developed. All spoil disposal sites will have a flat top and be re-vegetated to increase soil stability through plant roots. The spoil disposal sites will be required to adopt a slope ration of 1:2, i.e. 1 vertical unit to 2 horizontal units, which is a standard slope angle to adopt.

In addition, all spoil sites will have a ditch around their edges to prevent water from surrounding areas entering the interface between the spoil and the natural ground, which can result in erosion and instability of the disposal sites.

3.2.17 Machinery

Equipment required during the construction phase will be imported by the construction contractor to site, equipment will either be sourced within Pakistan or imported. As far as possible equipment installed and used for T4HP will be utilized such as the batching plant (including crushing, washing and grading facilities). The following list outlines the major machinery and vehicles that are envisaged to be required for the project construction works:

Hydraulic excavators	Refueling truck	Welding machine 30 kW
Dump trucks	Water tanker	Vibratory roller
Concrete batching plant	Water pump	Submersible pump
Motor grader	Tower crane	Fork lifter
Bulldozer	Mobile crane	Low bed trailer
Wheel loader	Air compressor	Diving Equipment
Self-loading crane	Tractor	Work boat
Transit mixer	Generator 365 kW, 100kW and 150 kW	Dredger
Concrete pump car		

3.2.18 Storage of Explosives

Explosives required for blasting will be stored at the existing T4HP explosives facility. All safety codes and regulations prescribed by the government in this respect will be followed and explosives magazines will be guarded continuously.

3.2.19 Construction Power

Construction power for the execution of the T5 project will be serviced by existing capacity from Tarbela. Some minor updating and uprating of the existing localized systems will be required; however, no new grid infrastructure will be constructed to import power. As uninterrupted power supplies cannot be guaranteed, back-up diesel generator sets will be connected. Back-up generators will be located and operated in accordance with requirements set out in the ESMP.

3.2.20 Miscellaneous

Safety will be paramount during Project construction. Safety related infrastructure will include lighting, security and pedestrian and vehicle access arrangements. Accident prevention measures will be designed in accordance with relevant regulations and good industry practice. The project work sites will have restricted entry and visitors will only be allowed entry on permits issued by the project authority. All Project personnel will be provided with identity cards and passes issued by the Project authority which will be checked at suitably located entry check posts.

3.2.21 Operation and Maintenance Requirements

The project will be operated and maintained by WAPDA as part of the wider Tarbela Dam complex. The main purpose of the Project is to utilize water that would otherwise be spilled during high flow season to generate electricity, however, its turbines will have similar efficiency to the remainder of the turbines in the complex and will be able to be economically operated throughout the year depending on the availability of water and requirement to release water for irrigation.

The number of skilled staff required for operation and maintenance of the project is estimated to be 384 persons. In addition to this a number of opportunities will exist for services roles such as cleaning, secretarial, and catering.

3.2.22 Decommissioning

Decommissioning will include:

- Temporary work-sites decommissioning (e.g. coffer dams, borrow pits, accommodation sites)
- End of life decommissioning

These are discussed in more detail below.

Temporary Work Site Decommissioning

During construction temporary worksites will be set up. These will include:

- Borrow pit sites, quarries, storage and batching facilities
- Accommodation
- Equipment storage (laydown) areas
- Temporary access roads

In general, these sites will be returned to their original state ensuring that there is no deterioration of the site. WAPDA will ensure through the construction ESMP that a coherent record of the state of the site throughout the period of construction is maintained.

End of Life Decommissioning

The operational phase of the scheme is expected to last a minimum of 30 years (Project life) and it is difficult to know whether the Project would be decommissioned on its own or as a rotating activity of the wider Tarbela Dam. The preparation of decommissioning plan is considered not applicable at this stage of the Project. WAPDA should develop a decommissioning plan 1-2 years prior to the decommissioning date, the objective of which will be returned the site to a condition suitable for reuse in line with the proposed end use. In conjunction with the decommissioning plan and decommissioning ESMP should be developed. End of the Project life decommissioning is not considered further in this ESA.

3.3 Power Evacuation

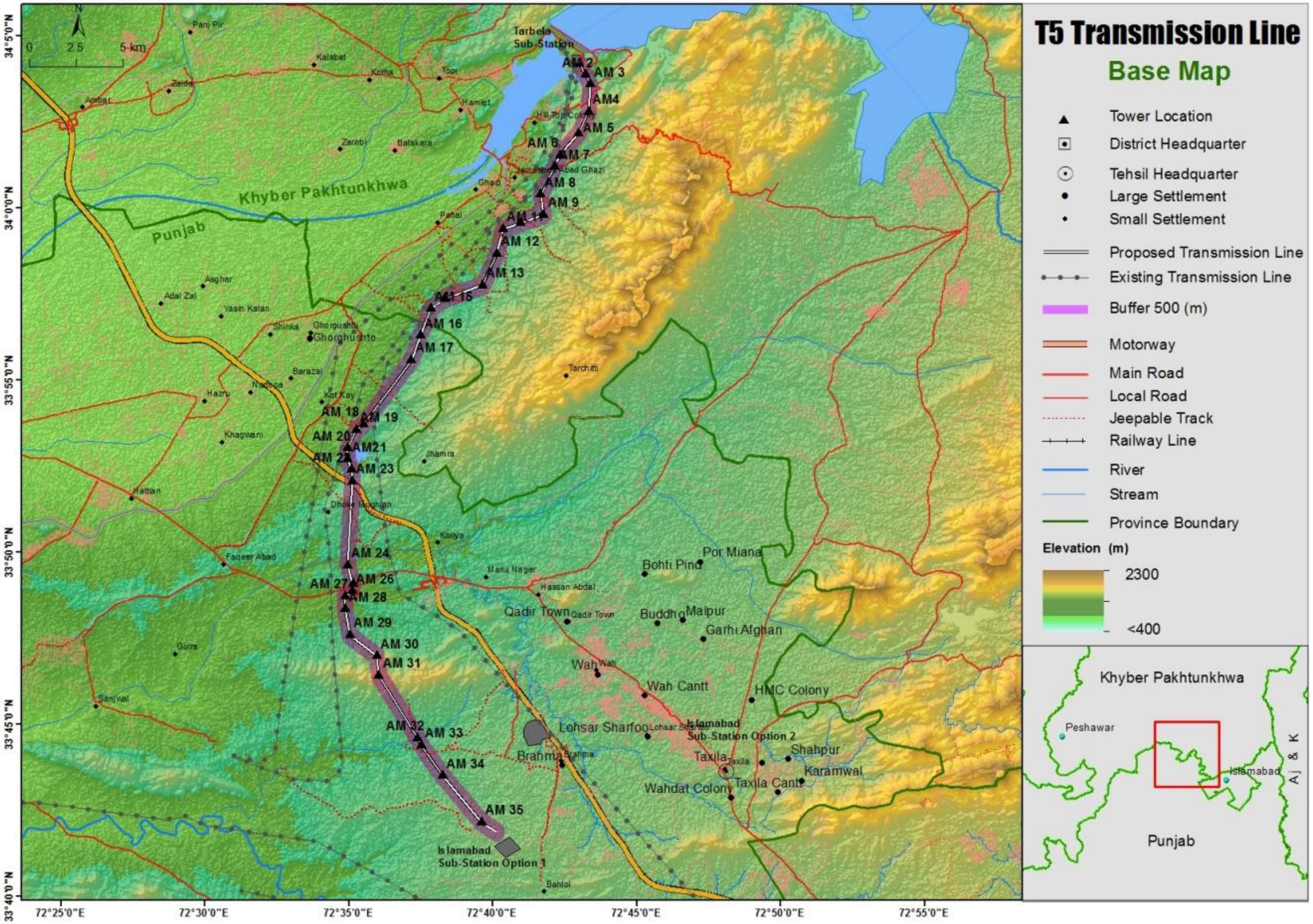
3.3.1 Transmission Line Route

The Tarbela to Islamabad West Grid Station transmission line will starts from the new Tarbela 500kV switchyard and will terminate at Islamabad West grid station near Wah Town, District Attock. The length is approximately 50km with a total of 35 angle towers. The line passes through two districts of two provinces. The first stretch of proposed route of transmission line lies within Haripur District of Khyber Pakhtunkhwa (KP) Province. After this the line enters Attock district of Punjab Province. The route of the Tarbela – Islamabad West grid station line is illustrated in **Figure 3.5**.

In Haripur district, the transmission line routes pass through villages of Pakki Ban, Harbara, Dhamrai, Bera, Piplian. Ghara, Barwasa, Umer Khana, Gahri Mehra, and Minar Kot

While in Attock district, the transmission line passes through villages of Bahtar Mera, Katariyan, Dhok Khaliq Dad, Islamgarh, Burhan, Noorabad, Dhok Mughal, Dhok Ghar, Narcey, Qibla Bandi, and Qutab Bhandi

Figure 3.5: Route of the Tarbela – Islamabad West Transmission Line



3.3.2 Power Evacuation Components and Layout

For the Tarbela to Islamabad West transmission line, both double circuit and single circuit towers will be used; see **Figure 3.6** for typical tower design.

Figure 3.6: Double Circuit Tower and Single Circuit Flat Formation Tower

The Tarbela – Islamabad West transmission line will be constructed in accordance with typical NTDC specifications. Towers generally have a construction footprint of 200m^2 and range in height from 46m for normal towers to 56m for special towers. Foundations are expected to have been excavated to a depth of 2-3m with tower footings extending a further 1m above ground level as a general rule. The typical span between towers is 300m, although this distance increases or decreases depending upon the topography and geography of the location. In hilly areas the length decreases while in populated areas it is generally greater. The height of each tower varies following similar criteria e.g., for river crossings a 56m high special tower is normally required. Generally, every tenth tower is assigned as a "dead tower" for the purposes of maintenance and repairs. Dead towers are designed to withstand increased structural loading caused by events such as earthquakes that have been experienced in the region and also the failure of one or more conductors. They can accept unbalanced loading and mitigate the potential for cascading tower failure along the length of the transmission line.

NTDC policy is to maintain a 60m (30m either side of the center line) Right of Way (RoW) that would be clear of development as far as possible.

Ground clearances adopted by NTDC are in accordance with the National Electrical Safety Code (ANSI C2) currently applicable in the United States. Conductor to ground clearances currently applicable (at a maximum temperature of 65.5^{0}C) are given in **Table 3.7**.

Table 3.7:Conductor to Ground Clearance

Item	220 kV (m)	500 kV (m)
Cultivated land traversed by vehicles	7.92	9.45
Communication and Power Lines Power Lines up to 132kV	7.92 5.00	 6.70
Highways	7.92	9.45
Railroads	8.84	9.14
River at high flood level	9.14	9.14
Places accessible to pedestrians only	8.84	9.14

Building roofs	7.62	9.14
Top of trees (Orchards)	6.00	6.00
Canals	9.14	9.14
Lightning Protection Wires	5.00	6.70

Source: Construction of 500 Kv Grid Station and Allied Transmission Line at Shikarpur: Policy Legal and Administrative Framework (NTDC 2012)

3.3.3 Grid Station

A 500/765 kV grid station will be constructed at Islamabad West to receive power from both T5HP (500 kV) and Dasu Hydropower Project (765 kV). The list of key equipment to be housed at this grid station include:

- 4x760 MVS 500/220 kV transformers along with allied equipment
- 4x250 MVA 220/132 kV transformers along with allied equipment
- Four 765 kV line bays
- Ten 500 kV line bays
- Twelve 220 line bays
- Ten 132 kV line bays

The feasibility study of the grid station is yet to be carried out. A typical layout of 500 kV grid station is shown in Figure 3.7. The key components in the proposed 500 kV grid station are; (i) bay, (ii) control building, (iii) residential colony with water supply and sanitation facilities, (iv) fencing and landscaping, and (v) Access road. These key components are further described in the following sections.

Bay

A substation "bay" is the physical location within a substation fenced area where the high voltage circuit breakers and associated steel transmission line termination structures, high-voltage switches, bus supports, controls, and other equipment are installed. For each transmission line, 500-kV circuit breakers, high-voltage switches, bus supports, and transmission line termination structures would typically be installed. The 500-kV transmission line termination structures are approximately 40 m tall. Figure 1shows a perspective sketch illustrating the appearance of a typical 500-kV substation with multiple line connections.

Control Building

One or more control buildings are required for the substation to house protective relays, control devices, battery banks for primary control power, and remote monitoring equipment. The size of the building depends on design of the grid station. Typically, the control building will be constructed of concrete block, pre-engineered metal sheathed, or composite surfaced materials. Special control buildings may be developed within the substation developments to house other control and protection equipment.

Residential Colony

An employee residential colony will be built on one side of the grid station to house about 100 families. Common drinking water supply (through groundwater wells) and sewerage facilities (with septic tanks) will be established to provide water and sanitation facilities to the colony.

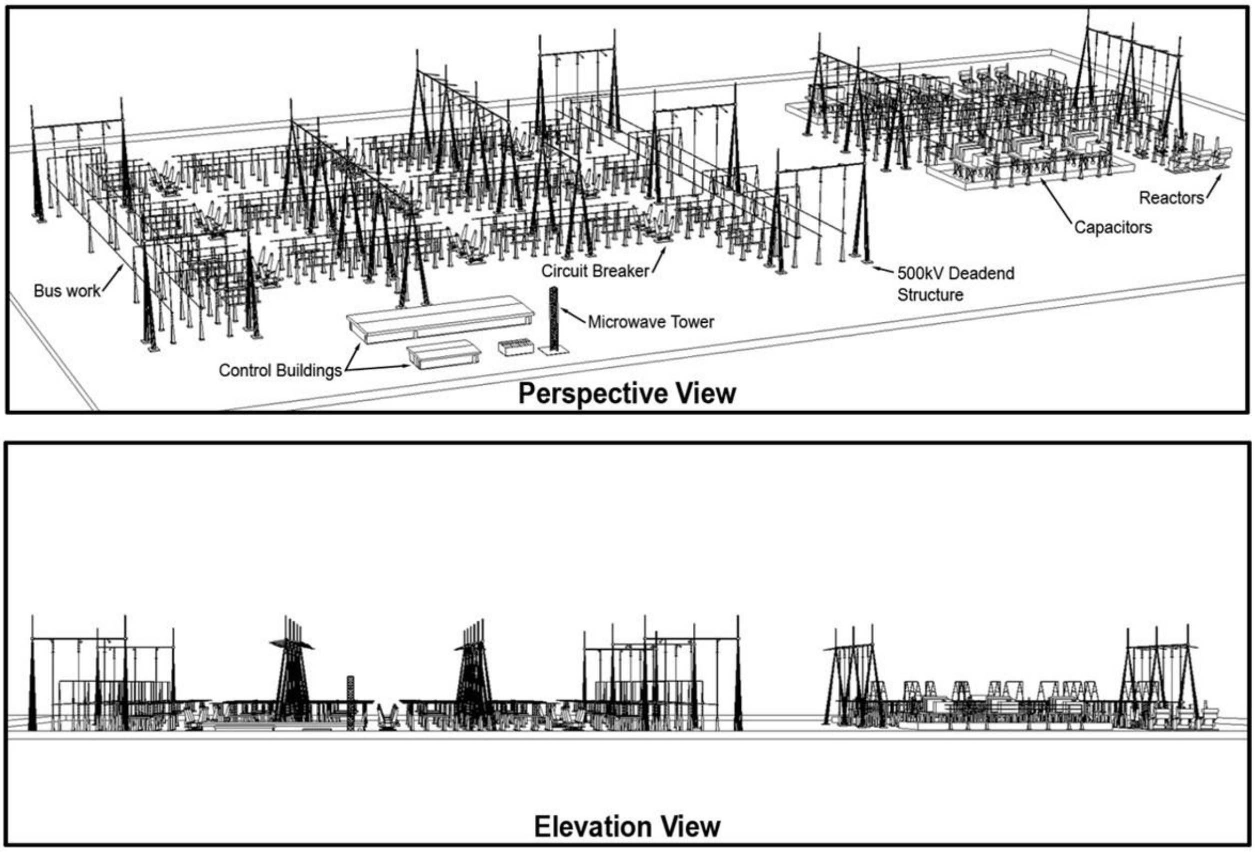
Fencing and Landscaping

A security fencing (a 2 m fencing wall with barbed wire on top) will be constructed around the entire perimeter of the grid station to protect sensitive equipment and prevent accidental contact with energized conductors by third parties. Landscaping using native vegetation will be established where allowed.

Access Road

The grid station site is currently connected to the Brahma – Bahlol road by a 2 km gravel road. This 2 km road will be reconstructed to provide access for personnel, material deliveries, vehicles, trucks, heavy equipment, low-boy tractor trailer rigs (used for moving large transformers), and ongoing maintenance activities.

Figure 3.7:Typical 500 kV Grid Station



3.3.4 Temporary, Related and Auxiliary Infrastructure

A number of facilities, referred to as 'related' infrastructure, are required to be developed or controlled by NTDC and its contractors to support the development of the main transmission components. Related facilities assessed as part of this ESA are:

- Construction camp for office and construction personnel (will be established at the proposed grid station site)
- Mobile camp for re-stringing works
- No access roads will be generally built by NTDC for the 500 kV transmission lines
- Construction lay down areas
- Spoil disposal areas
- Construction power supply.

3.3.5 Construction Activities and Program

The process for constructing the new connecting line will follow standard NTDC practice for transmission line construction. The key stages in the construction process are summarized in **Table 3.8**. For sections of the line that cross water bodies or existing service infrastructure, additional planning work is required and will be carried out during the detailed design stage.

Table 3.8: Typical activities in overhead transmission line construction

Stage	Activity	Description
1	Site Preparation	This may include: • Vegetation clearance where the line passes over or close to trees which could infringe safe clearances • Verification of local utilities and underground services prior to works and establishing of safeguards and obtaining of necessary agreements • Geotechnical and geographical surveys in advance of works where necessary • Any intrusive works undertaken in accordance with archaeological chance find procedures.
2	Site Enabling Works	This may include: • Determining access requirements (routes and detailed arrangements agreed in advance with land owners): – For tower locations where no vehicle access is required, access will be via the RoW / surrounding land with no new access construction. Normal practice in Pakistan is to transport construction materials from the closest road access by personnel or donkeys where possible. – For tower locations where it is determined vehicle access is required, access will be via: – existing access roads – the RoW / surrounding land with no new access road construction – in certain circumstances where ground conditions prevent normal access, it may be necessary to construct a temporary access road.
3	Civil Works	Tower foundations are constructed first, either four or one foundations per tower depending on the final tower design. The foundations are mechanically excavated and filled with concrete. Piled foundations may be required in some areas where ground conditions are unstable. The dimensions of the excavation will differ depending on the type of tower to be installed. Concrete would be delivered by ready mixed concrete truck from batching plants strategically located along the route. Foundation strengthening works typically require increasing the bulk of concrete in the foundation, depending on the additional tower loads that are expected. This normally involves excavation around the existing foundation and application of additional concrete.
4	Steel Erection	Steelwork sections for the towers will be delivered by road using a 4 x 4 truck. The assembly of each tower at ground level would proceed as far as possible until the utilization of a crane becomes necessary to enable the higher sections of the tower to be completed. It is normal

		practice to use cranes to erect steelwork, subject to good access being available. In very rare cases where terrain is difficult and to minimize disturbance, steelwork may be delivered by helicopter.
5	Conductor Stringing	Stringing is undertaken using a winch to pull the conductor along the towers and a 'tensioner' at the other end to keep the conductor above the ground. Typically, the section length is 8-10km. These winch locations are not fixed and can be selected to minimize impact at sensitive locations.
6	Testing of Equipment	Overhead line components including conductors, insulators, towers, joints and fittings are designed and tested to prove compliance with structural, mechanical and electrical requirements.
7	Reinstatement of Tower Construction Area	At completion, the area would be cleared and tidied up. Fences and hedges would be repaired and access routes and disturbed land would be reinstated in agreement with the land users and title owners. Any site security fences would be retained throughout the dismantling and construction process.

3.3.6 Construction Approach

The construction approach and procurement strategy to be employed for the Power Evacuation Facilities will be driven by the short timeframe within which to develop and commission the works. The procurement strategy is yet to be finalized however it is likely that NTDC will adopt an Engineer Procure Construct (EPC) type of contract for these works where the EPC contractor will design the works, procure the equipment and undertake the construction works all in one package. The letting of this contract would follow standard World Bank procedures including pre-qualification and competitive bidding.

Both skilled and semi-skilled construction workers will be required throughout the project. It is estimated that, during construction, the project will generate employment of about 60 people in total.

3.3.7 Temporary and Permanent Land Requirements

The 50 km Tarbela – Islamabad West transmissinon line does not require any permanent land acquisition. The land needed for transmission line towers (each tower require about 200 square meters of land) will be temporarily occupied during construction and will be subjected to short-term disturbance during construction and then some restriction to mechanical agricultural equiment during operation. For Islmabad West Grid Station, about 226 acress of land will be required on permanent basis.

3.3.8 Construction Camps

For the construction of new transmission lines, there are three main workforce activities, namely, foundation laying, tower erection and stringing. Based upon the new connecting line construction, three types of construction crews are deployed for the work. The estimated work force required for each group of activities is shown in **Table 3.9** below.

Table 3.9:Estimated work force

	Staff	Foundation Crew (FC)	Tower Erection Crew	Conductor Stringing Crew
1	Site Manager	1	Same as FC	1

2	Site Engineer	1	Same as FC	1
3	Supervisor	1	Same as FC	2
4	Foreman	1	Same as FC	1
5	Surveyors	1	-	1
6	Skilled Workers	4	4	6
7	Semi-skilled Workers	-	2	6
8	Unskilled Workers	8	Same as FC	12
9	Drivers	1	Same as FC	2
	Total	18	6	32
	Overall Total			**56**

The total number of crew, skilled and unskilled labor to be employed will depend on the Contractor's activity schedule. The Contractor will be advised to hire unskilled labor from the local communities. A training program will be recommended for unskilled workers at the detailed design stage.

For the client and supervising engineer staff, there are plans to use the existing T4HP extension office building and a further existing building located between the T5 tunnel and the service spillway. However, in order to use these as camp offices, some building renovation will be required. These two buildings will provide all the facilities required for Project Management. Security at Tarbela is generally provided at the perimeter of the site and for the T4HP there is limited additional security at the office. This position is continually under review and we would expect WAPDA to provide security for these facilities as necessary.

The Contractors will need their own offices and associated facilities. It is anticipated that the foundation and tower erection contractors would have separate camps containing both offices and accommodation for their staff.

Unskilled workers have been recruited from the local community and they have a preference for living in their family homes and using transport provided to travel to site on a daily basis. Whilst this might suit the individuals is does increase the transport that the contractor has to provide and this is a significant drawback. The take-up of the accommodation on site for the T4HP Project has been less than expected and this is possibly due to the poor quality of the available site accommodation.

Two options are being considered at present with regards to accommodation of construction workers for the T5HP Project and which would be utilized for the construction of the new connecting line, 1) refurbishment of existing accommodation to an acceptable standard and 2) development of a new construction worker camp on the right bank of the Dal Dara channel, approximately 1km downstream of Dal Dara weir. The proposed area is almost flat and only clearing and grubbing is required. The area is easily accessed from both the T5HP and T4HP office locations. In addition, there is also potential for land on right side of the service spillway to be levelled for use as a labor camp.

The labor requirements of the stringing crews for the upgrade works is estimated at 32. As these teams will be working for relative short time periods over a long distance, temporary accommodation arrangements will be required. Mobile camps (tents) that can be erected, taken down and moved along the Power Evacuation Facilities RoW as stringing progresses, have been proposed.

3.3.9 Access Roads

For the new connecting line, existing roads used for access to the T5HP construction site may be used. For construction works, workers are dropped off at the nearest surfaced road with the required equipment and materials. The materials are then either carried or loaded on transportation to the work site. Further minor access routes may need to be defined to complete construction/re-stringing works. This needs more detailed information. The key access routes need to be identified and shown on maps of appropriate scale.

3.3.10 Construction Materials

Concrete aggregate materials required for the new connecting line will be recycled from the T5HP Project or T4HP excavation activities as far as practicable, and if required, it can be supplemented by rocks extracted from the Indus River bed. A full list of coarse aggregate sources identified for the T5HP Project is provided below:

- T5HP Project excavations
- T4HP stockpiles
- The Indus River bed in the vicinity of the T5HP Project
- Commercial quarries at Qibla-Bandi and Lawrencepur.

A quarry area for fine aggregate (sand) has been identified on the left bank of the Dal Dara channel just downstream of the proposed switchyard area. The quality of the sand will be reviewed after investigation results have become available. The quality of the sand will be reviewed after investigation results have become available. As an alternative, sand from Qibla-Bandi and Lawrencepur, some 20-30km downstream of Ghazi town on the left side of the Indus valley can be used. These well-established commercial quarries can provide good sources of riverine sand that can help to provide more workable concrete than is possible from crushed rock.

It is intended that the T4HP batching plant will be maintained for the T5HP Project and this should have the capacity to provide the majority of concrete requirements. If an additional batching plant is required a number of acceptable locations exist close to the proposed new facilities.

Construction lay down areas will be designated for transmission pylon materials in the vicinity of the new transmission line.

3.3.11 Safety Parameters

For Extra High Voltage (EHV) lines, safety considerations are of two types, namely system safety and public safety. After some reconnaissance, NTDC determined that the RoW applicable to the Power Evacuation Facilities would be 80m (40m from either side of the center line) which is the basis for setting the ADI for this ESA. The RoW public safety design constraints require the following:

- Beneath the transmission lines, general farming activities are allowed however, trees higher than 2.5m are allowed under no circumstances in the RoW.
- Persian wheel wells are allowed to remain, however, tube wells with submersed cylinder hand pumps are not due to the piping, well rods and cranes required for their refurbishment, which could result in contact with the transmission line.
- No residential buildings or public buildings are allowed in the RoW.

Non-residential farm buildings are permitted providing a 10.2m clearance is maintained and tower heights can be increased to accommodate such occurrences.

3.3.12 Operation and Maintenance Requirements

The power evacuation facilities will be operated and maintained by NTDC in accordance with its general system maintenance procedures. This involves an inspection regime which requires access to the towers from time to time and visual inspection of the line corridor. Where defects or repairs are noted, then maintenance crews will be mobilized to undertake the corrective works. Land users and title holders are required to keep tree heights within the 2.5m limits and this requirement is enforced by the NTDC inspection teams. Also, the ability to access the right of way is ensured. Should larger scale works be identified, then this will generally be undertaken by suitable call-off contractors under individual contracts.

3.3.13 Decommissioning

As decommissioning is anticipated to be far into the future, it is difficult to produce an accurate and meaningful prediction of the significance of impacts and their effects. Typical impacts associated with decommissioning works for transmission lines relate to:

- Waste disposal
- Removal of foundations
- Occupational health and safety.

Operations during the lifetime of the power evacuation facilities should not lead to any deterioration of the site. NTDC will ensure through an operational ESMP that a coherent record of the state of the site throughout the period of construction and operation is maintained. The site will be returned to a condition suitable for reuse in line with the proposed end use. A full environmental departure audit would be required to examine in detail all potential environmental risks existing at the site and make comprehensive recommendations for remedial action as necessary. Following completion of demolition, a final audit would be carried out to ensure that all remedial work has been completed.

3.4 Pilot for Floating Solar Panels in Tarbela Reservoir

There are two critical issues that large installation of solar power plants face: (a) availability and cost of land, and cumbersome acquisition process; and (b) construction of transmission line to connect to the grid. Recently in a lake in Japan floating solar panels have been installed. Considering this development, the Tarbela reservoir area offers huge potential for installation of a floating solar power plant, over 7,000 MW as surface area is available already acquired by the Government as well as the transmission line is available and if needed can be strengthened easily. Generally, during most of the year Tarbela is operated as four-hour peaking in the evening and if more water is available only then additional generation is done during other parts of the day. A combination of solar and hydel generation from Tarbela can be synchronized providing constant flow of electricity to the grid all day long during most part of the year. The solar plant would generate energy during the day and the hydel plant would generate during the evening and night hours when solar is not produced, except in few flood months when hydel can generate all day long.

In order or test the floating solar plant in Tarbela reservoir and sort out all implementation, operational and maintenance and management issues of the floating solar plant, synchronization of operation of hydel and solar plants in practice, the project would include pilot for installation of 10MW of floating solar panels in the Tarbela reservoir area. This idea seems to be quite promising. Even if only 60% of the surface area of the reservoir at the dead storage level is used to install the solar panels it could provide about 7,000 MW that is equal to total installed capacity at Tarbela after T4HP and T5HP are commissioned without acquiring any land and water would also be available for cleaning/maintenance. In addition, power from solar panels can be supplied to the grid using the existing network. Therefore, cost of supply is expected to be very less, particular considering very short and incremental gestation period for the solar plant.

3.5 Summary of Project Costs

The overall implementation costs of T5HP, excluding development of grid station at Islamabad, are given in Table 3.10. The cost of T5HP is about USD826 million. WAPDA would finance about USD124.5 million and NTDC about USD8.6 million, and the remaining amount will be financed by World Bank by providing additional finance (AF) under T4HP.The cost of land for Islamabad West Grid Station will be funded by Dasu Hydropower Project since it will receive power from both Dasu and T5HP projects. The grid station itself, all equipment, 765 kV, 500 kV, and 132 kV equipment, bus bars and control station etc., would be funded from the proposed World Bank FundedTransmission Modernization project.

Table 3.10:Estimated cost of T5HP and Financing Plan

	Total	WB IBRD AF	AIIB	WAPDA /GoP	NTDC /GOP	Total
A. Power House and Tunnel Works	**302.7**	**92.2**	**150.0**	**60.5**		**302.7**
B. Turbines, generators and auxiliaries						
B1. Turbines generators and related equitment,	251.4	111.1	90.0	50.3		251.4
B2. Transformers, switchyard electrical. connection	68.4	19.7	35.0	13.7		68.4
B3.1 Transmission Line to Islamabad West	43.0	34.4			8.6	43.0
B3.2 EAP and SAP cost of Transmisison line	15.0	15.0		-		15.0
Sub-total B	**377.7**	**180.2**	**125.0**	**63.9**	**8.6**	**377.7**
C. Implementaton of SAP and EMP, Dam Monitoring						
C1. Social Action Plan (SAP) for legacy issues	4.2	4.2		-		4.2
C2. Environmental Management Plan (EMP)	3.0	3.0		-		3.0
C3. Dam saftey and montoring program	5.8	5.8		-		5.8
Sub-Total C	**13.0**	**13.0**		**-**		**13.0**
D. Consultancies for Supervision						
D1. Construction Supervision consulting services	28.5	28.5		-		28.5
D2. M&E, supervision of EMP and SAP, Project	3.5	3.5		-		3.5
Sub-total D	**32.0**	**32.0**		**-**		**32.0**
E. Project Management, TA, Training						
E1. PMU support and audits	8.8	8.8		-		8.8
E2. Capacity building TA, POE, training	6.2	6.2		-		6.2
E3. Strategic studies, pilots and future project preparation	27.6	27.6		-		27.6
Sub-total E	**42.6**	**42.6**		**-**		**42.6**
Fees and IDC	**58.1**	**33.1**	**25.0**	**-**	**-**	**58.1**
Total Project Cost	**826.1**	**393.0**	**300.0**	**124.5**	**8.6**	**826.1**
Share as percentage of Total Cost		48%	36%	15%	1%	**100%**
a/ WAPDA/GOP share - Component A: 20%, Component B: 20%						
Tax Content at 19%	145.9					

4 Analysis of Alternatives

This chapter presents the analysis of various alternatives considered during planning and design of the T5HP, routing of transmission line and siting of grid station.

4.1 No Project Alternative

Pakistan is suffering from an acute power and energy crisis, which is primarily caused by the increasing gap between the supply and the demand of electricity. The current (2015-2016) generating capability of Pakistan is 18,760MW in summer and 14,833 MW in winter, whereas the current demand is about 22,880 MW. Thus the current short fall is 4,120 MW and 8047 MW in the summer and winter seasons respectively. Pakistan's power needs are increasing with a growth rate of 7 to 8 % (according to Pakistan Electric Power Company, the demand will be 96,000 MW by 2029-2030) whereas the generation additions are too slow to accompany the same pace and there will be insufficient generation to meet the future demand in the coming years.

Another major problem in the sector is the high cost of electricity generation. In the past the country has not invested sufficiently in its huge hydropower potential and is strongly dependent on the existing thermal power plants. These plants are not running up to their full capacity, due their dependency on imported fuel. With limited indigenous oil, Pakistan has to import over 70% of its requirements resulting in a debilitating drain on the country's balance of payments. Lack of foreign exchange to pay for fuel supplies has resulted in production of electricity below capacity of the present plants. Although several gas field plants have been commissioned during the last two decades, the reserves in these gas fields are dwindling.

Power shortages result in long hours of load shedding, impacting households, industrial and commercial activities. Lack of power affects people's quality of life, schools, colleges, clinics and hospitals; shops and businesses, reducing sales and revenues; and industry, reducing productivity. It also deters investment. This means, on a macro level, reduced economic growth which translates into loss of livelihoods, jobs and income. The financial impact of load shedding has been estimated at 3 percent to 4 percent of GDP, costing about USD 10 billion a year. This situation is causing serious economic losses to the country and is responsible for increased unemployment and poverty.

The 'no project alternative' will result increased gap in demand and supply leading to more load shedding and power cuts with considerable social and economic impacts such as impeded economic growth, increased unemployment and poverty. Hence without project alternative is not realistic and Pakistan need to build additional generating plants to eliminate the power shortages.

4.2 Alternatives to T5HP Project

The relevant alternative projects to the proposed T5HP Project can be grouped into three categories: (i) hydropower projects other than T5HP, (ii) other renewable projects such as wind and solar, and (iii) thermal power (coal, oil and gas). The other potential options such as demands side management and improved utilization efficiency, and reduced transmission and distribution losses, are already being undertaken by the government through various projects, but they are unlikely to fully cover the energy shortfall. These projects include World Bank funded Pakistan - Electricity Distribution and Transmission Improvement Project, and Asian Development Bank funded Energy Efficient Investment Program. Pakistan is also planning to import about 1,000 MW of electricity from Central Asia (CASA 1000) to partly address the shortfall.

4.2.1 Alternate Hydropower Projects

Pakistan has a lot of hydropower potential in the Upper Indus Basin. Out of an estimated potential of 46,000 MW so far only about 6,500 MW or 14 percent is utilized. Investing in hydropower development can provide additional generating capacity less expensively and in an environmentally cleaner manner than any thermal alternative with almost no long-term fuel cost. Development of hydropower potential can contribute in reducing the cost of electricity generation, reducing the sector deficit by injecting positive cash flow, saving foreign exchange by displacing imported fuel and reduction of carbon dioxide (CO2) emissions.

The government is planning to build 10 major hydropower projects in Indus and its tributaries including the World Bank funded Dasu Hydropower Project. All these projects are greenfield developments and each of these projects will have significant social impacts primarily from land acquisition for building dam, reservoir, power house, switchyard, offices, access roads etc. Compared to these projects T5HP, which is just an augmentation of existing Tarbela Dam, doesn’t require any land for building the dam and reservoir. Further the land required for all associated facilities such as access roads, powerhouse, switchyard, workers camp, batching plant, spoil disposal areas, etc. are located within the sites owned and managed by WAPDA, and no people live in these areas. The T5HP is also a least cost option compared to other planned hydropower projects and can be implemented in a short time of four years.

4.2.2 Alternate Renewable Energy Projects

The main sources of alternative renewable energy available to Pakistan are small and medium scale hydropower, wind and solar power. These options are being actively pursued and have the same beneficial impact in avoiding the environmental externalities of fossil generation. However, the scale and nature of these resources are such that these cannot be viewed as a mutually exclusive substitute for T5HP. Both of these options need to be developed to the extent technically and financially feasible: they are complements, not substitutes to T5HP. Further as explained in the previous section, the T5HP doesn’t require any additional land acquisition and hence a better option compared to other renewable energy projects. Also T5HP require shorter implementation period (because dam and tunnel already exist), compared to other hydropower projects.

4.2.3 Comparison with Thermal Power Projects

In Pakistan, the domestic gas resources are limited, oil is mostly imported and exploitation of Thar coal is still under investigation. As explained in Section4.1, the present generation is highly dependent on imported fuel which is very expensive. T5HP is compared with various thermal alternatives such as High Sulfur Fuel Oil, Thar Coal plant, Natural Gas plant and Combined Cycle Gas Turbine -in terms of their CO2and other emissions, and presented in Table 4.1.

The CO_2 emissions from thermal alternatives vary from 0.68 to 1.74 million tons per annum, while CO_2 emissions from T5HP are negligible (further discussed below). In addition, thermal generation will emit large amounts of particulate matter (PM), sulfur dioxide (SO_2), carbon monoxide (CO), and nitrogen oxides (NOx) - adversely damaging ambient environment and public health.

The impacts of air pollution caused by thermal power generation are significant. High concentrations of NOx can cause inflammation and reduced lung functions. High concentrations of SO2 can also affect breathing functions and can cause inflammation of the respiratory tract. SO2 also contributes to the formation of particulate matter (PM) in the atmosphere. PM can penetrate into sensitive parts of the respiratory system, and can cause or aggravate cardiovascular and lung diseases. The impacts of thermal alternatives are much more difficult and costly to mitigate than the limited health impacts from hydropower projects.Health damage cost for thermal alternatives may vary considerably as can be seen fromTable 4.2.

Table 4.1: Comparison between Hydropower and Thermal Alternatives

		Hydro-Power	Thermal			
	Unit	T5HP	High Sulfur Fuel Oil	Thar Coal	Natural Gas	Combined Cycle Gas Turbine
Technical						
Required Capacity[1]	MW	1,410	250	250	250	250
Load Factor	%		85	85	85	85
Annual Electricity Generated	GWh	1,826	1,862	1,862	1,862	1,862
Efficiency	%		39	39	39	55
Calorific Value	Btu/Kg		40,216	21,844	936.8	936.8
Calorific Value	TJ/Ton		0.042	0.02		
Annual Fuel Consumption	million		0.4 tons	0.86 tons	16.28 mmbtu	11.55 mmbtu
Environmental						
Annual CO_2 Emissions	million tons	0	1.33	1.74	0.96	0.68
Annual CH_4 Emissions	tons	0	14		17	12
Annual PM Emissions	ton	0	1926	222	71	50
Annual CO Emissions	ton	0	258		309	219
Annual NO_X Emissions	ton	0	3437	1340	4296	3046
Annual SO_2 Emissions	ton	0	240,968	2,640	531	377
Annual Total CO_2 eq. Emissions	million tons	0	1.331	1.739	0.965	0.684

Note [1]: Required capacity for thermal alternatives to generate approximately 1826 GWh
Source: Consultant's estimate

Table 4.2: Health Damage and CDM Costs of Thermal Alternatives

Health Damage Cost	**Unit**	**T5HP**	**HSFO**	**Thar Coal**	**Natural Gas**	**CCGT**
NOx damage cost (1,308 USD/t)	Million USD	0	4.50	1.75	5.62	3.98
PM damage cost (1,504 USD/t)	Million USD	0	2.90	0.33	0.11	0.08
CDM Cost						
CDM Price of CO_2 (9.5 USD/t)	Million USD	0	12.63	16.52	9.16	6.49

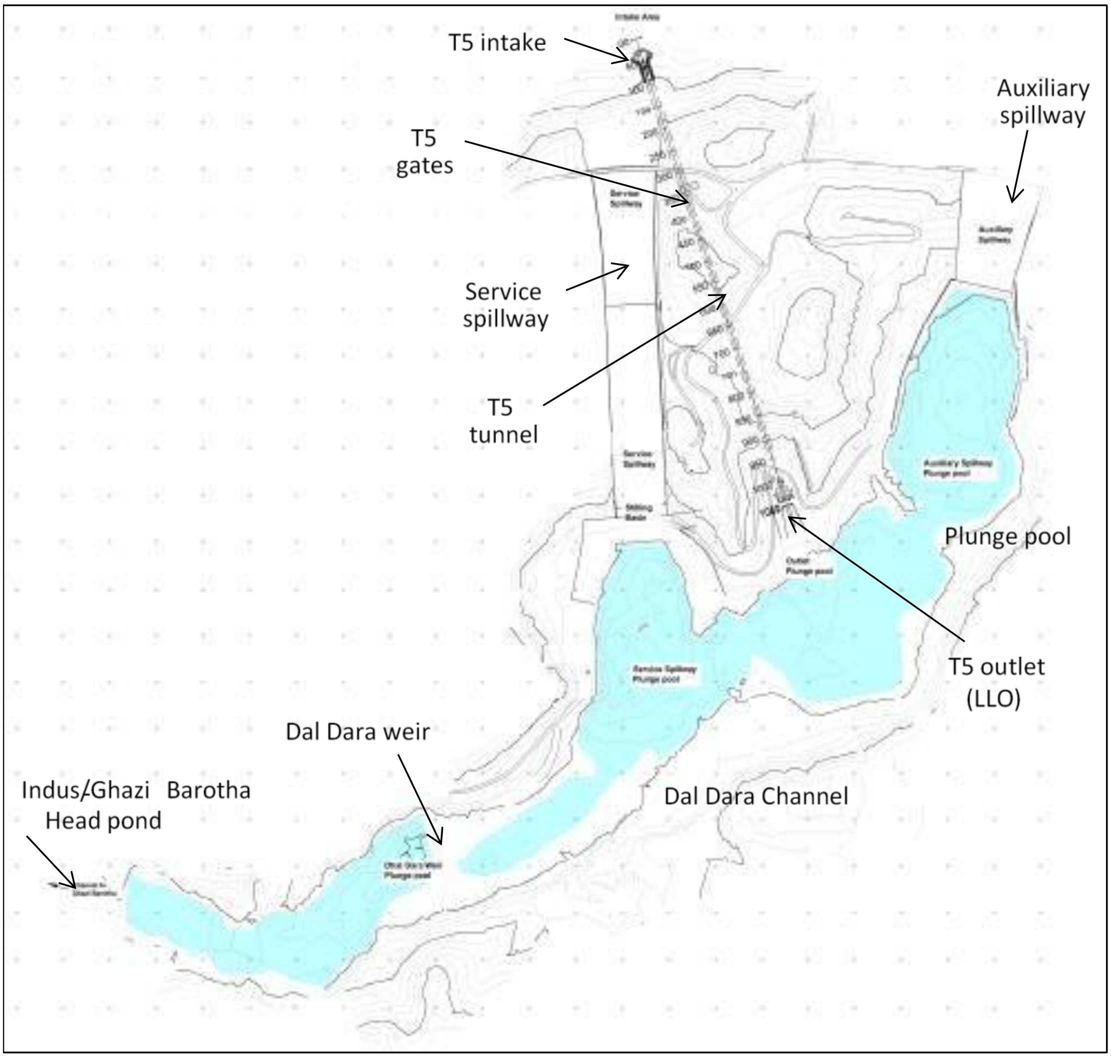
Note: source of health damage costs is European Environmental Agency 2011: Revealing the costs of air pollution from industrial facilities in Europe.

4.3 Alternatives to T5HP Layout and Design

The Tunnel 5 of Tarbela is originally designed to release irrigation flows during high flow season between May and July. The current layout of T5 is shown in Figure 4.1. The T5 is a

213 m length of tunnel, whose intake is located close to the Indus left bank between the main and auxiliary spillways (at an elevation of 362.7 masl) and outlet (a low level outlet, LLO, with a flip bucket structure) is located towards the plunge pool (elevation 361.9 masl). The plunge pool is connected to the main Indus (Ghazi Barotha Head Pond) through a manmade channel and weir (called Dal Dara Channel and Weir). The function of Dal Dara weir is very critical since it will maintain the minimum water level in the Dal Dara channel so as to ensure that there will be sufficient water within the plunge pools of Main and Auxiliary spillways. The weir raises the water level in the channel to about 11m above the level of the Ghazi headpond.

Figure 4.1: Layout of Current Tunnel 5 of Tarbela Dam



The key components of proposed T5HP design are:

- Intake
- Connection from T5 tunnel to Powerhouse and LLO
- Powerhouse location and type
- Tailrace.

Several options for each of the above component were considered and described in the following sections. Options for each component were studied in combination with other components to select the final design option. The combination of series of options are referred as ‘Cases’ and 11 such cases were studied for the Project as shown in Figure 4.2.

4.3.1 Intake Options

Tarbela reservoir is being filled up with sedimentation and with ongoing sedimentation process and delta movement, it is expected that current T5 intake will be blocked within next 10 to 30 years. If the intake level is raised above the current level the life of tunnel can be increased, and more power can be generated due to increased head. The following two options were considered for intake:

I. Raised intake (selected option): In this option the intake level will be located at 421 masl, about 58.3 m level higher than the current level. A new tunnel will be built at this point and will be connected to the existing tunnel
II. Existing intake: In this option existing intake level will be kept as it is at 362.7masl

4.3.2 Connections Options from T5 to Power House and LLO

The following potential arrangements were considered for modification of T5 tunnel to connect to the new power house and existing or new LLO. The tunnel can be separately connected to power house and LLO (Options A and B) or directly connected to the new power house and then to the LLO (Options C and D).

A. Bend at the T5 portal with a penstock to the power house and a connection to the existing LLO (selected option)
B. Bifurcation on the T5 tunnel with a tunnel to the powerhouse and using the existing tunnel to the existing LLO
C. Bend at the T5 portal with penstock to the powerhouse and new LLO
D. Straight connection at the T5 portal with new LLO as part of Power house.

4.3.3 Power House Locations

A power house will be required to accommodate three numbers of 482 MW turbines. A number of potential powerhouse locations were identified as described below.

a. Powerhouse to west of T5 using existing LLO (selected option): In this option a new powerhouse will be built on the concrete structure between main spillway and T5 outlet.
b. Powerhouse to west of T5 with new LLO: In this option a new powerhouse will be built in the same location as above option, an in addition a new LLO will be built.
c. Powerhouse on centerline of T5 with new LLO
d. Underground powerhouse before T5 portal: This will be an underground structure.
e. Powerhouse at or below Dal Dara weir

4.3.4 Tailrace Option

The tailrace is the outlet of the powerhouse, returning waters back to the river once the water has been through the turbines. Three options were considered for tailrace as described below. The last two options will allow the turbines to access the lower water level of the Ghazi Barotha to produce more power generation.

P. Tailwater at higher level to plunge pool: In this option the water from the power house will be directly discharged in to the plunge pool

C. Tailwater at lower level to plunge pool and Ghazi Barotha head pond via culvert and canal: In this option, the water from the power house will feel to a culvert across Dal Dara channel (a 360 m concrete structure buried beneath the current channel bed) and then to canal (710 m long), along the left bank of the channel, that will discharge downstream of Dal Dara Weir.

T. Discharge to Ghazi Barotha head pond via either long tailrace tunnel: In this option a new tailrace tunnel of about 1000 m length will be built from the power house to Ghazi Barotha head pond.

4.3.5 Selected Option

The final option for the T5HP layout and design has been selected based on the study of combination of various above options proposed for each component. The combination these options are divided as 11 cases (Figure 4.2) and all these cases were evaluated in terms of their technical, economic, environmental and social impacts. Finally, Case 1C, comprising the following, has been chosen for the T5HP design

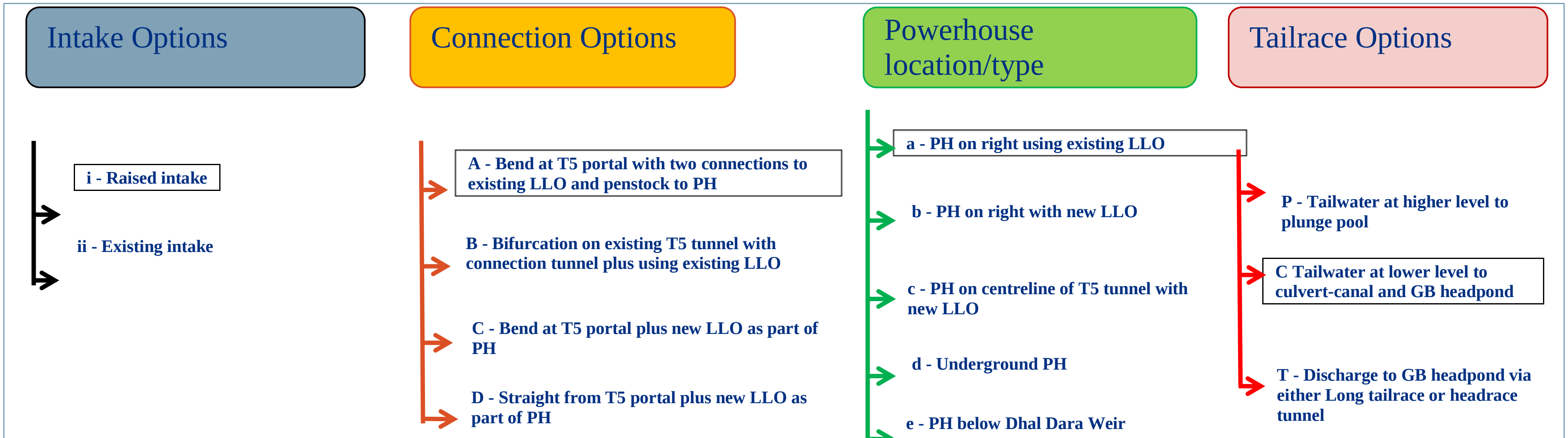
- Raised intake to reduce the risk associated with blockage of existing intake due to moving sediment delta
- Modification to the existing tunnel to connect to a new penstock to the power house. The existing LLO structure will be retained through use of existing tunnel.
- Powerhouse situated on the rock promontory between the existing LLO structure and the Service Spillway plunge pool
- Tailwater culvert and canal to allow discharge directly to the Ghazi Barotha head pond level.

Technically the selected option Case 1C is more preferable due to its technical robustness and a high degree of integration with the operational regime of the overall Tarbela Dam Project. Environmentally and socially, the selected option has the following advantages:

- More power generation compared to other options. The increase in energy will make the Project similar in performance to the existing power stations at Tarbela.
- Due to increased intake level, the life of T5 tunnel will be increased to minimum by another 10 to 20 years and safeguard against intake closure because of sudden movement of sediment. Without the raised intake the current intake level is expected to be blocked by in another 10 to 30 years. The extended life of T5 tunnel will ensure the irrigation for an extended period of 10 to 20 years.
- The irrigation flows will not be obstructed even when the power house is not in use (e.g. during repairs) due to provision of separate penstock to power house from the main tunnel.

Environmentally the selected option has few disadvantages related with construction works such as generation and disposal of more spoils and additional construction works in the Dal Dara channel. But these impacts are construction related and can be easily managed by implementation of ESMP presented in this ESA. The construction works related to T5 during months of May to July will obstruct the irrigation discharges and hence no construction works will be taken up during months of May to July that will affect the irrigation discharges of T5. The impact of irrigation discharges due to raised intake are also found to be minimum; from a historical record of 40 years on the reservoir water levels are found to be well above the 421 masl (the proposed intake of T5) except for only 6 days in last 40 years.

Figure 4.2: Summary of options for each component and for overall project



Note: Selected options are shown in a box

Case	Code	Design case	Tailrace variant	Comment
Case 1P	iAaP	Penstock option keeping existing LLO	Without tailwater culvert and canal	
Case 1C	iAaC		With tailwater culvert and canal	Selected option
Case 2P	iBaP	Tunnel bifurcation and new tunnel connection keeping existing LLO	Without tailwater culvert and canal	
Case 2C	iBaC		With tailwater culvert and canal	
Case 3P	iCbP	Penstock option with new LLO	Without tailwater culvert and canal	
Case 3C	iCbC		With tailwater culvert and canal	
Case 4P	iDcP	Straight connection to PH over demolished T5 Outlet and new LLO	Without tailwater culvert and canal	
Case 4C	iDcC		With tailwater culvert and canal	
Case 5	iBdC	With tunnel bifurcation & underground powerhouse	With tailwater culvert and canal	
Case 6	iCbT	Tailrace Tunnel (TRT) to below Dal Dara Weir	Long Tailrace tunnel to below Dal Dara Weir	
Case 7	iBeT	Headrace Tunnel (HRT) with PH below Dal Dara Weir	Direct discharge to below Dal Dara weir	

4.4 Alternatives to Switch Yards

There is an existing switchyard in the Tarbela (located on the downstream of the dam) and generator transformers for all existing power houses including T4 power house are directly connected to the existing switch yard. This switch yard has no additional space to accommodate three additional circuits from T5HP power station, and associated equipment such as switch gear, circuit breakers, etc. Any future expansion to this grid station can only possible by reclaiming more land in the Indus/Ghazi Barotha head pond. Further in order to connect this existing switch yard, the circuits from T5 need to cross two existing 220 kV and three 500 kV lines.

The other option is to build a new switch yard on the left bank on the south side of Dal Dara channel across the proposed T5HP power house. Technically this option is more feasible and environmentally also this option is preferable due to avoided impact on the aquatic habitat (land is to be reclaimed in Ghazi Barotha head pond for the above option). Socially also there are no issues for this option since all the land required for this switch yard is within the Tarbela and free of squatters. Hence a new switchyard will be built for T5HP.

4.5 Alternates to Power Evacuation

Two 500 kV circuits will be needed from the proposed switch yard to evacuate power from T5HP. There are already three existing 500 kV transmission lines and two 220 kV transmission lines to evacuate power from Tarbela to different load centers in the country. These transmission lines are sufficient to carry existing power generation of 4790 MW from Tarbela (including Tarbela 4) and do not have adequate capacity to carry another 1410 MW to be generated from T5HP. However two of the existing transmission lines to be upgraded to carry two 500 kV circuits along with upgradation of existing grid stations or a new transmission lines can be built with a new grid station. Three options are considered for the evacuation of power from T5HP and are shown in Figure 4.3 and include:

- Option 1: Upgradation of existing 103 km length of single circuit 500 kV transmission line from Tarbela to Rewat with double circuit 500 km transmission line and upgradation of existing 500 kV grid station at Rewat
- Option 2: Reconstruction of existing 35 km length of 220 kV double circuit transmission line from Tarbela to Burhan with a 500 kV double circuit transmission line and reconstruction of existing 220 kV Burhan grid station
- Option 3: A new 52 km length of 500 kV double circuit transmission line from Tarbela to a new grid station located close to Islamabad know as Islamabad West Grid Station. The new Islamabad west grid station is anyhow will be built for evacuation of other hydropower projects from Upper Indus Basin, including Dasu Hydropower Project.

A comparative evaluation of above three options are given in Figure 4.3. Option 2 of reconstruction of 200 kV line is discarded since it is not technically feasible.

Options 1 and 3 are technically feasible and both options need to be considered for further planning and design. In thins ESA study detailed baseline studies have been carried out for both the options. Option 3, building a new 500 kV double circuit to the new Islamabad West Grid Station, should be a first priority option since (i) upgradation of existing transmission lines require closure of power transmission through the existing lines during winter months, (ii) technically reliable and low system losses, and (iii) easier to implement. Though new transmission line will have more social impacts compared to other options, but considering the development of grid station at Islamabad for Dasu other hydropower projects, a new transmission line is preferable for the T5HP. However, the potential risk with this option is that the development new grid station may not be completed by the time T5HP is commissioned (expected to be commissioned by 2020) due to risk of delay in land acquisition for the new grid station and its development.

Option 1, upgrading existing 500 kV line, will be of second priority and should be considered in case it appears by next year (say by end of 2016) that Islamabad west cannot be developed in due time to connect generation from T5HP. Option 1 will have minimum social impacts compared to Option 3 since there is already an existing right of way for transmission line and no additional land acquisition is required for both transmission line and also the Rewat grid station. Detailed baseline studies also have been carried out for the Option 1 and presented in the **Annex 2**. If this option will be pursued in future, impacts and mitigation measures need to be prepared.

Figure 4.3: Options for Power Evacuation from T5HP

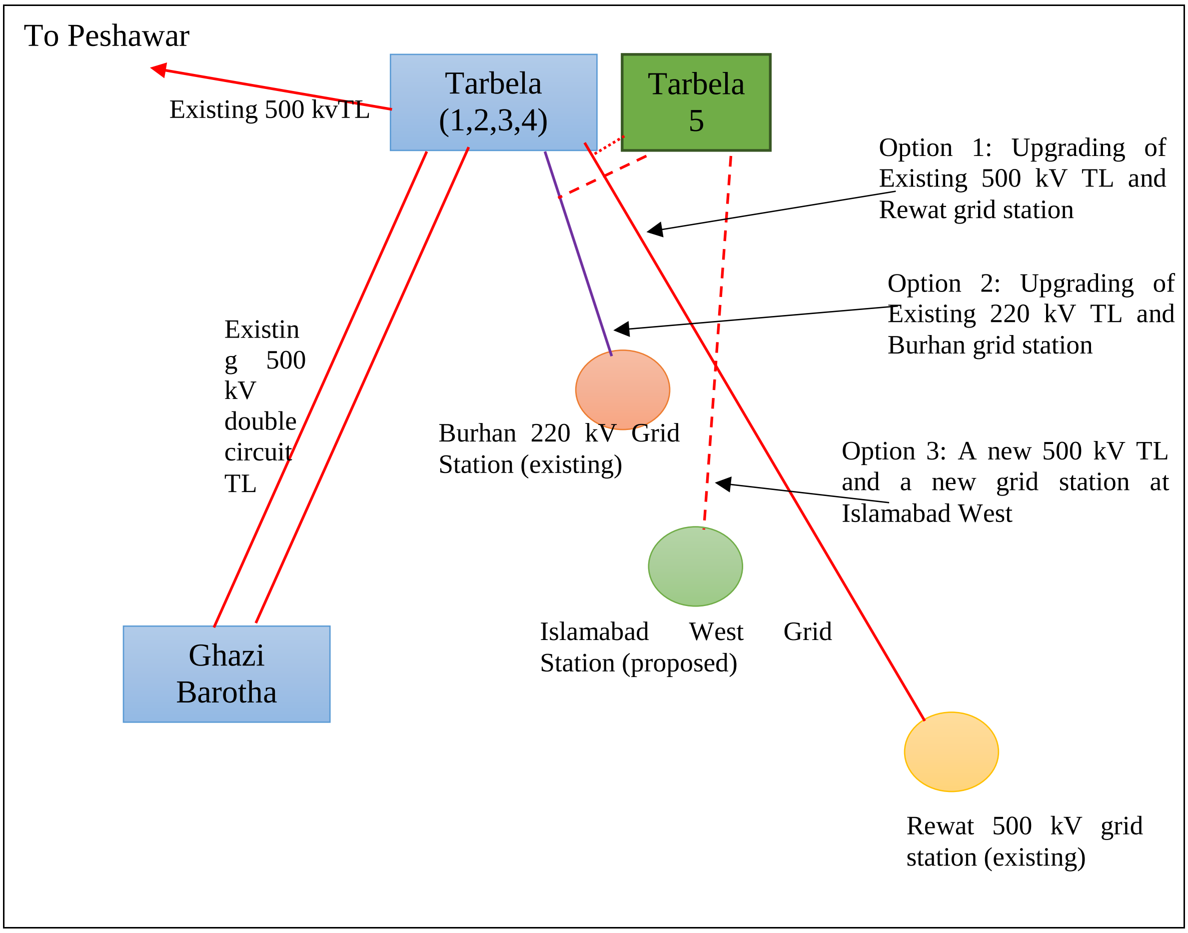


Table 4.3: Comparison of Power Evacuation Options from T5HP

	Option 1 (second priority)	**Option 2**	**Option 3 (first priority)**
Description	Upgradation of Tarbela to Rewat 500 kV single circuit line to double circuit	Reconstruction of Tarbela to Burhan from 220 kV double circuit line to 500 kV double circuit	Tarbela to Islamabad West Power Evacuation Route with a new 500 kV double

	Option 1 (second priority)	**Option 2**	**Option 3 (first priority)**
			circuit
Length of line	103km	35 km	52 km
Detailed scope of work	• 500 kV second circuit stringing on quad-bundled Drake conductor (3.5 km). • Dismantling of 500 kV Single Circuit (S/C) T/L • One No. 500 kV line bay at Rewat grid station	• Two 500 kV line Bays and 3x750 MVA, 500/220 kV transformers at Burhan. • Dismantling of existing Tarbela–Burhan 220 kV line. • 500 kV D/C T/L on quad-bundled Drake conductor from Tarbela 5th Ext. HPP to Burhan (35.1 km).	500 kV Double Circuit (D/C) T/L on quad-bundled Drake conductor from Tarbela 5th Ext. HPP to Islamabad West (52.4Km). Two No. 500 kV line bays at Islamabad West S/S.
Cost	USD 31.3 million	USD 47.9 million Highest interconnection cost	USD 33.4 million
System reliability	Technically reliable Transmission losses are higher than Option 3	Technically unreliable Highest transmission system losses	Technically reliable Lowest transmission system losses
New transmission line corridor	Not required	Not required	required
Disruption to the existing power supply	Require power shut down from existing lines on seasonal basis during lower water months	Similar to Option 1	No power shut down required.
Constructability	Difficult than Option 3	Not easy to implement	Easier
Land requirement for Grid station	No additional land is required	Additional land is required for 500 kV grid station	Land acquisition is required.
Construction period	One year		Three years
Risks of completing this line by the time T5HP is ready to generate power	No risks. This option can be implemented and can be made ready by the time T5HP is commissioned in 2020		The planning of the grid staton site is still in primary stages. Hence there could be some risks associated with delay in engineering design, procurement and land acquisition process for the grid station. If there is a delay, this option will be not be ready by the time T5HP is commissioned
Recommendation	Second priority option. This option will be considered by next year, by June 2016, if it is understood that Option 3 can be implemented in due time to connect generation from T5HP. This option can be implemented in one year.		First priority option.

4.6 Alternate Sites for Grid Station

A feasibility study[4] carried out in 2012 for evacuation of 24 hydropower projects from northern Pakistan have recommended development six grid stations at Chilas, Mardan, Mansehra, Aliot, Islamabad, and Lahore. Islamabad west station would be common for both Tarbela and Dasu Projects and it would be an important hub of energy in the northern side of grid serving Islamabad and northern Punjab. It is estimated that about 200 acres of land is required for the construction of proposed grid station to receive power from both Dasu (765 kV lines) and T5HP (500 kV lines). Three sites have been identified by NTDC for developing of this grid station at a distance of 25 to 30 km from Islamabad on northern side close to Brhma interchange on Motorway 1. All these sites are located in Fateh Jang Tehsil of Attock District. These are:

- Site 1: Moza Kamalpur Miyan
- Site 2: Brahma Pathergarh
- Site 3: Moza Chaharat

A comparative evaluation of these sites in terms of their technical and environmental criteria is presented in Table 4.4. The site 1 at Monza Kamalpur Miyan is recommended due to availability of flat land and access roads. Further, due to availability of an existing access road, Site 1 it has lesser social impacts compared to other two sites where more land acquisition and resettlement would be required for building the access road.

Table 4.4: Comparison of Various Sites for Islamabad West Grid Station

Criteria	**Site 1: Moza Kamalpur Miyan (recommended)**	**Site 2 Brahma Pathergarh**	**Site 3 Moza Chaharat**
Suitability of the site for grid station.	This is a flat land and suitable for development and installation of various faculties for 500 kV and 765 kV lines	This is a badland formation (with undulated terrain and sudden depressions of 6 to 10 m) and hence not suitable for development and installation of 500 kV and 765 kV lines.	Land form is somewhat similar to Site 2 but with lesser depressions. Suitable for substation, but transmission line cannot be brought and taken out; and the site is not suitable for distribution of power
Land use	The land is being used for agricultural purpose	Most of the land is being used for agricultural purpose, while some parts are left barren	Similar to Site 2
Environmental	Environmentally all	Similar to Site 2. A	Similar to Site 2

[4]Feasibility Study Report for Evacuation Of Power From 26 Hydropower Projects In The North, NTDC 2012.

sensitivity	the sites can be grouped in to same category and no environmental sensitivity or sensitive receptors are noticed in the site.	small stream is flowing through the area. This site is close to Motorway 1 and may be subjected to noise pollution from the traffic.	
Access roads	Access road is available from Motorway 1	A 2 km of access roads need to be built	A 1 km of access road needs to be built
Land acquisition and resettlement	Land acquisition is required but no physical displacement is required since no households are located in this site.	Similar to Site 1. Additional land acquisition is required for access roads.	Similar to Site 1. Additional land acquisition is required for access roads

5 Environmental and Social Baseline Conditions

The power generation element of the T5HP project activities cover a limited area located at the left bank of the Indus on left side of the Tarbela dam (see **Figure 3.3**). Direct and indirect impacts are expected not to extend more than 5 km upstream and 10 km downstream of the dam and 2 km inland on both sides of the river. Some indirect impacts might be expected at larger distance in quarries and borrow areas situated at some 20 – 40 km from Tarbela.

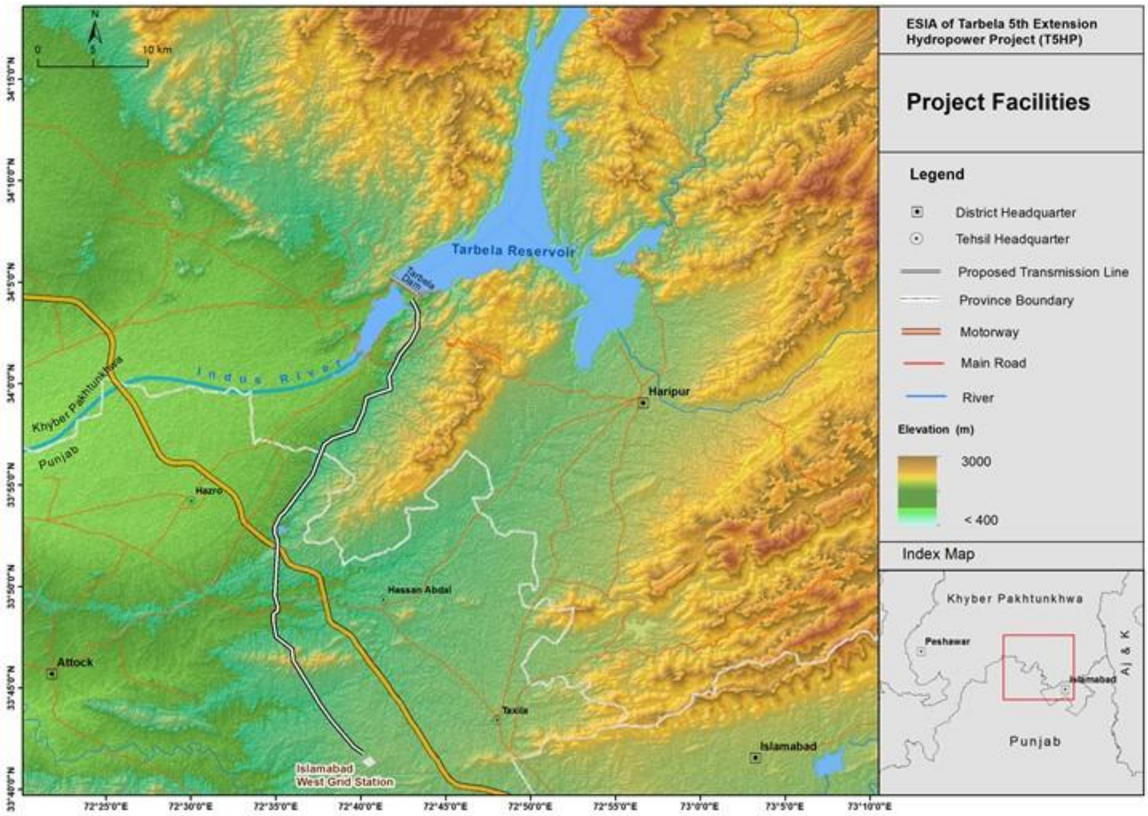
The construction and O&M activities associated with transmission line for power evacuation would be limited to a corridor of about 500 m width along the transmission line route.

5.1 Physical Environment

5.1.1 Physiography

The terrain map of the project area is shown **Figure 5.1**.

Figure 5.1: Terrain map of the Project area



Physiography of the Dam Site

Tarbela Dam and storage reservoir are located near to the end of a relatively narrow valley of the Indus cutting through the Hazara hills. These hills form a part of the foot slopes of the Western Himalayan Mountains. The river valley near the dam is up to 1.8 km wide and filled with alluvial deposits, which are submerged by the reservoir. The northern part of the reservoir stretches about 100 km upstream and is situated between much higher mountains with elevations over 2400 m. The hill sides near the dam are generally steep and are rising to an altitude around 600 masl.

The Ghazi- Barotha headpond is a small regulating reservoir immediately downstream of the dam and belonging to the Ghazi-Barotha barrage. This barrage is situated at a distance of seven kilometers from Tarbela. From here the topography slopes more gently via a transitional zone and further down towards the agricultural plains of Punjab.

The TDP stretches over two different administrative districts: The right bank is Swabi district, whereas the left bank belongs to Haripur district. Swabi district lies between the Indus and Kabul Rivers. The total area of Swabi district is 1,543 km^2 with mostly hilly terrain (78 percent) and the remaining part is flat. The northern part is predominantly hilly and is sloping towards the agricultural plain in the south. The majority of the hills are found in the Gadoon area in the north-east. They are a continuation of the Mahaban Hills. Other important hills, the Naranji Hills are situated in the north-western corner of the district.

The heights of the Naranji Hills in the north vary between 750 to 1,400 masl. In the south, along the border of the Nowshera district there are hills forming part of the Khattak Hills, north of the Kabul River. From the foot of these hills the southern plain runs down, at first rather steep sloped and then gently down towards the Kabul River. The lower southern half of the district slopes towards the Indus River.

Physiography of the Transmission Line and Grid Station

Transmission line falls in two districts, Haripir and Attock. Haripur district can be divided into four regions. The first Maidan-e-Hazara consists of plain area of Haripur district surrounded by the mountains of Tanawal in north, Koh-e-Gandgar in the west and Khanpur in the South. Haripur city and the majority of the villages of the district are situated in this region. The second region Tanawal which is mainly mountainous is subdivided into upper and lower Tanawal lying in the north of Maidan-e-Hazara. A major part of lower Tanawal is sandwiched between Maidan-e-Hazara and upper Tanawal. Haripur comprises of lush green plains surrounded by mountains with a number of water resources.

Topography of Attock districtis characterized by plains and badland topography in some areas. The area in the north-west and south is hilly and on the north, the hills are southern extension of the hills of Abbottabad district i.e., the southern hills of the Gandgar range of Haripur district form a projection in the north of Attock Tehsil. The range is rugged and is covered with brush forest. There are several isolated ridges. The eastern boundary of the district is the Soan River. The KheriMoorat ranges cuts near the boundary in Fateh Jang Tehsil. This ridge rises to a height of about 950 meters. On southern boundary of the district is the Soan River which meets the Indus. An important feature of the topology of Attock district is the general slope, which is from north-east to south-west.

Proposed grid station site is located in Fateh Jang Tehsil of Attock district. The topography of the proposed site for Grid Station is plain with low level slopes. Undulations in some nearby areas can be observed mainly due to rain water drainage effect which causes cutting and erosion to the land. But such type of land cutting/erosion is not characterized for sedimentation load of the dams via rivers and streams as it remains inside the undulated area center points and not move out of it.

5.1.2 Land use

The land use of the proposed project could be defined in reference to the proposed tower/pylon locations provided from NTDC for all 35 Angle Markers (AM) of the entire project area. Based on the proposed transmission line route towers site locations and the grid station land use baseline is given in the below as (**Table 5.1**). Detailed land cover maps are prepared for the project area as part of this ESA study and presented in Figure 5.32

Table 5.1: Land use details of the Transmission Line and Grid Station

Section	Location	Land Use
AM 01 - AM 07	T5 Powerhouse to Omar Khana	The land use the first part of this section is comprised of Tarbela Dam project site offices, reservoir of Ghazi Barrage and open store yards just at the start point of the proposed TL. The middle part of this section is again of hills formation with steep slopes and open scrub land with vegetation cover of trees, shrubs and bushes. While the last part of this section is of moderate hills slopes comprising of rangeland with residential houses of village Omar Khana. The local communities use these lands for animal grazing and fuel wood collection, this activity is not site specific and is carried out on a larger area surrounding the proposed AM sites. Onward from Umar Khana village the land is characterized by various slopes and agricultural fields. The Hamlet colony is the largest human settlement along the proposed TL in this section.
AM 07- AM 23	QiblaBandi to M1(Peshawar-Islamabad Motorway)	The first part of this section is of agricultural fields and scattered residential houses of Hamlet colony peripheries and village Pipyala. In the middle part of this section onward to Pipyala village, the proposed TL passes from the open scrub land with scattered shrubs and vegetation cover and land of various villages' the land is of barren type with rain fed agricultural practices along with scattered residential houses. The existing 500 kV Tarbela Rawat line is also passing side by side during this part. The last part of this section is of same nature regarding land use with the addition of Qibla Bandi Dam. Basically this dam is for irrigation purpose with an average of 1 square kilometre reservoir. The land is of arid type with sand deposits and quarry sites for sand mining. Qibla Bandi is the next populated human settlement in this section.
AM 23 - AM 26	Burhan plain area (with M1, Haro	This section is comprised of Motorway, Haro River and GT road crossing points. The land is of barren

Section	Location	Land Use
	River & GT road)	type with scattered residential house. The crossing point at M1 is characterized by hills formation with semi-arid zone shrub forest of low height vegetation. In the middle part of this section the proposed TL will cross GT road at Burhan, Eucalyptus trees of average height of 40 feet will need to be cleared on both the sides. The last part of this section is of green fields with uplift irrigation system as the average water table is high. This part is located in the Burhan village periphery on GT road.
AM 26-AM 29	Burhan (periphery of Burhan village)	Burhan is next densely populated human settlement in along the proposed TL. This part of the land is of agricultural fields with uplift canal irrigation system. Residential houses are widespread the plain areas of this part. The last part of this section is just below the hills, the area of this part is also of barren type with various slops and undulated formation and of waste land type.
AM 29-AM 32	Hills site on Back of Burhan village)	This area is comprised of hills formation with local bushes and non-timber forest type vegetation of semi-arid zone. The area has neither residential houses nor any other type of anthropogenic activities.
AM 32-AM 35	PindSahab Khan to BahtarMera	The land of this part of barren type with various slopes and undulated patches formations. The slopes form the natural drainage system and flows in the form of Nullah but the existing situation based on the field visits for baseline shows that there is no chance of flooding and land cutting. There are agricultural fields with rain fed irrigation system, while at some sites the uplift canal irrigation system also exists. This area is also comprised of residential houses but not densely populated.
Grid Station (AM 35 to Loose point)	Proposed Grid Station site(Kamalpur Miyan village)	The proposed grid station site land is of plain agricultural fields. The proposed grid station will cover an area of 200 acres with the operational capacity of 500kV. This site is surrounded by residential houses from all the sides. Few houses are very close to the proposed grid station site while the rest of residential houses are at considerable far. The site area has natural drainage pattern due to low level of slopes. There are no surface water bodies and the irrigation is done with the help of (DW) dug wells/tube wells (TW). An abundant DW and cattle shed (*Pakka* type) will be permanently affected as

Section	Location	Land Use
		these are present in the acquiring 1500 Kanals of land.

5.1.3 Geology

Geology of the Dam Site

Tarbela dam is located in the Hazara Hills, which are part of the mountain group known as the Lesser Himalayas. The Hazara Hills are composed of crystalline and metamorphic rocks with non-fossiliferous sedimentary deposits and gabbroic intrusions, all ranging in age from Precambrian to Permian. The present geologic structure is the result of extensive folding, shearing and faulting associated with regional crustal deformation arising from the northward subduction (under thrusting) of the Indian Sub Continental Plate below the Eurasian Plate.

There are three distinct geological formations at the Tarbela Damsite: the Salkhala Formation, forming the right bank; the Hazara Formation, forming the bedrock base of the Indus River; and the Kingriali Formation, forming the left bank. The general orientation of bedding indicates that the banks of the river are the limbs of an anticline, the axis of which has been eroded by the Indus River. The geological mismatch between the right and left banks is considered to be the result of displacement along a nearly vertical fault running along the right side of the valley.

The left bank area, where T5HP facilities are located, is occupied by the Kingriali Formation consisting of thick to thin beds of dolomitic limestone, phyllites and quartzite. The basic igneous rock (dolerite/diabase) is also present as sills and dykes in the area; however, one thick and massive bed is intruded in the in-situ rock and is exposed along the right side of the spillway channel. Several possible faults have been identified in the project area. A geological cross section along Tunnel 5 is presented in **Figure 5.2**.

Geology of the Transmission Line and Grid Station

The geological formations along the transmission line corridor in Haripur district consists of four prominent formations, namely the Dakhner, Samana Suck, Lockhart and Patala. Brief descriptions of these formations are given below:

Dakhner: This formation consists of argillite, sandstone and subordinate limestone. The sandstone and subordinate limestone are dark grey to greenish grey. Its upper contact with the Samana Suck formation is un-confirmable.

Samana Suck: This formation exhibits limestone and calcareous sandstone. The limestone is yellowish grey to dark grey, medium to thick bedded, partly argillaceous and formed locally. The sandstone is brownish grey, medium to coarse grained glance and is resistant. Both the upper and lower contacts with the Lockhart and Dakhner formations are un-confirmable respectively.

Lockhart: The limestone is light to dark grey, medium to thick bedded, massive, nodular and resistant having dark grey, thinly laminated shale intercalations. The upper contact with the Patala formations is confirmable.

Patala: This consists of inter-bedded shale and limestone with subordinate sandstone. The shale is dark greenish grey, thin bedded and fossiliferous. The sandstone is brownish grey, thin bedded and displays weak bedding whereas the limestone is white to light grey and nodular.

Quaternary: The recent to sub-recent deposits forming the land (cultivated and uncultivated) comprises loess and flood plain deposits.

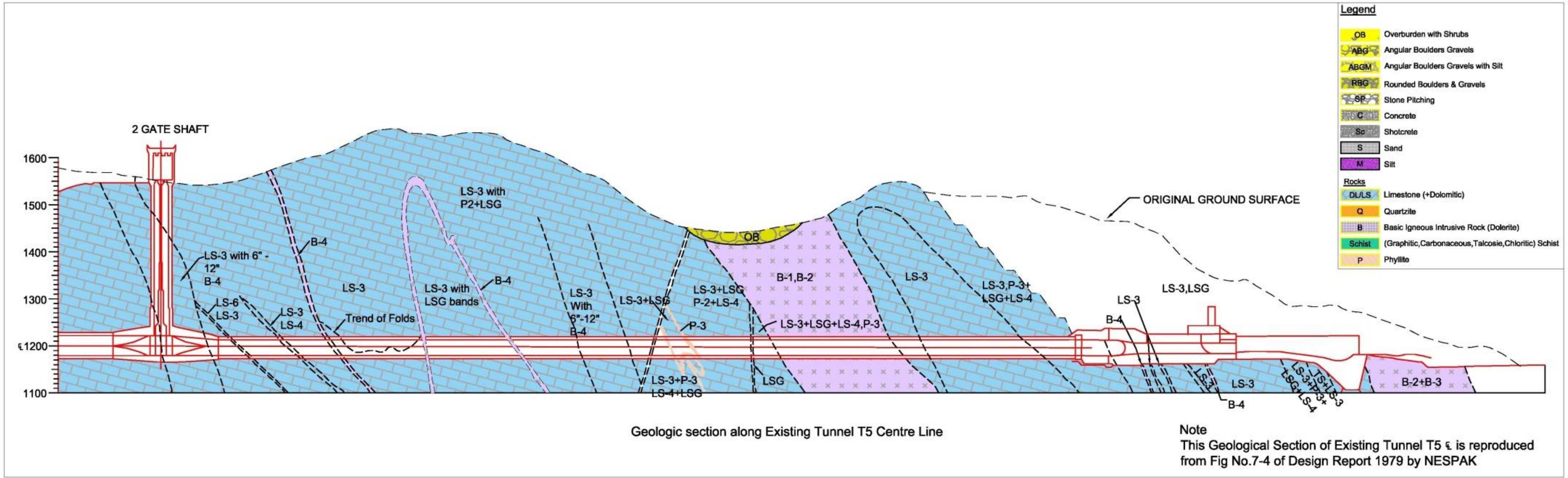
Attock district for the most part lies in the 'Pothwar Plateau'. The rocks that underlie the 'Pothwar' are the soft grey sand-stones and orange to bright red shale of the Siwalik system. The district is a renowned collecting ground for the animal fossils so characteristics of this rock group.

Further north, between Fateh Jang and Attock cities there are several similar lime stone ridges which together form the Kala Chitta hills.

The high ground in the extreme north of the district, near Attock and north of Lawrence Pur is formed buy a much older rock series-known as the Attock slates.

The general trend of these hill ranges is from east to west, parallel with the general trend of the Himalayan ranges further north of which they form the foothills and outer ramparts. Based on the field visits finding and secondary data, the soils are mainly silty and sandy loamy clay with organic particles.

Figure 5.2: Geologic section of Tunnel 5 showing different rock units (reproduced)



Source: NESPAK, 1997, Design Report Fig 7-4

5.1.4 Seismicity

Several studies were undertaken at the design of Tarbela dam and subsequently on the seismicity of the dam area. One such important study was done by National Engineering Services Pakistan (PVT) Limited in November 1995. The most recent study was done during the detailed design phase of T4HP in 2011. The major earthquake observed in recent past is 2005 Kashmir earth quake of magnitude 7.6 earthquake which had its epicenter 100km north-east of Tarbela.

The main active tectonic faults at the Tarbela are:

- Darband fault
- Panjal fault
- Dal Darra fault
- Hazara thrust system faults
- Attock – Cherat range faults.

Seismic monitoring has been carried out in Tarbela area through a micro seismic network by the Directorate of Seismic Studies. The epi-centers of micro earthquakes are scattered throughout the area and follow no discernible pattern. Frequent smaller magnitude earthquakes indicate that the tectonic stresses are constantly relieved instead of accumulated for a major earthquake to occur.

Based on the historical record of seismic events in the region, the T4HP study considered a design earthquake of 0.21g with 10% probability of exceedance.

5.1.5 Soils

Soils in the Project area are shallow and rocky on the hillsides, brown colored, calcareous and low in organic matter with predominantly loamy textures. They are in use as grazing land and covered with low scrubs. Near the river some alluvial soils can be found. Most of these soils are uncultivated with scattered bushes or trees. Loamy or clay loam soils have been developed in wind-blown deposits (loess and cover sand) found further down in the plains situated South and West of the town of Topi. They are mostly in use for agriculture and partly irrigated, a broad range of crops are grown on these lands. East of Ghazi predominantly brown residual clay loam soils can be found developed on the hilly slopes of the hinterland and foot slopes of the Hazara hills. There is no irrigation but partly cropped (*barani*) and partly in use as grazing area.

The arable soil of the Swabi district has developed either from river alluvium or loess sediments. Texture of the river alluvium terraces ranges from sandy loam to loamy sand, and loam approaching clay loam.

There are three main types of alluvial deposits on the valley bottom of the Indus River (the lower terrace and riverbed):

- Dense rounded to sub-rounded boulder gravel, which predominates at the site. The coarse components of the boulder gravel are in grain to grain contact while the voids are completely or almost completely filled with medium to fine sand. Coarse sand and fine gravel sizes are almost entirely missing from this gap-graded material.
- Open voided, highly pervious rounded boulder gravel, termed “openwork”, having the same coarse component as the material described above. However, voids between boulders are not filled or only partially filled with sand.

- Sand, gravelly sand, silty sand and silt layers, found throughout the foundation. The largest sand layers were located in the central portion of the main embankment foundation where their thickness is as much as 1.32 m to 2.64 m. Sampling and testing proved that the sand is quite dense, with relative densities approaching 100 percent. Consolidation testing established that alluvial silts are also very dense and relatively incompressible, indicating that they were subjected to a considerable pre-consolidation load.

Soils of the Sobra and Qibla Bandi areas are sandy in nature and the soil of the Gandaf area is typically clay dominant. It is for these reasons that the areas have been selected for borrow materials in the project construction. In the area of the proposed powerhouse there is no soil present as the area is generally existing concrete structures or a steep rock slope.

The soils in Haripur district are dissected loess plain or dissected piedmont plains and have silty loam and silty clay loam respectively. In the southern part of the area there are four prominent formations, namely the Dakhner, Samana Suck, Lockhart and Patala. See below for a brief description of these formations:

Dakhner: This formation consists of argillite, sandstone and subordinate limestone. The sandstone and subordinate limestone are dark grey to greenish grey. Its upper contact with the Samana Suck formation is un-confirmable.

Samana Suck: This formation exhibits limestone and calcareous sandstone. The limestone is yellowish grey to dark grey, medium to thick bedded, partly argillaceous and formed locally. The sandstone is brownish grey, medium to coarse grained glance and is resistant. Both the upper and lower contacts with the Lockhart and Dakhner formations are un-confirmable respectively. Fossil record shows brachiopods, gastropods and cactropods. It has been assigned as early to middle Jurassic age.

Lockhart: The limestone is light to dark grey, medium to thick bedded, massive, nodular and resistant having dark grey, thinly laminated shale intercalations. The upper contact with the Patala formations is confirmable. The formation has yielded forminifers, algae cords, molluscs and echinoids. It has been assigned as early-middle Paleocene age.

Patala: This consists of inter-bedded shale and limestone with subordinate sandstone. The shale is dark greenish grey, thin bedded and fossiliferous. The sandstone is brownish grey, thin bedded and displays weak bedding whereas the limestone is white to light grey and nodular.

Quaternary: The recent to sub-recent deposits forming the land (cultivated and uncultivated) comprises loess and flood plain deposits.

In Attock district limestone crops out everywhere along the low hills. The area is part of Potohar plateau that was formed mainly during the quaternary period. The area is mostly composed of alluvial (clayorsil) and gravel caps. The clay of the area shows five distinct strata or layers. The lowest layer is of coarse pebble with sand or clay. Stratum is that of alluvium deposited by the older system of the Soan basin over the pebble bed. During this period the Soan was a mighty river, bigger than the present day Indus. The next upper layer consists of the alluvium deposits of the present river system. Then there is the air borne top layer of silt or clay called Loess and at the top is the gravely conglomerate and loose gravel cap deposits. Pebble beds, pebble mounds and pebble ridges form a conspicuous feature of the landscape.

5.1.6 Soil Quality

Soil quality data collected in 2011 as part of T4HP study is used in present analysis. The samples were taken from four different locations and were tested using the services of SCARP Monitoring Organization, WAPDA. Thesoil sampling locations are illustrated in **Figure 5.3** and described along withthe sampling period in **Table 5.2**. The results of the soil samplings are given inTable 5.3.

Figure 5.3: Location of sampling points

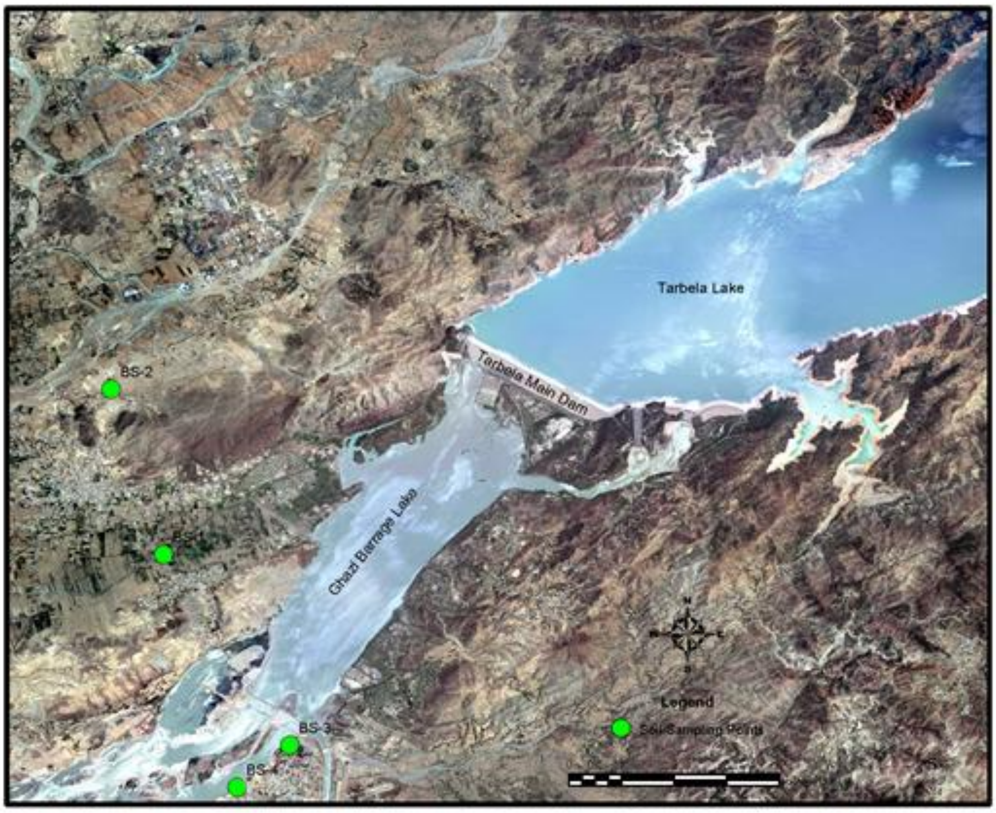


Table 5.2: Soil sampling locations / sampling codes

	Location	Sampling Period	Sampling Code
T4 ESIA Baseline Sampling			
1	Topi Area behind Topi house	February 2011	BS–1
2	Topi Area near Gandaf crossing	February 2011	BS–2
3	Village Jammo Ghazi	February 2011	BS–3
4	Village Qazipur	February 2011	BS–4

Table 5.3:Soil sampling results

Parameter	Unit		Sampling Code			
			BS–1	**BS–2**	**BS–3**	**BS–4**
Saturation Percentage			30	30	28	36
pH of Saturation			7.9	7.9	8.0	8.0
EC x 103 at 25^{oC}			0.65	0.8	1.0	1.1
Soluble Cations	Ca+Mg	M_{eq}/Litre	5.0	6.0	9.5	6.5
	Na	M_{eq}/Litre	1.25	1.5	1.5	3.45
	K	M_{eq}/Litre	0.27	0.36	0.3	0.19
Soluble Anions	CO_3	M_{eq}/Litre	-	-	-	-

	HCO_3	M_{eq}/Litre	4.0	5.0	5.5	5.5
	Cl	M_{eq}/Litre	1.2	0.8	4.8	1.6
	SO_4	M_{eq}/Litre	1.32	2.06	1.0	3.06
Sodium Adsorption Ration (SAR)			0.79	1.86	0.68	1.9
Organic Matter			0.4	0.5	0.5	0.4

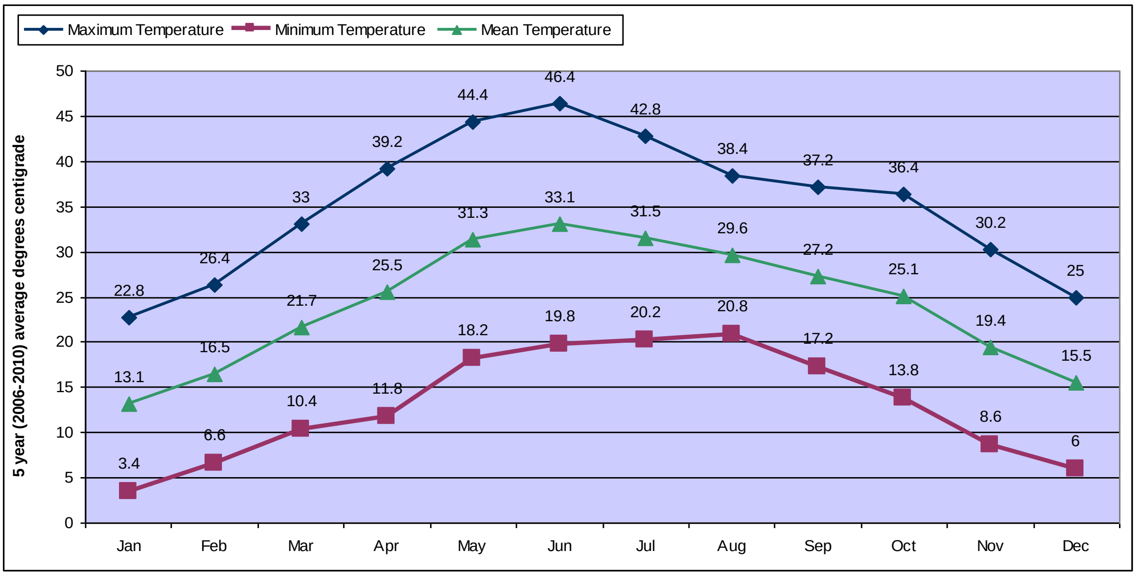
5.1.7 Climate

Two seasons prevail in the project area: winter (October to March); and summer (April to September). In general, the climate of the area is mildly hot in summer and cold in winter. According to the Köppen Climate Classification, the project area can be classified in to Humid Subtropical Climate.

Temperature

December to February are the coldest months and the minimum temperatures vary between 2 and 11°C in these months, whereas the maximum temperature during March to July vary between 31 and 48°C. Swabi district has more extremes in climates, with its summer season being very hot. A steep rise of temperature is observed from May to June and even July, August and September record quite high temperatures. There is a rapid fall of temperature recorded from October onwards to the coldest month of January. The maximum, minimum and mean temperature of the dam area for the last five years is presented in **Figure 5.4**.

Figure 5.4: 5 Year Average Monthly Temperatures (°C) in the Tarbela Area (2006-2010)



Source: Hydrology Directorate – Tarbela, WAPDA

Along the transmission line, temperature varies according to the elevation. Temperature begins to rise rapidly from the end of March, till June, which is the warmest month. The temperature remains high during July to September. With the onset of southwest monsoon by the end of June, the temperature begins to decrease gradually; however, the drop is rapid only after October. January is the coldest month. The data shows that the average monthly temperature varies from 10.81°C in January to 36.33°C in June. The average monthly temperature ranges from 13.30°C in the month of January to 33.81°C in the month of June. The **Table 5.4** gives the monthly temperature levels between the years

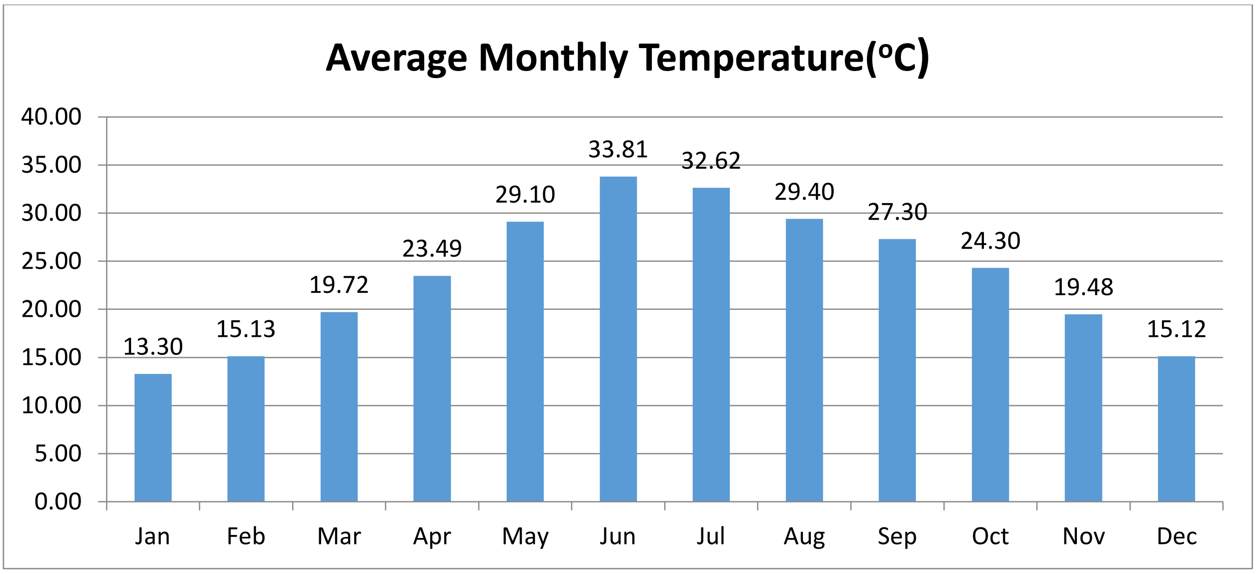
2005 to 2014 and **Figure 5.5** gives the average monthly temperature details between the same periods.

Table 5.4: Air Temperature °C along the Transmission Line

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2005	12.45	13.75	19.11	22.11	25.58	32.41	29.30	28.61	26.97	23.43	17.66	15.00
2006	13.14	19.02	19.26	22.74	31.43	33.11	31.86	27.80	26.10	24.17	18.75	13.93
2007	12.79	15.25	18.14	25.74	29.76	33.97	33.44	29.80	27.54	23.00	20.78	14.42
2008	10.81	13.28	20.56	22.73	29.61	36.33	32.60	28.51	26.21	24.17	19.21	16.46
2009	14.43	15.61	19.90	23.10	28.33	30.94	32.14	30.17	27.50	23.56	17.80	15.48
2010	15.68	15.39	22.34	25.34	28.72	31.42	30.58	28.07	25.64	25.27	19.96	14.94
2011	13.56	15.27	19.70	22.65	31.14	35.29	33.45	29.23	27.07	23.86	20.82	14.64
2012	12.11	12.77	18.02	22.64	27.99	34.22	34.98	31.38	28.68	26.15	20.64	15.78
2013	13.75	16.38	20.96	24.49	30.98	35.06	34.14	30.11	29.35	25.41	19.66	15.11
2014	14.29	14.55	19.21	23.36	27.45	35.31	33.75	30.30	27.97	23.93	19.55	15.47

Source: (NCEP Data Analysis- Pakistan Meteorological Department)5

Figure 5.5: Average Monthly Temperature (Ten years Data Analysis)



Source: NCEP Data-Pakistan Meteorological Department

Rainfall

The average monthly rainfall at Tarbela is 78.86 cm with most of the rainfall occurring in the months of July and August. Towards the end of the cold weather in January and

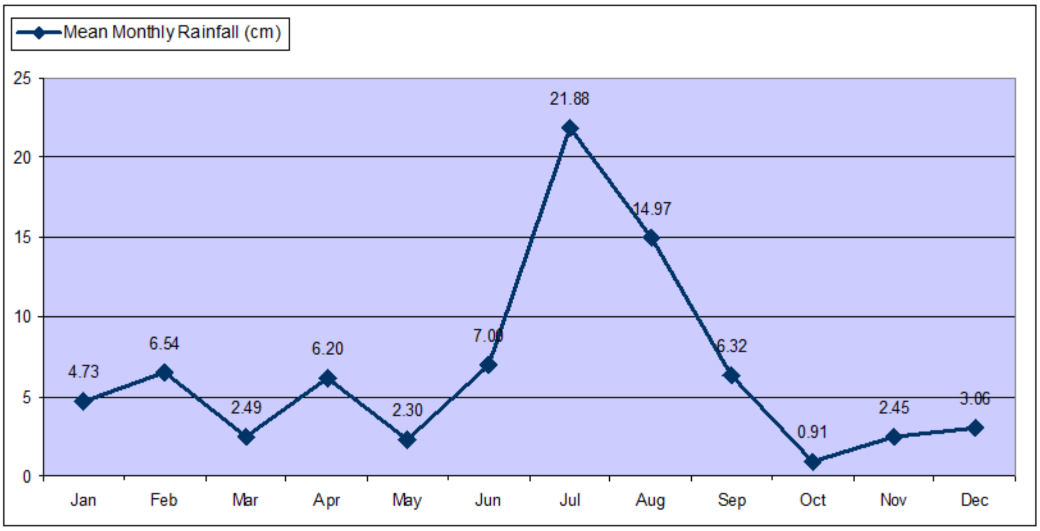
[5]Climate modeling was employed using the NCEP Reanalysis data sets.

The NCEP/NCAR Reanalysis 1 project is using a state-of-the-art analysis/forecast system to perform data assimilation using past data from 1948 to the present. A large subset of this data is available from PSD in its original 4 times daily format and as daily averages.

Simulation was run using these data sets and the coordinates of the project area which produced the results presented in the report

February there are occasional thunder storms and hail storms. The mean monthly rainfall for the Tarbela is provided graphically in **Figure 5.6**.

Figure 5.6: Mean Monthly Rainfall (2006-2010) at Tarbela



Along the transmission line, the last ten years annual rainfall data shows variation between very low rainfalls in the month of December as compared to high precipitation in the month of July. The **Table 5.5** gives the details on the annual rainfall of the area.

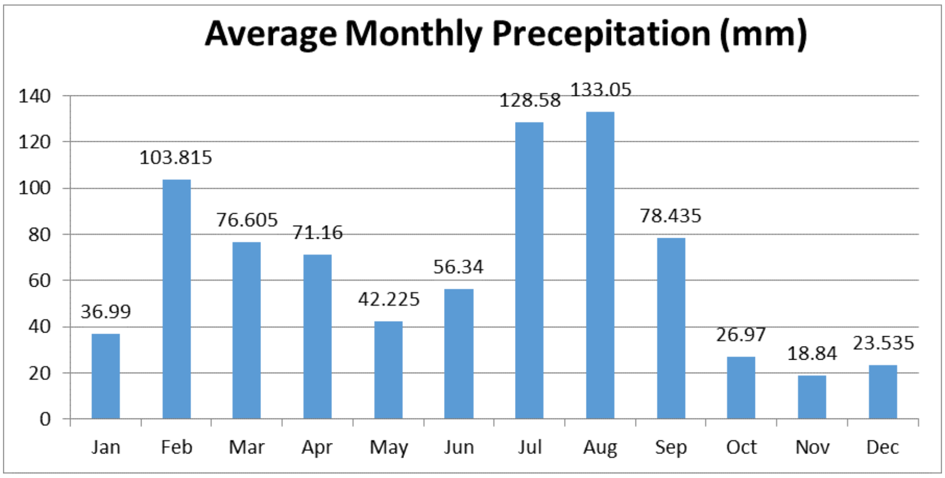
Table 5.5: Annual Rainfall Data along the transmission line

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2005	86	119	97	45	56	13	124	81	56	28	21	2
2006	72	63	70	33	36	52	238	196	62	40	52	112
2007	1	135	148	3	39	97	130	95	71	3	11	5
2008	93	21	0	133	38	129	114	146	39	22	22	55
2009	71	94	58	125	36	19	44	75	42	3	17	2
2010	4	147	20	40	51	65	286	169	47	14	1	5
2011	2	137	53	77	33	59	104	119	101	42	25	0
2012	39	54	32	105	36	10	65	155	128	16	7	54
2013	2	186	91	92	19	88	80	219	77	35	24	0
2014	0	82	197	57	78	32	102	77	161	67	9	0

Source: NCEP Data-Pakistan Meteorological Department

For further detail average monthly precipitation for the last ten years has been recorded and analyzed and presented in **Figure 5.15**. The monthly average precipitation varies from 23.53 mm in the month of November to 133.05 mm in the month of August.

Figure 5.7:Average Monthly Precipitation along the transmission line



Humidity

Humidity is the amount of water vapor in the air and indicates the likelihood of precipitation, dew or fog. The relative humidity in the Project area is quite high throughout the year due to evaporation from the Tarbela Reservoir with maximum humidity recorded in the month of August. This increase in humidity is attributed to the monsoon rains and consequent high evaporation rate. Average monthly humidity at Tarbela is presented in **Table 5.6**.

Table 5.6: Average Monthly Relative Humidity(%)at Tarbela (2006-2010)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
81	79	72	65	57	66	81	86	78	72	80	84

Source: Hydrology Directorate – Tarbela, WAPDA

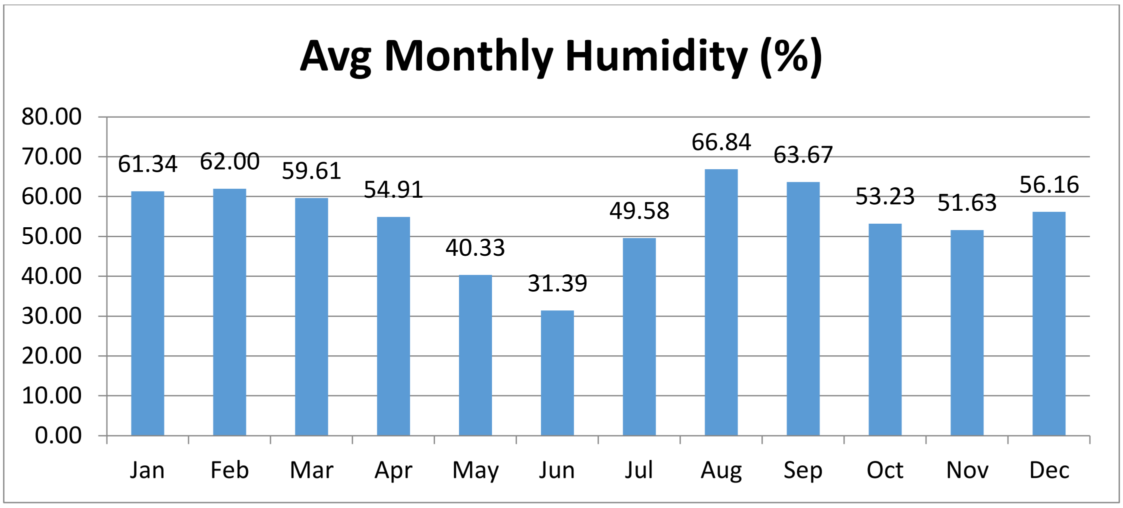
Along the transmission line, the monthly average humidity for the last ten years varies from 31.39 % to 66.84 %.**Table 5.7** gives the monthly humidity levels between the years 2005 to 2014 and **Figure 5.8** gives the average monthly humidity levels between the same periods.

Table 5.7: Average Monthly Relative Humidity (%) along Transmission Line

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2005	77.7	78.5	77.7	66.6	60.8	43.0	75.3	83.0	80.8	64.9	63.8	65.2
2006	74.1	73.9	77.3	65.3	40.8	36.7	65.7	92.6	85.0	72.2	71.3	77.1
2007	76.5	80.6	76.5	62.0	47.7	45.5	54.7	78.7	72.9	61.0	60.2	71.9
2008	77.2	72.6	74.0	71.2	49.6	36.0	62.4	85.8	78.8	68.7	64.1	68.0
2009	76.9	74.4	71.2	67.2	47.1	41.3	61.6	74.6	74.9	66.3	71.3	68.6
2010	71.9	74.9	67.5	65.0	52.0	47.9	73.0	91.6	83.0	53.8	57.2	66.0
2011	68.2	72.3	65.9	62.4	38.8	29.3	51.4	80.1	79.2	67.9	60.6	66.8
2012	71.6	72.0	68.4	72.4	49.4	29.2	44.1	68.1	68.7	49.1	50.1	65.5
2013	69.1	72.1	67.3	61.0	37.6	36.6	53.1	73.8	66.9	66.0	60.4	64.5
2014	73.0	72.8	69.6	65.9	60.2	31.2	53.8	73.8	73.8	68.8	60.6	60.4

Source: NCEP Data-Pakistan Meteorological Department

Figure 5.8: Average monthly humidity along the transmission line



Source: NCEP Data-Pakistan Meteorological Department

Evaporation

The evaporation data (2006-2010) at Tarbelais presented in **Table 5.8**. Total annual evaporation over the last five years has ranged between 84.9 to 96.6 cm with an overall average of 86.1 cm. Monthly data show that the maximum evaporation is recorded during summer (April to September), with the highest evaporation in June. Comparison of the yearly evaporation and rainfall data show that total evaporation exceeds rainfall by about 9 percent.

Table 5.8: Mean Monthly and Annual Evaporation (cm) at Tarbela

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean
2006	1.87	3.41	5.26	10.84	16.00	15.11	9.64	7.42	8.06	6.73	3.55	1.48	**89.37**
2007	2.81	2.51	4.58	10.10	13.04	14.24	9.84	8.35	6.29	7.21	3.59	2.35	**84.91**
2008	1.95	3.47	7.30	7.48	13.63	11.73	8.87	7.16	8.28	8.60	4.22	2.60	**85.29**
2009	2.02	2.95	4.67	6.27	14.17	16.24	15.36	10.50	9.02	8.86	4.41	2.17	**96.64**
2010	2.02	2.42	6.64	11.49	7.80	17.25	11.18	6.98	7.57	7.19	3.90	2.00	**86.44**
monthly mean	**2.13**	**2.95**	**5.69**	**9.23**	**10.52**	**14.91**	**10.97**	**8.08**	**7.84**	**7.71**	**3.93**	**2.12**	**86.08**

Source: Hydrology Directorate – Tarbela, WAPDA

5.1.8 Rock Stability and Landslides

The rocks of the hills nearby the dam site are of poor stability in places and protective measures i.e. shotcrete through the cut-slopes with additional grouted rock bolts to provide strengthen to the hills, were adopted during the construction of the Tarbela Dam to avoid land-sliding. Despite these protective measures, during 1981 cracks were discovered on the gunited (spray concreted) surface of the outlet slope outlining a large mass of moving rock resulting in a failure involving approximately 76,500 m3 of material, extending from El. 396 m to 536 m in the center of the outlet slope, and forming a large cone of talus at the base. Approximately 27,000 m^3 of additional material fell from the slides and the top of the slide scarp. This was subsequently repaired. Moreover, small scale landslides have been observed during the rainy season at different places in the Project area although there are easily managed.

5.1.9 Sedimentation

The Indus River is one of the largest sediment producing rivers in the world. The main source of sediment is from the glacial landscape and erosion from steep sided barren slopes. The predicted rate of sediment inflow was 0.294 billion cubic meters (BCM) per year meaning that the dam would silt up to 90 percent capacity in 50 years and thereafter continue to provide only about 1.2 BCM of live storage (World Commission on Dams, 2000 Chapter on Tarbela). A number of sediment management measures were examined at the time but considered not to be feasible.

In practice, the actual sediment inflow rate has been significantly lower than predicted, with an average rate of 0.106 BCM, i.e. 36 percent of the predicted rate. However, the proportion of sediment inflow trapped in the reservoir (the trap efficiency) was slightly higher than predicted. The useful life of the dam is now considered to be 85 years although, as with the prediction, the usable storage will gradually decline over this period. An unexpected aspect of the sediment deposition however, is the advancement of the sediment delta, which is now located 14 km from the dam. There are concerns that under earthquake loading, the sediment may liquefy and block all low-level outlets, including power intakes.

Measures are being investigated to reduce the risk of liquefaction damage and also to prolong the life of the reservoir. These include physical measures such as provision of an underwater protection to the low level outlets, including power intakes and sluicing tunnels to remove sediment, and management measures to reduce the proportion of sediment deposited and its location. Reduction in sediment load entering the reservoir is not possible due to the altitude and nature of the catchment. In terms of management measures, the operating rule of the reservoir has been changed to raise the minimum drawdown level from 396 m to 417 m and thereafter raise it gradually every year. This would have the effect of depositing sediment in the upper reaches and would reduce the advance of the sediment delta, but at the cost of reducing live storage with the tradeoff of reducing water availability in the dry season.

5.1.10 Hydrology

Tarbela Reservoir was designed to store water from Indus River for irrigation purposes and releases from the reservoir entirely depend upon irrigation indents from the Provinces. The mean monthly water releases from the dam for the last five years (2006-2010) are provided in **Table 5.9**and also depicted in **Figure 5.9**and **Figure 5.10**. It is evident that monthly releases vary from 1,194 million cubic meters (Mm^3) to 16,881 Mm^3.

Presently the irrigation water demand downstream of Tarbela is met predominantly by releases from Tunnels 1, 2 and 3. Additional demand is met by Tunnel 5 in the first instance and Tunnel 4 is then used to make up any difference.

Historically Tunnel 4 mainly releases water during the months of May, June and July, as demonstrated by the data in **Table 5.10**. **Table 5.11**provides the irrigation releases of Tunnel 5. It is evident from the discharge data for Tunnels 4 and 5 that there has consistently been a significantly higher discharge from Tunnel 5. This results from Tunnel 5 being given priority for water releases to meet the additional water requirement.

Table 5.9: Mean Monthly Flow Releases from Tarbela Reservoir (Mm^3)

Y/M	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2006	1,543	2,246	2,251	1,959	7,643	11,022	12,631	18,811	8,314	4,909	5,008	2,097	**78,433**

2007	1,501	2,495	2,171	3,084	7,221	10,362	11,570	13,507	9,621	4,897	4,724	2,270	**73,423**
2008	963	2,241	1,930	2,045	5,668	10,910	13,568	11,965	9,263	3,577	4,330	1,776	**68,237**
2009	933	2,197	2,619	2,092	6,053	9,971	10,386	14,802	9,054	4,737	4,009	2,257	**69,108**
2010	1,032	2,222	2,398	2,487	5,339	9,098	16,492	25,323	9,535	4,441	4,737	3,281	**86,383**
Mean	**1,194**	**2,280**	**2,274**	**2,333**	**6,384**	**10,273**	**12,929**	**16,881**	**9,157**	**4,512**	**4,561**	**2,336**	**75,116**

Source: Hydrology Directorate – Tarbela, WAPDA. Mean: 5 years' monthly mean.

Figure 5.9: Mean Monthly Flow Releases (2006-2010) from Tarbela Reservoir (Mm^3)

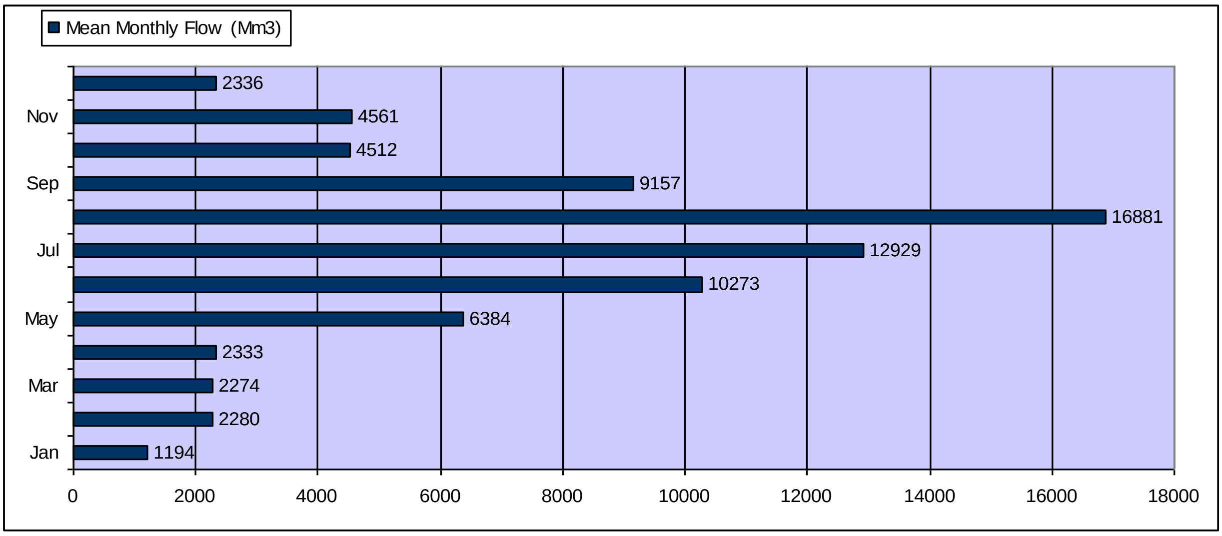


Figure 5.10: Releases from Tarbela Reservoir (Mm^3)

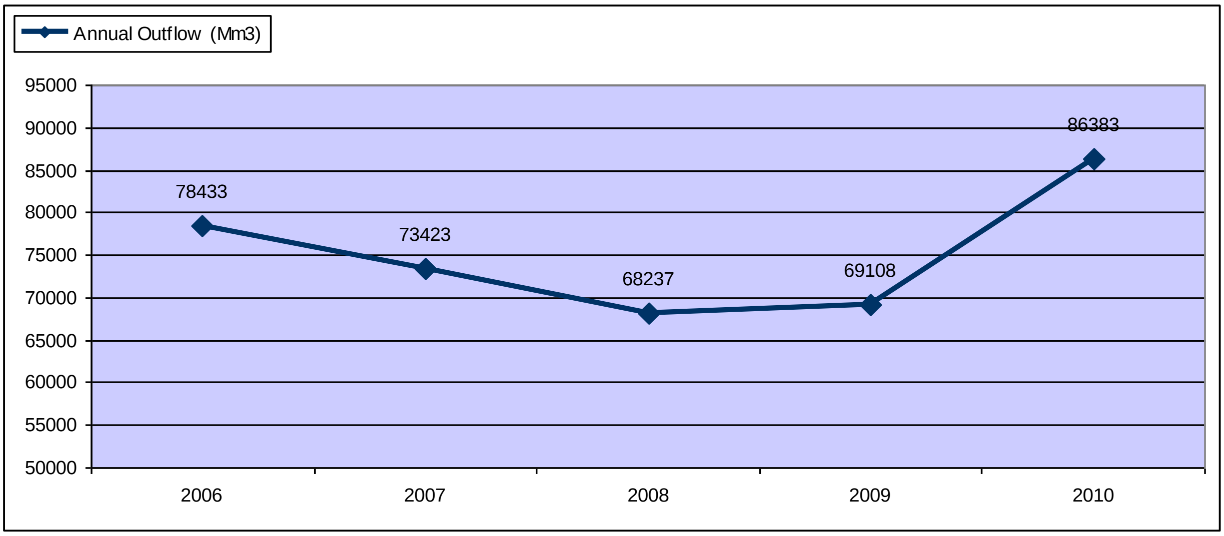


Table 5.10: Historical Irrigation Releases from Tunnel 4 (Mm^3)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1974						1,206	1,740	699				
1975	342	687	919	1,533	4,118	4,954	3,173					342
1976			173	102	639							
1977				93	124	12			222	74		
1978		12	173	945	1,125							
1979				68	2,427	382						
1980				502	4,053							
1981			25	3,477	4,052	666						

1982												
1983					1,674	863					7	
1984	123	185		159	1,726	752						123
1985					1,940	1,776						
1986				64	1,498	1,011			247	49		
1987	542		999	284	1,660	1,134			37	469		542
1988	617			919	1,977	555						617
1989				107	232	493						
1990												
1991												
1992												
1993				492	2,473	1,208						
1994				23	1,819	247						
1995					1,962	394						
1996				218	1,829							
1997			14	31	1,946	3,358						
1998				1,079	2,800	1,106						
1999				530	3,603	2,327						
2000				10	90	242						
2001						4						
2002						37						
2003						257						
2004				524	1,934	640						
2008					16							
2010						422						

Source: WAPDA.

Table 5.11: Historical Irrigation Releases from Tunnel 5 (Mm^3)

Year	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1974				703	5,828	1,126					903	2,348
1975	1,155	3,341	4,463	2,898	895	3,452	2,472					
1976					86	4,062	1,378					
1977							2,561					
1978							3,043			993		
1979						678	3,736			3,190	1,233	790
1980		1,443	698	875	1,883	3,348	3,119	109	490	2,893	543	189
1981		248	85	0	1,514	2,177	3,692					1,042
1982		419	994	660	2,263	4,206	1,545				750	422
1983		560	263	0	942	3,578	2,314			977	531	92
1984					2,434	2,602	1,136			533	60	
1985					745	1,554	4,429			984	363	208
1986					2,505	4,775	933					
1987		97	129	205	1,880	2,792	2,967			218	184	81
1988					6	134	0					
1989					1,504	475	0					
1990					1,504	1,327	4,213	312				
1991					101	2,200	1,413					
1992					20	3,482	3,690	303				
1993					418	3,441	386		182			
1994					0	835	4,087	882	552			
1995					228	2,510	0					
1996			5		932	3,154	3,053					
1997					158	2,274	0					
1998					134	2,868	2,565					
1999					208	2,484	1,256					
2000						1,743	4,276					
2001				703	5,828	1,126	0				903	2,348
2002	1,155	3,341	4,463	2,898	895	3,452	2,472					
2003					86	4,062	1,378					
2004							2,561					
2008							3,043			993		
2010						678	3,736			3,190	1,233	790

Source: WAPDA.

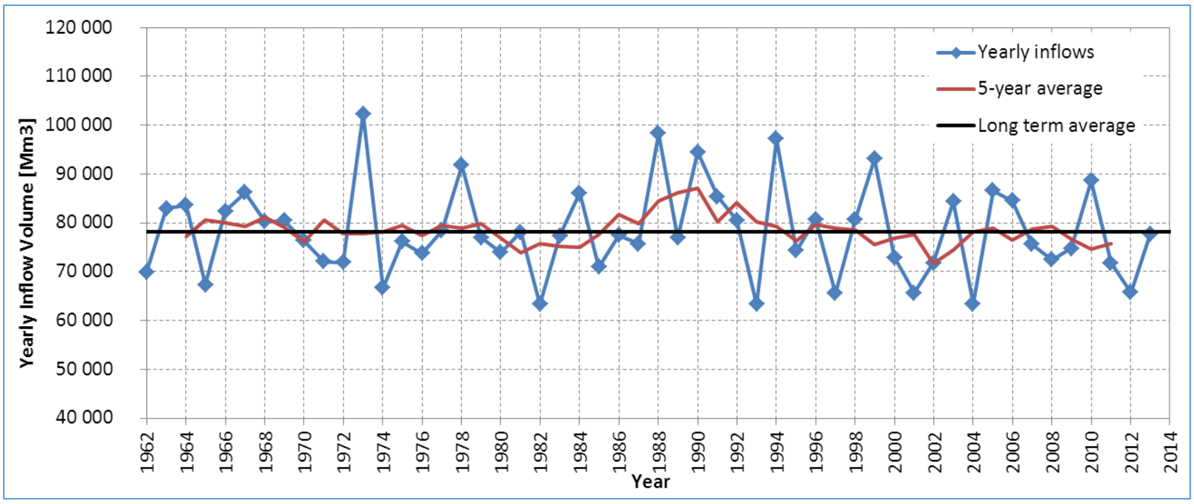
5.1.11 WaterInflows

An inflow database with 10-day discharges is available from 1962 to 2013. **Table** 5.12presents an analysis of the yearly inflow series. The 52-year series is shown in **Figure 5.11**. It can be seen that the yearly inflows are rather stable since the coefficient of variation is only 0.118. Noticeable dry years are 1974, 1982, 2001, 2004 and 2012. Significant wet years are 1973, 1988, 1990 and 1994. According to the 5-year moving average, it seems that no trend affects the yearly inflows at Tarbela.

Table 5.12: Indus River at Tarbela - analysis of yearly inflows

Year	V (Mm3)	Year	V (Mm3)	Year	V (Mm3)	Year	V (Mm3)
1962	69 814	1975	76 130	1988	98 312	2001	65 679
1963	82 929	1976	73 789	1989	76 897	2002	71 835
1964	83 665	1977	78 450	1990	94 530	2003	84 362
1965	67 366	1978	91 797	1991	85 432	2004	63 392
1966	82 441	1979	77 045	1992	80 574	2005	86 585
1967	86 260	1980	73 937	1993	63 296	2006	84 582
1968	80 292	1981	78 142	1994	97 248	2007	75 599
1969	80 427	1982	63 363	1995	74 323	2008	72 448
1970	76 333	1983	77 426	1996	80 756	2009	74 821
1971	72 049	1984	86 124	1997	65 590	2010	88 650
1972	71 867	1985	70 961	1998	80 742	2011	71 826
1973	102 368	1986	77 485	1999	93 132	2012	65 754
1974	66 680	1987	75 696	2000	72 952	2013	77 667
Sample size (years)					n	52	
Mean					M	78 431	Mm^3
Standard Deviation					S	9 277	Mm^3
Coefficient of Variation (S/M)					Cv	0,118	
Median					Me	77 426	Mm^3
Maximum					Max	102 368	Mm^3
Minimum					Min	63 296	Mm^3
Sample size (years)					n	52	

Figure 5.11: River Indus at Tarbela – time series of yearly inflows – 52 years



5.1.12 Environmental Flows from Tarbela – Ghazi to downstream Indus

The construction of Tarbela and Ghazi-Barotha projects have influenced the water flows downstream of the Ghazi barrage. Nearly 54 km of the Indus between Ghazi barrage and tailrace of Barotha power station is affected by the water diversion from Ghazi barrage.

This section is mostly dry in low flow season (October to April). To compensate the reduced flow, about 28 m3/s of environmental flow is released from Ghazi barrage to Indus to meet the requirement of aquatic habitat and drinking water requirements.

5.1.13 Flooding

Flood management was not considered at the design stage of the dam and therefore no predictions were made with regard to flood potential at that stage. It subsequently became apparent that the impact of the Tarbela Dam Project on attenuation of actual high flood peaks was significant during the filling period of June through to August, for impounding approximately 12 BCM, or 19 percent out of the *kharif* inflow of 64 BCM. Attenuation of peak Indus River flows is variable depending on the timing of the flood in relation to the reservoir level that is drawn down prior to the wet season. The peak flows in July 1988, July 1989 and August 1997 were reduced by 21 percent, 26 percent and 43 percent respectively, whereas a peak flow of similar magnitude in September 1992 was attenuated by only 2 percent as the reservoir levels were already considerably higher in readiness for the forthcoming irrigation season[6].

During the flooding in Pakistan of August 2010 there was a 28 percent reduction of the peak flood (inflow reservoir 29,500 m^3/sec and outflow 21,300 m^3/sec) with a record discharge of the spillway of Tarbela. However, this did not result in any damage.

5.1.14 Hydrology along Transmission Line

The project area for T5 covers more than 50Kms and crosses two provinces mainly through Haripur district of KPK and Attock district of Punjab. Hydrology of Haripur district is characterized as a network of river system.Siran, Daur and Haro are the well-known rives of the district. River Indus enters the district at Durband in the north- west, flowing along the western boundary of Haripur, feeds Tarbela reservoir, and exits the district at Ghazi. Siranriver enters Haripur at Bir and falls into Tarbela Lake near Bir. The Daur River has less water and comparatively shorter course than Siran. It has its catchment area at DaungaGali of district Abbottabad in the east and flows through the plains of the district towards west, joining Siran near Gandger range eight km above Tarbela. The Haro River with adequate water originates from the southern end of DaungaGali range where it has two tributaries, the eastern known as Dhund and the western is called KarralHaro. The two streams join at the head of Khanpur tract that ultimately falls into Khanpur dam. The hydrology of Haripur district can be best seen from the blow given map.

District Attock is the rain fed district and agriculture is mainly relaying on the rain. The area in district Attock has gentle to steep topography with deep water table (15 m) in north east (Tehsil Hazro) to very deep (120 m) in south west (Tehsils Jand and PindiGheb).

The major source for the irrigation to crops is rain. Both surface water and underground is used for irrigation system. There are several perennial streams and nullahs (Haro, Soan, Sill, Naindna, Dotal, Raisi, Ghambir, Namal, Soka, Gandakas, Saghar, Ghanir, Jhablat and Kala Pani), mini dams, water ponds and lift systems for both drinking and irrigation. Besides these, river Indus and river Soan also pass along the boundaries of district Attock.

[6] World Commission on Large Dams case study report "Tarbela Dam and related aspects of the Indus River basin Pakistan" November, 2000

5.2 Chemical Environment

5.2.1 Surface Water Quality

The surface water quality baseline was established by combining baseline survey data collected for the Project and baseline survey and monitoring data obtained for the T4HP ESA. Water quality for the Project was sampled at four locations on 06 June 2015: the plunge pool, Dal Dara channel, Ghazi-Barotha Headpond and at the T5 intake. For the T4HP ESA baseline surface water quality was monitored at three locations: Tarbela Dam Reservoir, Ghazi-BarothaHeadpond and downstream of the Ghazi Barrage Under the T4HP ESMP biannual surface water quality monitoring has also been carried out using the services of Pakistan Space and Upper Atmosphere Research Commission (SUPARCO).

A list of surface water sampling stations forming this baseline, along with the sampling dates is provided in **Table 5.13**.

Table 5.13: Surface water quality sampling locations/ sampling codes

Sr. #	Location	Sampling Period	Sampling Code
T4 ESIA Baseline Sampling			
1	Tarbela Dam Reservoir	February 2011	BS–1
2	Ghazi Barrage Pond	February 2011	BS–2
3	Downstream Ghazi Barrage	February 2011	BS–3
T4 EMP First Monitoring Sampling			
1	Tarbela Dam Reservoir	29 October 2014	FMS–1
2	Ghazi Barrage Pond	29 October 2014	FMS–2
T5 ESA Baseline Sampling			
1	Plunge Pool	6 June 2015	T5BS-1
2	Dall Dara (downstream)	6 June 2015	T5BS-2
3	Ghazi Pond	6 June 2015	T5BS-3
4	T5 Intake	6 June 2015	T5BS-4

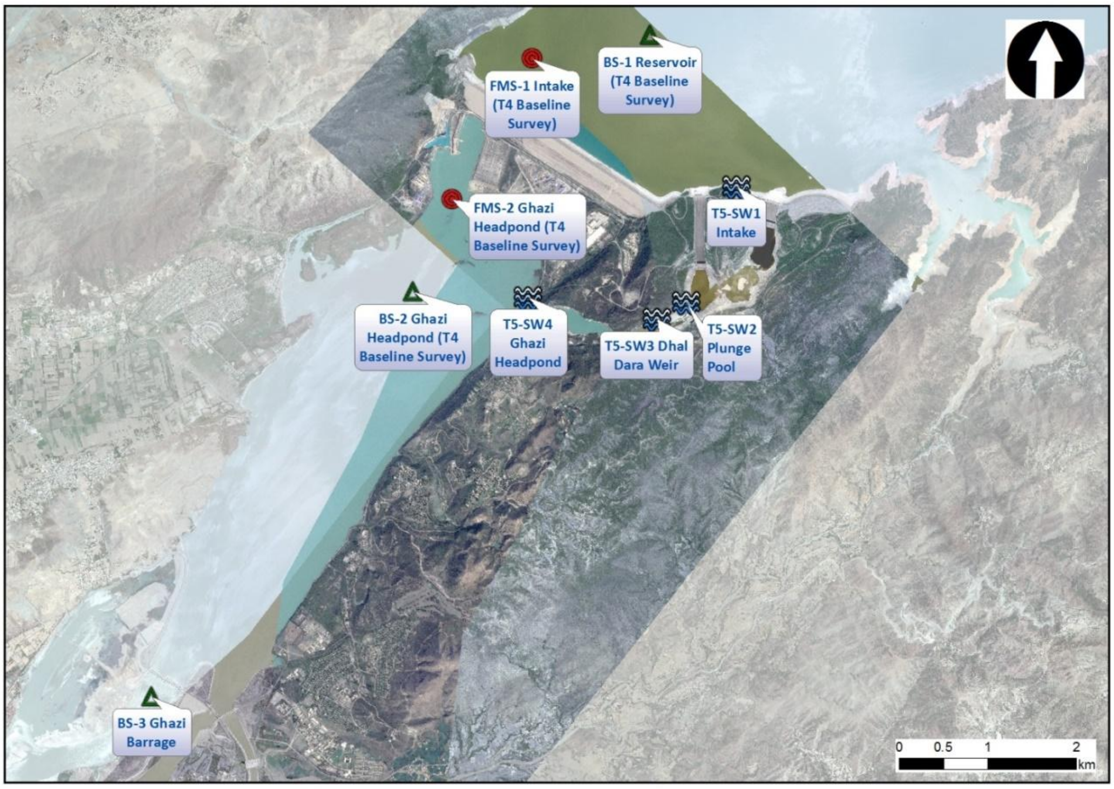
The locations of the T4HP surface water quality monitoring sites are shown in **Figure 5.12**along with the locations of the four Project surface water quality monitoring sites.The results of the surface water quality testing conducted during different sampling periods are given in

Table 5.14.

The water quality data has been compared with the national surface water criteria set by Pakistan Environmental Protection Agency[7] (Pak-EPA). Under this system, surface water is classified AA to D. Classes C and D are most appropriate for the surface water at Tarbela; Class C covers *"water for propagation of balance growth of fish and other aquatic resource"* and Class D applies to *"surface waters that are primarily used for agricultural irrigation and livestock watering, and industrial cooling waters"*.

The results show that all water quality parameters measured are within Class C and/or D with the exception of the pH at Tarbela Dam Reservoir (FMS-1) in October 2014.

Figure 5.12: Project and historical water quality sampling locations



[7]available via www.mocc.gov.pk

Table 5.14: Surface water quality results

Parameter	Unit	Surface Water Criteria		T5BS				BS			FMS	
		Class C	Class D	T5BS 1	T5BS 2	T5BS 3	T5BS 4	BS–1	BS–2	BS–3	FMS–1	FMS–2
Physical parameters												
Total Dissolved Solids	mg/l	1000	1000	91	88	94	104	PN	PN	PN	PN	PN
Conductivity	uS/cm	1500	1500	PN	PN	PN	PN	200	220	220	164	203
Color	TCU	NGVS	NGVS	>15	>15	>15	BDL	PN	PN	PN	PN	PN
SAR (Sodium Adsorption Ratio)		NGVS	5	PN	PN	PN	PN	0.2	0.3	0.3	PN	PN
RSC (Residual Sodium Carbonate)	meq/l	NGVS	1.25	PN	PN	PN	PN	PN	PN	PN	PN	PN
Turbidity	NTU	NGVS	NGVS	29.8	29.5	25.6	1.82	PN	PN	PN	<0.1	0.88
Temperature		**	NGVS	PN	PN	PN	PN	PN	PN	PN	21.2	19.7
Chemical parameters												
pH		6.5-8.5	6.5-8.4	8.05	8.04	7.85	7.98	PN	PN	PN	8.6	8.35
BOD	mg/l	8	8	PN	PN	PN	PN	PN	PN	PN	PN	PN
Dissolved Oxygen	mg/L	>5	>4	PN	PN	PN	PN	PN	PN	PN	7.16	6.99
Chloride	mg/L	NGVS	100	2	2.4	6.2	2.4	7	10.5	10.5	PN	PN
Residual Chlorine	mg/l	NGVS	NGVS	BDL	BDL	BDL	BDL	PN	PN	PN	PN	PN
Nitrate	mg/l	NGVS	NGVS	1.2	1.2	2.3	1.1	PN	PN	PN	BDL	BDL
Nitrite	mg/l	NGVS	NGVS	BDL	BDL	0.03	BDL	PN	PN	PN	PN	PN
Ammonia	mg/l	1	NGVS	PN	PN	PN	PN	PN	PN	PN	0.1	0.11
Ammonium	mg/l	NGVS	NGVS	PN	PN	PN	PN	PN	PN	PN	0.2	0.2
Total Nitrogen	mg/L	NGVS	NGVS	PN	PN	PN	PN	PN	PN	PN	0.06	0.06
Phosphate	mg/L	NGVS	NGVS	PN	PN	PN	PN	PN	PN	PN	0.1	0.1
Total Phosphate	mg/l	NGVS	NGVS	PN	PN	PN	PN	PN	PN	PN	0.2	0.3
Anionic Detergents as MBAS	mg/L	0.5	NGVS	PN	PN	PN	PN	PN	PN	PN	PN	PN
Phenolic Compounds as Phenols	mg/L	0.01	NGVS	BDL	BDL	BDL	BDL	PN	PN	PN	PN	PN
Oil and grease	mg/L	2	NGVS	PN	PN	PN	PN	PN	PN	PN	PN	PN
Chromium	mg/L	0.05	0.01	0.006	0.001	0.001	0.003	PN	PN	PN	PN	PN
Aluminium	mg/l	NGVS	5	BDL	BDL	BDL	BDL	PN	PN	PN	PN	PN
Antimony	mg/l	NGVS	NGVS	BDL	BDL	BDL	BDL	PN	PN	PN	PN	PN

Arsenic	mg/L	0.05	0.1	0.0006	0.0002	0.0008	0.0008	PN	PN	PN	PN	PN
Boron	mg/L	1	1	PN	PN	PN	PN	PN	PN	PN	PN	PN
Barium	mg/L	NGVS	NGVS	0.028	0.031	0.022	0.026	PN	PN	PN	PN	PN
Beryllium	mg/l	NGVS	0.1	PN	PN	PN	PN	PN	PN	PN	PN	PN
Cadmium	mg/L	0.002	0.1	0.001	0.001	0.001	0.001	PN	PN	PN	PN	PN
Cobalt	mg/l	NGVS	0.05	PN	PN	PN	PN	PN	PN	PN	PN	PN
Copper	mg/L	0.007	0.2	BDL	BDL	BDL	BDL	PN	PN	PN	PN	PN
Cyanide	mg/L	0.005	1	BDL	BDL	BDL	BDL	PN	PN	PN	PN	PN
Fluoride	mg/L	1.5	1	0.26	0.31	0.3	0.48	PN	PN	PN	PN	PN
Iron	mg/L	0.3	5	PN	PN	PN	PN	PN	PN	PN	PN	PN
Lead	mg/L	0.01	0.1	BDL	BDL	BDL	BDL	PN	PN	PN	PN	PN
Lithium	mg/l	NGVS	2.5	PN	PN	PN	PN	PN	PN	PN	PN	PN
Manganese	mg/L	0.1	0.2	BDL	BDL	BDL	BDL	PN	PN	PN	PN	PN
Mercury	mg/l	0.000012	0.01	BDL	BDL	BDL	BDL	PN	PN	PN	PN	PN
Molybdenum	mg/l	NGVS	0.01	PN	PN	PN	PN	PN	PN	PN	PN	PN
Nickel	mg/l	0.05	0.5	BDL	BDL	BDL	BDL	PN	PN	PN	PN	PN
Selenium	mg/L	0.005	0.02	BDL	BDL	BDL	BDL	PN	PN	PN	PN	PN
Vanadium	mg/l	NGVS	0.1	PN	PN	PN	PN	PN	PN	PN	PN	PN
Zinc	mg/L	0.086	2	0.002	0.006	0.002	0.001	PN	PN	PN	PN	PN
Total Hardness as CaCO3	mg/L	NGVS	NGVS	90	87	93	90	PN	PN	PN	PN	PN
Biological parameters												
Fecal Coliform	No./100 mL	1000	1000	PN	PN	PN	PN	PN	PN	PN	PN	PN
Total Coliform Bacteria	No./100 mL	5000	NGVS	PN	PN	PN	PN	PN	PN	PN	PN	PN

<: Less Than, ≤: Equal or Less Than, -: Not Defined UO = Un-objectionable; OL = Odorless; NGVS = No Guideline Value Set ; PN = Parameter Not tested; BDL = Below Detection Limit

*available via www.mocc.gov.pk (The concentration of all the analyzed parameters were found to be within the Class C and Class D standards of national surface water criteria – WWF 2007). The national surface water criteria are now followed in provincial level.

** The maximum water temperature change shall not exceed 3C° relative to an upstream control point.

Color Coding:

Above the Class C and Class D standards of national surface water criteria (WWF 2007)

5.2.2 Ground Water Quality

Groundwater Quality at the Dam Site

Water sampling results for the public water supply open well at Kukar Chawa, as well as the sampling results from T4HP ESA falling within the Project AoI have been used to determine the Project groundwater quality baseline. Dates of ground water sampling at each sampling location are provided in **Table 5.15**and results are given in **Table 5.16**. The locations of samples collected are shown in**Figure 5.13**. The groundwater baseline data shows that all parameters tested were well below the NEQS.

Table 5.15: Ground water quality sampling period

	Location	Sampling Period
1	Dhal Camp	April 2014
2	Dhal Camp	28 October 2014
5	Kukar Chawa	06 June 2015

Figure 5.13:Ground water quality sampling locations

Table 5.16: Ground water quality results – Drinking water

Parameter	Unit	NEQS	Sampling 1	Sampling 2	Sampling 3
Physical Parameter					
Temp. C	Deg. C	NGVS	19.8		PN
Colour	TCU	UO	UO	UO	BDL
Odour	-	OL	OL	OL	PN
Taste	-	UO	UO	UO	PN
TDS	mg/l	<1000	102	144	347
Conductivity	micro-S/cm	NGVS	230	288	PN

pH	-	6.5-8.5	7.4	8.26	7.3
Turbidity	NTU	<5	Nil	0.18	0.89
Chemical Parameters					
Alkalinity	m.mol/l	NGVS	0.5	1.2	PN
Bicarbonate	mg/l	NGVS	1	110	PN
Calcium	mg/l	NGVS	6.5	40	PN
Chloride	mg/l	<250	10	12	18.9
Nitrate as N	mg/l	≤50	0.338	0.13	0.9
Hardness	mg/l	<500	30	135	360
Magnesium	mg/l	NGVS	4.5	9	PN
Potassium	mg/l	NGVS	13	1	PN
Sulphates	mg/l	NGVS	18	20	PN
Sodium	mg/l	NGVS	17.5	7	PN
Biological Parameters					
Total Coliform	MPN/100ml	Must not be detectable in any 100ml sample	0	0	PN
E-Coli	MPN/100ml	Must not be detectable in any 100ml sample	0	0	PN
Faecal Coli form	MPN/100ml	Must not be detectable in any 100ml sample	0	0	PN
<: Less Than, ≤: Equal or Less Than, -: Not Defined UO = Un-objectionable; OL = Odourless; NGVS = No Guideline Value Set ; PN = Parameter Not tested; BDL = Below Detection Limit					

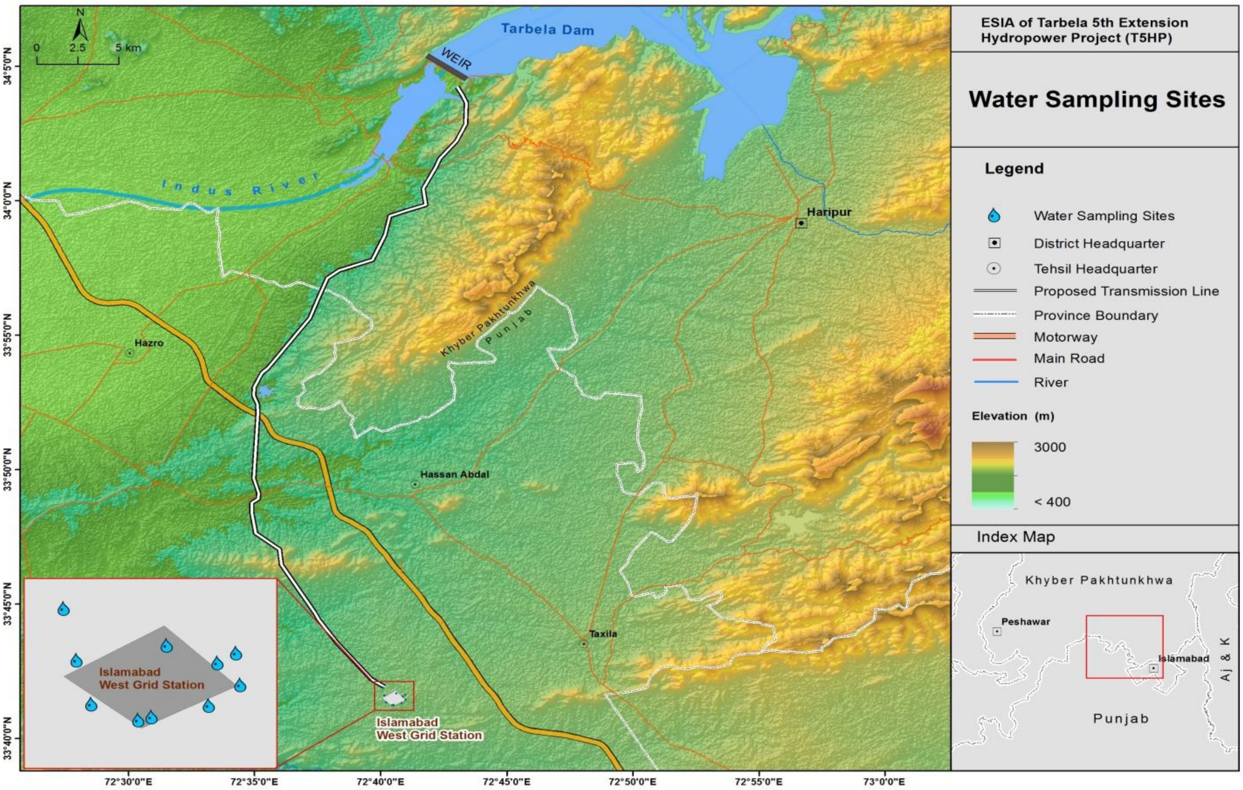
Groundwater Quality at Grid Station and along TL

The main ground water recharge system for the Haripur district is Tarbela Dam with other adjoining rivers passing through the district from north to south. While in Attock district the main source for ground water recharge is Indus and Haro Rivers, both the rivers enter the district from north and continue towards south.

Ground water sampling has not been done for transmission line route as the construction activities are limited to short period of time. Construction works for TL will not have long term impacts on ground water. The present status of ground water for TL is assessed from secondary data and relative analysis of the adjoin areas. Communities were asked during baseline survey for the ground water quality related questions for physical and biological parameters to be assessed. This practice has been opted as toanalyzeactual water quality status.

While for Grid Station ground water samples have been collected from the nearby borehole (BH) and tube wells (TW) at the proposed site for grid satiation. Samples were collected from the Bores and tube wells in the vicinity of the project area and were sent to PCRWR (Pakistan Council of Research in water Resources) for analysis. A total of 10 samples were collected from different locations around the proposed grid station site (refer to **Figure 5.14**) using sterilized bottles provided by PCRWR following proper sampling criteria.

Figure 5.14: Ground water quality sampling locations at grid station



These water sources are used for both agricultural purpose and drinking. The results show that physical parameters of the water sources were found good as there were no taste, color and odor in the water and all the chemical and physical parameters were within the prescribed limits except for the microbiological analysis, for which most of the results came out to be positive. The results were averaged out and are presented in Table 5.17.

Table 5.17: Ground water quality results at Grid Station

S.No.	Water Quality Parameter	Units	Det. Limit	Reference Method	Permissible Limits (PSQCA/NSDWQ, 2010)	Results (Average of 10 samples)	Measurement Uncertainty
Physical Parameters							
1	Color*	-	-	Sensory Evaluation	Colorless	colorless	NA
2	Electrical Conductivity	(µS/cm)	0.3	APHA, 22nd Edition	NGVS	700.3	± 5.8 %
3	PH	-	0.03	APHA, 22nd Edition	6.5-8.5	7.484	± 5.3 %
4	Turbidity	NTU	0.2	APHA, 22nd Edition	<5	BDL	-
Chemical Parameters							
1	Alkalinity	ppm	-	APHA, 22nd Edition	NGVS	315.5	± 9 %
2	Bicarbonate	ppm	5	APHA, 22nd Edition	NGVS	315.5	± 9 %
3	Calcium	ppm	2	APHA, 22nd Edition	NGVS	89.8	± 12 %
4	Carbonate	ppm	5	APHA, 22nd Edition	NGVS	BDL	-
5	Chloride	ppm	2	APHA, 22nd Edition	250	24.8	± 8 %

6	Hardness	ppm	5	APHA, 22nd Edition	500	320	± 6 %
7	Magnesium	ppm	1	APHA, 22nd Edition	NGVS	23.2	± 14 %
8	Potassium	ppm	0.2	APHA, 22nd Edition	NGVS	1.58	± 9.1 %
9	Sodium	ppm	1	APHA, 22nd Edition	NGVS	32.2	± 9.3 %
10	Sulfate	ppm	0.4	APHA, 22nd Edition	NGVS	16.4	± 1.95
11	Nitrate (N)	ppm	0.06	APHA, 22nd Edition	10	4.26	± 1.022
12	TDS*	ppm	-	APHA, 22nd Edition	1000	385	-
Microbiologicl Parameters							
1	Presence/Absence	+ve,-ve	-	Patent	-ve	+ve	-

Note: NGVS: no Guideline Value Set; **WHO**: World Health Organization; **APHA**: American Public Health Association; **BDL**: Below Detection Limit, **QC:** Quality control **CSS**: Customer Service Selection, **PSQCA**: Pakistan Standard Quality; Control Authority, **NEQS:** National Environment Quality Standards.

As apparent from the data above, the water quality in the project area is not suitable for drinking and has a significant content of biological contamination. Although the water could safely be used for the construction activities, however, for human consumption the project will require to either transport water to the project site or filter it at source in order to make it fit for human consumption.

5.2.3 AirQuality

Baseline monitoring for the Project has been undertaken at three sites, as shown in **Figure 5.15**. Site 3 (the viewpoint/switchyard) was selected as the closest accessible point to Kukar Chawa village, which could not be reached by the mobile monitoring van at the time of monitoring due to poor road conditions.Details of the site locations and monitoring periods are presented inTable 5.18.

The air quality monitoring at each of these sites includes measurement of concentrations of PM_{10} and $PM_{2.5}$, NO_2, CO and SO_2.The air quality analysis was carried out in June 2015 by Pakistan Space and Upper Atmosphere Research Commission (SUPARCO) in accordance with the measurement methods and defined averaging periods required by the NEQS.

The results of the Project baseline monitoring are presented in **Table 5.19**and**Figure 5.16.** Monitored concentrations of NO_2, CO, SO_2 and PM_{10} were well below the relevant NEQS; however, concentrations of $PM_{2.5}$ were close to the NEQS at sites 1 and 2 and exceeded the NEQS at site 3. Site 3 (view point) is the closest monitoring site to Kukar Chawa village, which indicates that exceedances may also be observed at the village where residential receptors are present. This data appears anomalously high given the lack of construction in the region and although there are natural dust sources such as dirt roads that could contribute to elevated levels of $PM_{2.5}$ and PM_{10} the data should be considered with caution and may not be widely representative of the baseline at this site. The $PM_{2.5}$ and PM_{10} levels at Site 3 should be corroborated through a monitoring survey immediately prior to construction as part of the construction monitoring programme.

Figure 5.15: Locations selected for Project baseline air quality monitoring

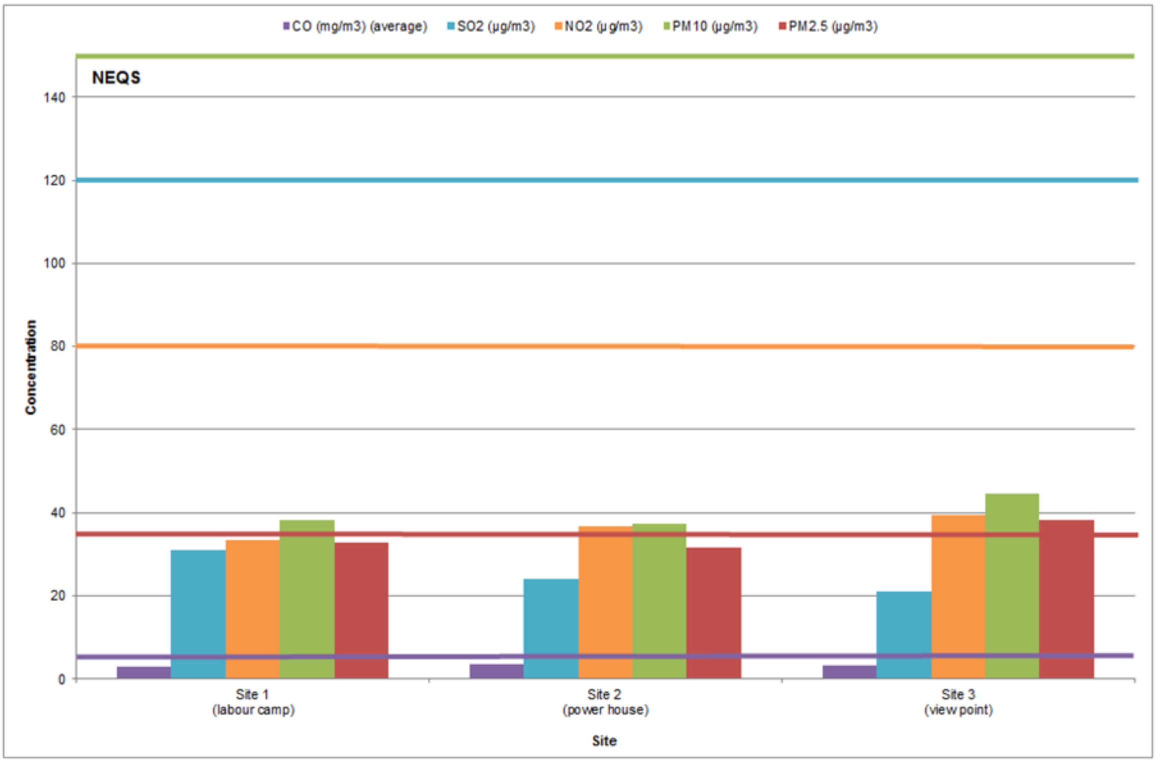
Table 5.18: Project baseline air quality monitoring sites and monitoring schedule

No.	Site name	Start date/time	Completion date/time	Duration	Latitude	Longitude
1.	Labour camp	04-Jun-2015/1300	05-Jun-2015/1300	24hr	34.07393°	72.70524°
2.	Power house	05-Jun-2015/1500	06-Jun-2015/1500	24hr	34.07564°	72.71980°
3.	View point/switchyard location	06-Jun-2015/1600	07-Jun-2015/1600	24hr	34.07135°	72.72269°

Table 5.19: Project baseline air quality monitoring results

Parameter	Averaging time		NEQS	Unit	Average concentrations		
					Site 1 (Labor camp)	Site 2 (Power house)	Site 3 (View point)
Carbon monoxide (CO)	1st third	8hr	5	mg/m^3	2.3	3.4	3.12
	2nd third	8hr			3.0	3.7	3.5
	3rd third	8hr			3.3	3.9	3.2
Sulphur dioxide (SO_2)	24hr		120	$\mu g/m^3$	30.9	24	21.1
Nitrogen dioxide (NO_2)	24hr		80	$\mu g/m^3$	33.4	36.8	39.5
Particulate matter (PM_{10})	24hr		150	$\mu g/m^3$	38.2	37.3	44.7
Particulate matter ($PM_{2.5}$)	24hr		35	$\mu g/m^3$	32.9	31.7	38.3

Figure 5.16:Project baseline monitoring results



T4HP ESA

Ambient air quality monitoring was conducted to inform the baseline characterization stage of theT4HP ESA using the services of SGS Pakistan (Pvt.) Limited. Three ambient air quality monitoring locations were selected within the T4HP project AoI:Ghazi Market, Topi-By Pass and Outlet Tunnel No.4.

As required by the ESMP of T4HP, biannual air quality monitoring is also conducted using the services of SUPARCO at two locations: Chinese Camp and Dhal Camp. A list of air quality monitoring locations along with details of the monitoring periods is provided in**Table 5.20**.The locations of samples collected during different sampling periods are shown in**Figure 5.17**. It is understood that monitoring was undertaken in accordance with the methods and averaging periods prescribed in the national ambient air quality standards, enabling comparison of monitoring results with the NEQS.

Table 5.20: Air quality monitoring locations/codes

Sr. #	Location	Monitoring Period	Monitoring Code
T4HP ESIA Baseline survey			BS
1	Ghazi Market	February 2011	BS–1
2	Topi-By Pass	February 2011	BS–2
3	Outlet Tunnel No.4	February 2011	BS–3
T4HP EMP First monitoring period			FMS
1	Chinese Camp	May 2014	FMS–1
2	Dhal Camp	May 2014	FMS–2
T4HP 4 EMP Second monitoring period			SMS
1	Chinese Camp	October 2014	SMS–1
2	Dhal Camp	October 2014	SMS–2

Figure 5.17: Air quality monitoring locations

Results of the air quality monitoring conducted during different monitoring periods are presented in **Table 5.21**and**Figure 5.18**; the data indicates that air quality at the monitored sites appears to be generally good. However, reports from the T4HP project site suggest that air quality is a concern due to emissions of particulate from crushers, batching plant and vehicles.

Table 5.21: T4HP ESA air quality monitoring results

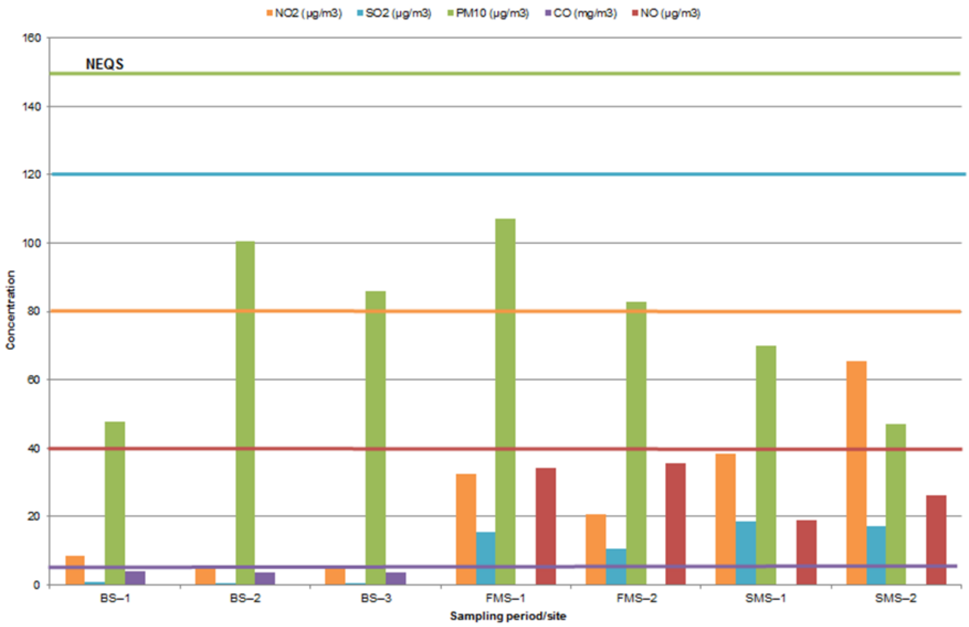
Parameters	**Unit**	**BS**			**FMS**		**SMS**		**NEQS**
		BS–1	**BS–2**	**BS–3**	**FMS–1**	**FMS–2**	**SMS–1**	**SMS–2**	
NO_2	µg/m^3	8.4	4.6	5.2	32.5	20.8	38.4	65.4	80*
SO_2	µg/m^3	0.7	0.4	0.4	15.3	10.5	18.6	17.2	120*
PM_{10}	µg/m^3	47.9	100.4	85.8	107.2	82.8	69.8	47.2	150*
CO	mg/m^3	4	3.6	3.5	-	-	-	-	5**
NO	µg/m^3	-	-	-	34.2	35.5	19	26.3	40*

Notes: NEQS presented for: * 24 hour averaging period; ** 8 hour averaging period

The transmission line passes through mostly rural areas and therefore the general air quality of the project area is good. Sampling for air quality was not incorporated due to the reason that the impacts will be over a very short period of time which would not affect the air quality of the project area. However, secondary data analysis of ambient air quality parameters like Carbon Monoxide (CO), Sulphur Dioxide (SO2), Nitrogen Dioxide (NO2) show that they are well within prescribed permissible limits of NEQS except for the Particulate Matter (PM2.5) which is high due to a cement factory located approximately two kilometers away from the proposed grid station site.

The ambient air quality will only be slightly affected during the construction phase and will minimize right after the construction work is completed. During construction of grid station and overhead transmission line, site preparation activities (excavation work, earth work, storage of exposed piles, truck dumping, and hauling and vehicle movement) may cause dust emission. Also, the vehicle exhaust will contribute to the air pollution but proper mitigation measures would be proposed for the construction areas to avoid these problems and to minimize the impacts on ambient air quality.

Figure 5.18: T4HP ESA air quality monitoring results



5.2.4 Noise

Baseline noise monitoring for the Project has been undertaken at three sites, as shown in **Figure 5.19**. Site 3 (the viewpoint/switchyard) was selected as the closest accessible point to Kukar Chawa village, which could not be reached by the mobile monitoring van at the time of monitoring due to poor road conditions.Details of the site locations and monitoring periods are presented in **Table 5.22**.

Figure 5.19: Locations selected for Tarbela 5 baseline noise monitoring

Table 5.22: Tarbela 5 baseline noise monitoring sites and monitoring schedule

No.	Site name	Start date/time	Completion date/time	Duration	Latitude	Longitude
1.	Labour camp	04-Jun-2015 15:00	05-Jun-2015 13:00	24hr	34.07393°	72.70524°
2.	Power house	05-Jun-2015 16:00	06-Jun-2015 15:00	24hr	34.07564°	72.71980°
3.	View point/switchyard location	06-Jun-2015 17:00	07-Jun-2015 16:00	24hr	34.07135°	72.72269°

Details on the measurement procedure and instrumentation used and equipment calibration history were not available.

The sound level meter was configured to measure L_{Aeq} parameter averaged over one hour intervals. L_{Aeq} dB is the A-weighted equivalent continuous noise level in decibels. The average $L_{Aeq,\ 1hr}$ for each measurement position over day time and night time periods are presented in **Table 5.23**.

Table 5.23: Project average baseline noise levels $L_{Aeq\ 1hr}$ dB monitoring results

Location	Daytime (06:00-22:00)	Night Time (22:00-06:00)
Site 1 (Labour Camp)	53	54
Site 2(Power House)	63	55
Site 3 (View point)	59	62

From the data above, it is noted that there is little variation in the daytime and night time noise levels recorded in the labor camp potentially due to the night time workings associated with T4HP. The elevated night time noise levels at Site 3 are not readily explainable and an additional round of baseline noise monitoring is recommended at this location immediately prior to construction to corroborate noise data from the baseline survey.

Tarbela 4 ESA

Baseline noise monitoring was conducted to inform the baseline characterization stage of theT4HP ESA. Three noisemonitoring locations were selected within the T4HP project AoI:Ghazi Market, Topi-By Pass and Outlet Tunnel No.4. The daily average monitoring results extracted from T4HP ESA are provided in **Table 5.24**.

The noise levels measured at different locations ranged from 45.2- 66.5 dB. Whilst the T4HP monitoring positions are not located within the study area they are considered to provide a representation of the noise climate in the wider environs. The recorded noise levels were above World Bank Standards.

Table 5.24: Baseline noise monitoring results extracted from T4HP ESA

Location	Average Daytime	Average Night time
Ghazi Market	61	51
Topi-By Pass	57	51
Outlet Tunnel No.4	62	52

Source: Data extracted from Table 6.10 Tarbela 4 ESA (source SGS Noise Monitoring Report)

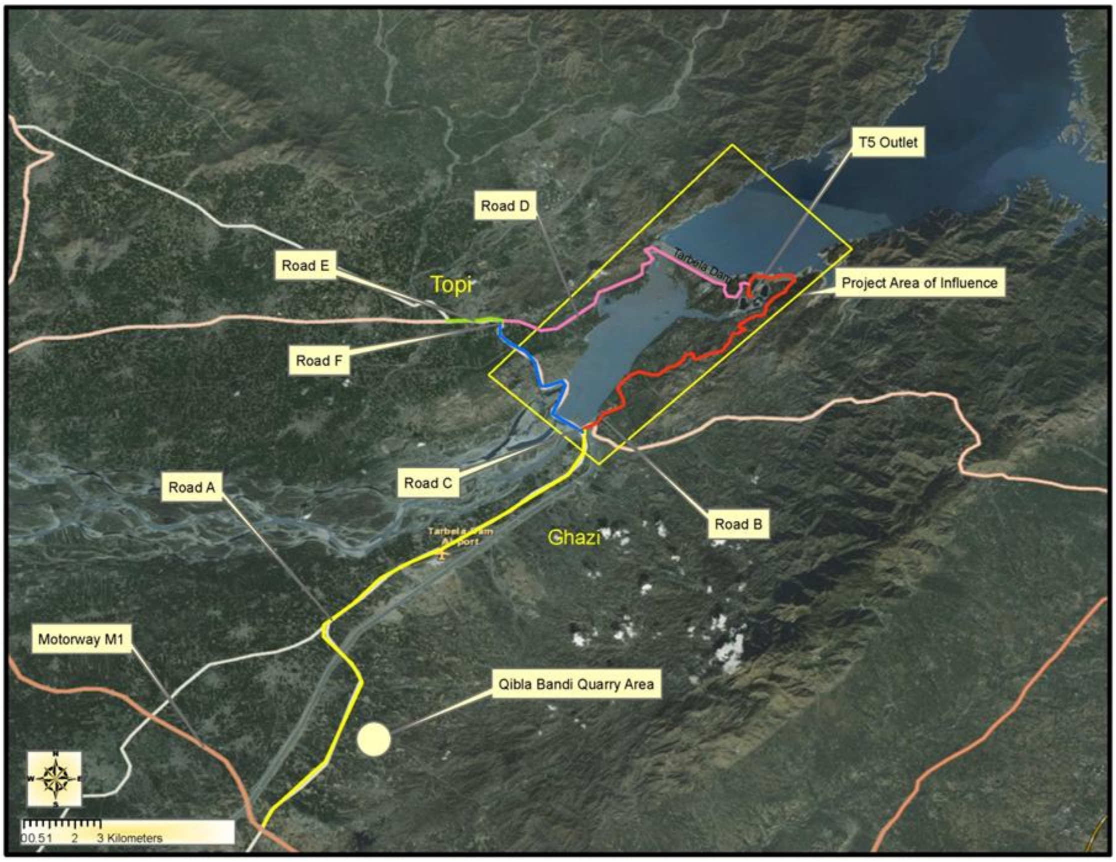
5.2.5 Traffic and Transport

It is expected that some roads within the Haripur district will be utilized for the Project. A description of existing roads in the Haripur district is as follows; note that road references are annotated in Figure 5.20

- M1 / Qibla Bandi is an asphalted road which begins in Islamabad and terminates at Peshawar City, with a total length of 155 km and six lanes in some sections. Nearer to the Project site (Ghazi Barrage), the road is comprised of a single carriageway with one lane for each direction of traffic. This road crosses Ghazi Barrage and moves toward Topi City and up to Swabi City (Figure 5.20).
- Roads A, C, E and F are all approximately 20m wide, asphalted roads that are owned by the National Highway Authority. All roads are in a good condition with the exception of a 2km section near Ghazi Market
- Road B is an asphalted road which is approximately 17m wide and has recently been repaired and considered to be in good condition
- Road D is an asphalted road which is approximately 20m wide, until the road passes the Right Bank Colony at which point the width of the road reduces to approximately 17m. This road is owned by the local government of Topi and is considered to be in good condition.

The roads in the area are currently used by commercial and private users including trucks, buses and mini-buses, rickshaw drivers, animal drawn carts and pedestrians.

Figure 5.20: Roads in the Haripur District



Source: Feasibility Study of T5HP

Traffic Numbers

A traffic survey was conducted at six observation points where up to six people observed and recorded the vehicle traffic flowing in both directions at the observation points from the hours of 7 am to 7 pm. The survey was undertaken on 8 June 2015 (roads A, B, C) and on 10 June 2015 (roads D, E, F).

During the traffic survey vehicle types (bicycle, tricycle, animal drawn vehicle, motorcycle, car, van, bus, truck) were recorded. The survey was scheduled at a time that would be indicative of average typical traffic flow and high traffic flow (e.g. avoidance of public holidays). The results of the data collected during the June 2015 traffic survey have been provided as a daily average in **Table 5.25**.

Table 5.25: Average daily traffic volumes in the project area by road

Traffic Mode	A	B	C	D	E	F
Animal Drawn	47	1	6	7	41	9
Motor Cycle / Rickshaws	3757	2048	1170	2124	1496	476
Cars / Pickups / Taxi	3128	2316	1320	710	600	404
Mini Buses / Bus/ Wagon	1316	304	343	75	56	66
Trucks / Tractor-Trolley	135	17	51	24	41	46
Average Daily Traffic (ADT)	**8383**	**4686**	**2890**	**2940**	**2234**	**1001**

Road A = M1/ Qibla Bandi to Ghazi; Road B = Ghazi and Topi to Left Bank Colony; Road C = Topi to Ghazi (Left Bank), Road D Topi to Right Bank Colony; Road E = Topi to Ghazi (Right Bank); Road F = Ghazi to Right Bank Colony.

The data provided in **Table 5.25** indicates that the roads with the highest volumes of traffic are road A (M1 / Qibla Bandi to Ghazi Road) and road B (Ghazi and Topi to Left Bank Colony Road).

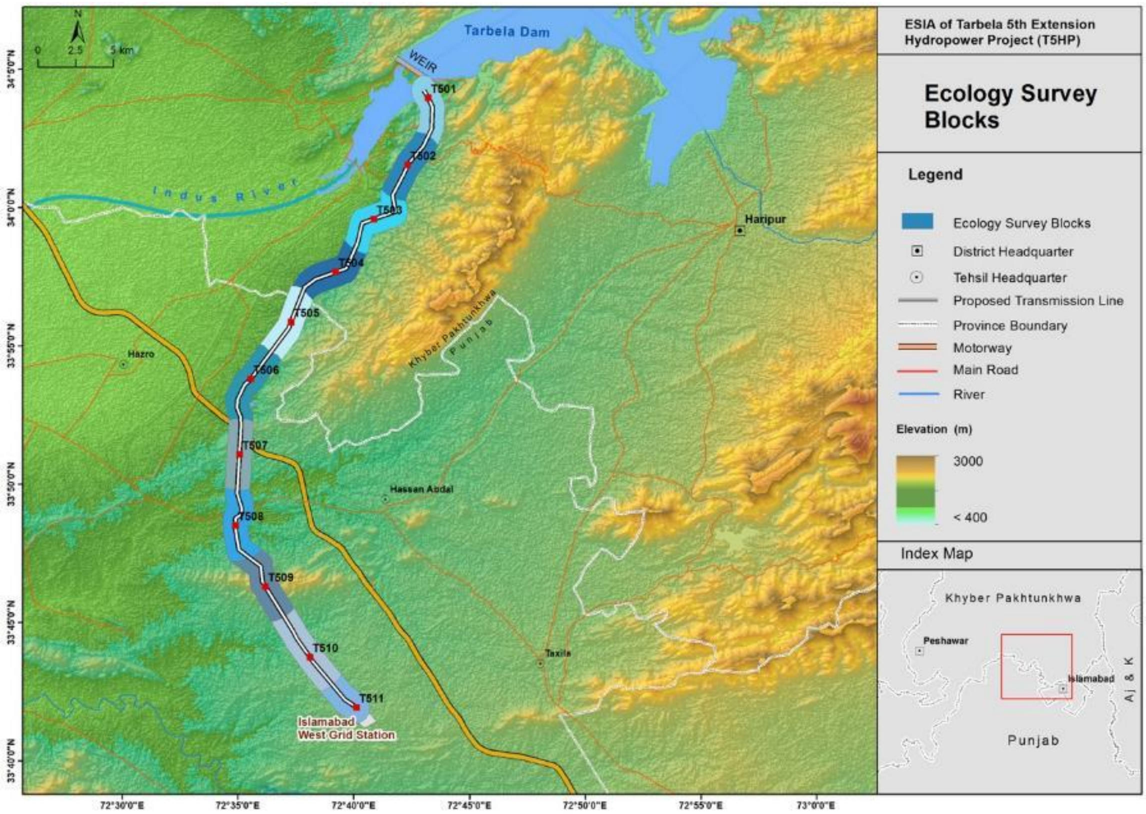
The traffic survey also found that peak times for traffic were 07:00 hrs to 10:00 hrs and 17:00 hrs to 19:00 hrs.

The baseline information from the T4HP ESA has also been considered to supplement the data collected in the June 2015 traffic survey. The T4HP baseline data showed an average daily traffic count that is broadly consistent with the data presented in **Table 5.25**.

5.3 Biological Environment

This section describes the ecological conditions in the study area (shown in**Figure 5.21**), focusing on the flora, mammals, and reptiles and amphibians. The diversity in these groups has been described along with the field observations and the conservation status of the species. The habitat of the study area has been characterized on the basis of biological and physical factors and its spatial delineation is provided. **Annex 3** provides checklists of recorded flora and fauna and fauna, along with other auxiliary data.

Figure 5.21: Study Area for the Ecological Baseline Study



The ecological baseline study focused on the following components:

- Assessment of vegetation and land cover classification
- Assessment of wildlife, on each of the following components;
    - Large mammals (carnivores/ungulates)
    - Small mammals
    - Reptiles and Amphibians
    - Identification of key biological receptors (species, habitats), likely to be affected by the project;

The field survey was carried around the project facilities (the proposed grid stations and transmission line, **Figure 5.21**), and one-kilometer buffer was added, to each side of the transmission line, to explore status of ecological receptors and their spatial pattern. The study was divided into sections of 5 x 1 km, and each section was thoroughly explored for all components of the biological environment, following standard methodologies.

5.3.1 Biodiversity Importance of Pakistan

Pakistan is located within the Palearctic and Indomalayan ecozones. The ecosystems of Pakistan range from coastline in the south to the mountain ranges of the Himalayas and Hindu Kush in the north along with deserts and plains [8]. The vegetation is dry and sub-humid land comprised of xerophytic shrubs and small trees, grasslands and steppe. This variation in relief and climate has bestowed Pakistan with rich biodiversity and many ecosystems, habitats and species of global significance. Pakistan has 195 mammal species (six being endemic), 668 bird species (25 being endemic), 177 reptile species (13 being endemic), 22 amphibians (nine being endemic), 198 fresh water fishes (29 being

[8] Convention on Biological Diversity (CBD) (2014). Pakistan Fifth National Report, Climate Change Division Government of Pakistan, Progress on CBD Strategic Plan 2010-2020 and Aichi Biodiversity Targets

endemic) and 5,000 species of invertebrates, as well as 5,700 species of flowering plants (over 400 being endemic).

Main threats to the terrestrial biodiversity are overgrazing, deforestation, illegal hunting, and habitat disintegration due to population growth and infrastructure development. The main threats to biodiversity of inland waters are pollution from industrial and municipal waste. The coastal and marine ecosystems are also threatened from pollution[9].

5.3.2 Protected Areas

Pakistan has 14 national parks, 72 wildlife sanctuaries, 66 game reserves, nine marine and littoral protected areas, 19 protected wetlands, and a number of other protected areas of grassland, shrub land, woodland and natural monuments.

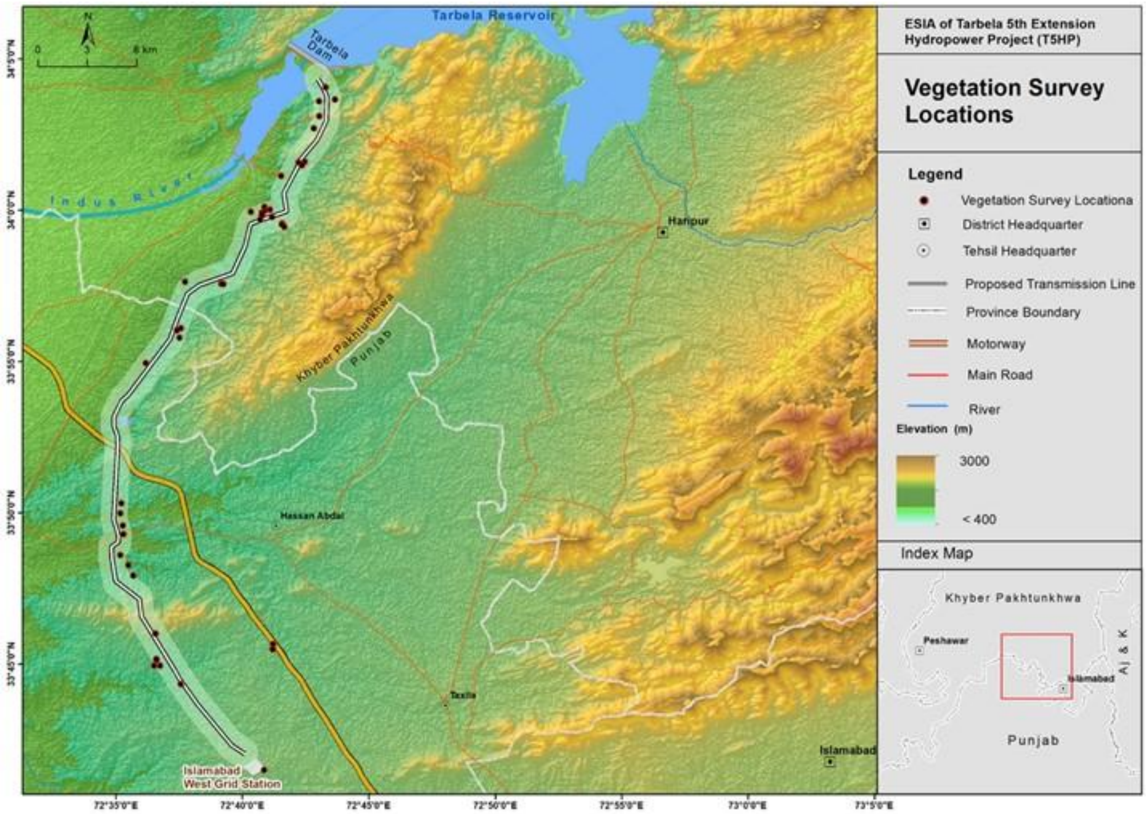
There are no protected areas for nature conservation designated at national or international levels within 15km of the Project, and therefore no further impact on designated sites is considered in this assessment.

5.3.3 Floral Biodiversity of the Project Area

Methodology of Field Surveys and Preparation of Landcover Maps

Field Surveys: The field surveys were conducted in the project area and adjoining locationsduring November 2015. The surveys focused on collection of vegetation data stratified into various habitat types. The data collected during the field surveys was finally used to produce a land cover/habitat types map of the project area. The locations that were surveyed during the field visits are shown in **Figure 5.22**.

Figure 5.22: Vegetation Survey Locations



9 Convention on Biological Diversity (CBD) Secretariat (2015). Pakistan – Main Details [Online]. Available at https://www.cbd.int/countries/profile/?country=pk (accessed 29 June 2015)

Determining floral diversity and the habitat types: The species that were seen during the fieldwork were photographed, identified in the field and those that were unable to be identified were collected and identified with the help of floral experts in National Herbarium of Pakistan (RAW) at National Agricultural Research Center (NARC), Islamabad. The nomenclature follows (Nasir and Ali, 1970). The species data were organized according to their taxonomic categories (family, genera and species).

Preparation of Landcover Map: Data pre-processing: The digital image over the study area consisted of;(1) Landsat 8 (WRS2 Path=150; Row=37; L1T processed level) acquired on April 13th, 2015 and; (2) A high resolution satellite imagery obtained from Bing i.e., Digital Globe Imagery of November 2012 at a spatial resolution of 1.19 m. These data were ortho rectified, and sub-set to the geographic extent of the proposed transmission line within a buffer of 1 km area (**Figure 5.22**). Image enhancement was done to improve the visual quality and interpretability of image.

These two datasets were fused together using high resolution merge technique and then processed for object bases image classification to match the landcover cases perceived during the fieldwork.

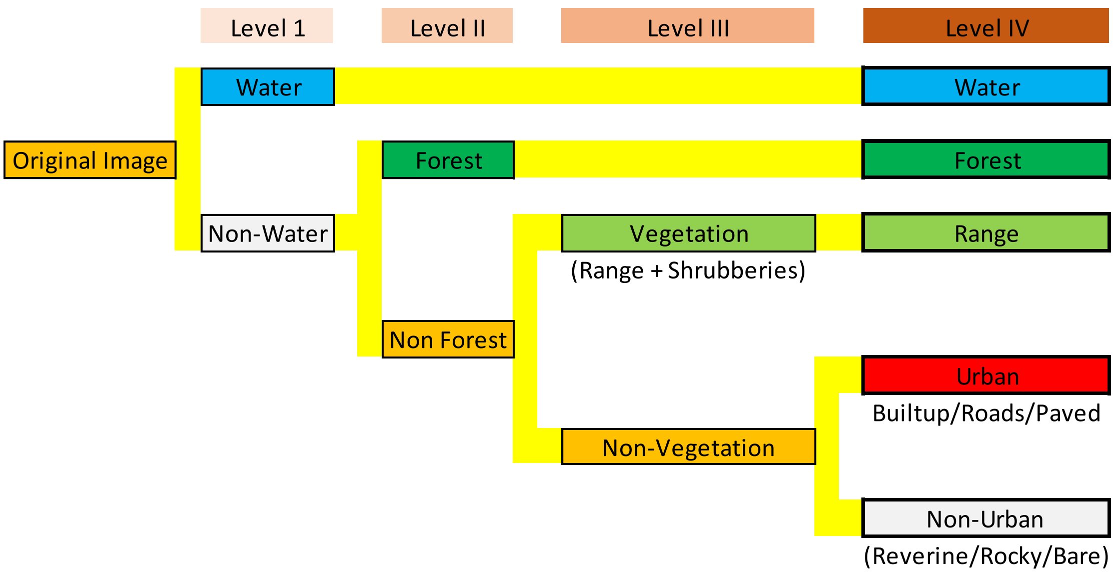
Object based Image Analysis: The approach used to map landcover of the project area was object based image analysis (OBIA), performed using commercially available software, 'eCognition developer' software version 8 (http://www.ecognition.com/suite). It uses a region merging technique to perform spatial partition or segmentation of the input image pixels. The outcome of segmentation can be controlled by user-defined parameters (threshold, shape and compactness) that must be assigned carefully according to the feature being extracted (Mathieu and Aryal, 2007). These parameters are defined by a trial and error approach to capture image objects of interest, however, beyond quantitative evaluation of the procedure, no segmentation result is fully convincing if it does not satisfy the human eye (Mathieu and Aryal, 2007). The OBIA parameters used to extract land cover information from the satellite data, are summarized in**Table 5.26**.

Once the segmentation was done, the resulting clusters were compared with thoroughly ground-truthed field data and assigned to respective classes. The level 4 of the segmentation process was used to fine tune the classification analysis (**Figure 5.23**).

Table 5.26: Segmentation Parameters applied for Image Analysis

Hierarchy	Threshold	Shape	Compactness
Level 1	75	0.3	0.5
Level 2	60	0.3	0.5
Level 3	50	0.3	0.5
Level 4	40	0.3	0.5

Figure 5.23: Optimal Segmentation Tree for the Discrimination of Landcover Categories



Plant Species Diversity

The project area lies at the eastern part of the Attock basin that has prominent South-westward- directed fluvial and alluvial sedimentation (Burbank and Tahirkheli, 1985; Pivnik and Johnson, 1995). The area for most of the part is “Pothohar”. The topography of area is a combination of hills and plains that are mainly drained by Haro River and its tributaries such as Nandna, Dhamruh and Banudra streams (Khan et al., 2002). The project area is fringed at North/Northeast by the by the ridges belonging to Gandghar Range, the most prominent physiographical feature of the area, that culminate into the Khari plains of tehsil Ghazi of district Haripur (KPK). Moving further towards south, the area is generally plain that is dotted by hills, the spurs and off shoots of the Gandghar Range and streaked by ravines and streams, coming from the Gandgarh Mountain, its offshoots and those from the Margalla Range. The Gandgar range exposes a suite of meta-sedimentary rocks, which have been co-related, with the Paleozoic sequences of Hazara and Attock-Cherat ranges (Gazetteer of the Hazara District, 1907).

All along the northern boundary the country is very much broken. The agricultural land in the adjacent land to the proposed transmission line is either rainfed or irrigated by mountain streams on their way to Haro River. Then comes the broken hill country round Wah and Hassan Abdal shot through by the Qandharipur, Lundi and Kherimar hills; that further end into sandy plains towards west.

The southern portion of the tract is a comparatively open plain from Haro up to Kala Chitta range. The soil is mainly of limestone formation in this area. In this portion, there is much good land, but it is scoured by many streams and nameless ravines that drain the area down to the Haro river.

The native vegetation is Sub-tropical scrub forests on Gandgar Mountains and at lower it has tropical thorn forests. It is a low evergreen forest. The predominant forest vegetation includes the *Acacia modesta*, co-dominated by *Dalbergia sossoo*. The vegetation is sparse, except in certain higher areas where it is under thick forest. It must be mentioned that the area between Burhan and Tarbela is highly infested with invasive *Lantana camara* that forms the under canopy in most of the cases. The spread of this weedy bush weakens towards south and it diminishes after Kherimar hill.

Annual average rainfall is 694 mm. On an average the rainfall is scanty, uncertain and unevenly distributed and mostly received in monsoon season. It is characterized by semi-arid climate and the maximum temperature exceeds 45°C in summer while falls below 20°C in winter (Census, 1998).

During the field survey, a total of 151 plant species (**Annex 3**) were recorded from the vicinity of the proposed project area. These species were represented by 130 genera belonging to 50 different families (**Figure 5.24**). It must, however, be iterated that this species list is far from complete and the survey was carried out during such a time when most of the seasonal flora has already diminished due to onset of winters.

The majority of the plant species belonged to Dicotyledonae (n=115) having 95 genera and 41 species. There were only 5 species of Pteridophytes that were recorded during the study (**Figure 5.25**).

Leguminosae, Asteraceae, Lamiaceae and Euphorbiaceae were the most represented families in the area having respectively 16, 8, 8 and 7 number of species **(Figure 5.26**).

Figure 5.24: Taxonomic summary of plant species recorded from the Project Area

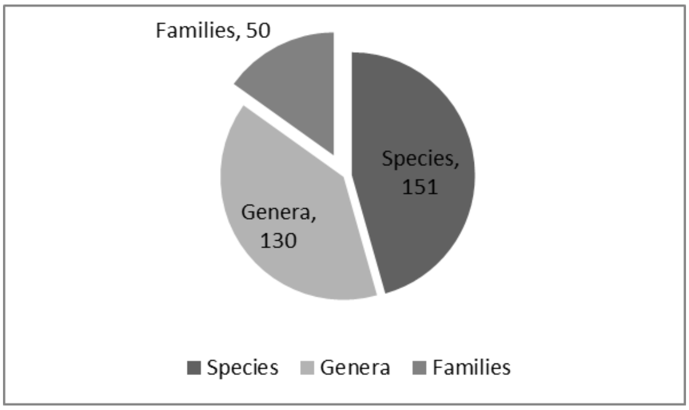


Figure 5.25: Breakdown of species recorded from the Project Area, into Major Plant Groups

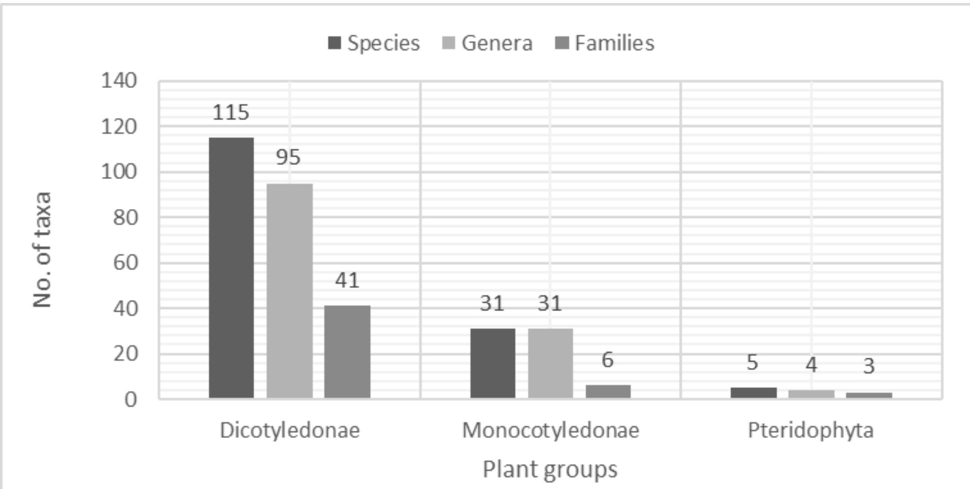
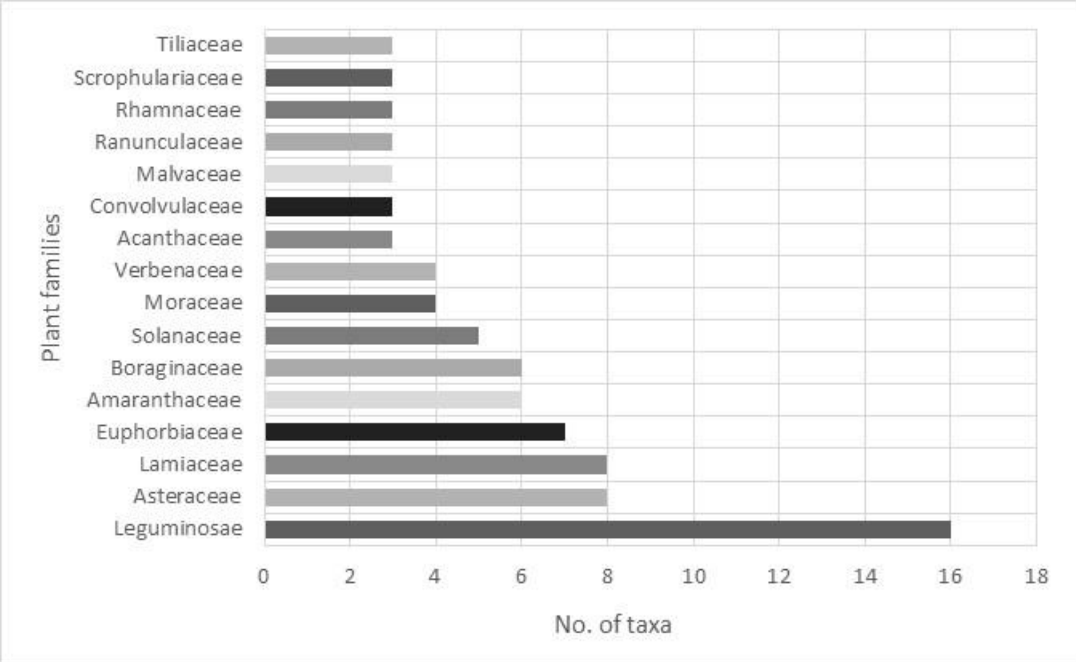


Figure 5.26: The Most Represented Vascular Plant Families from the Project Area

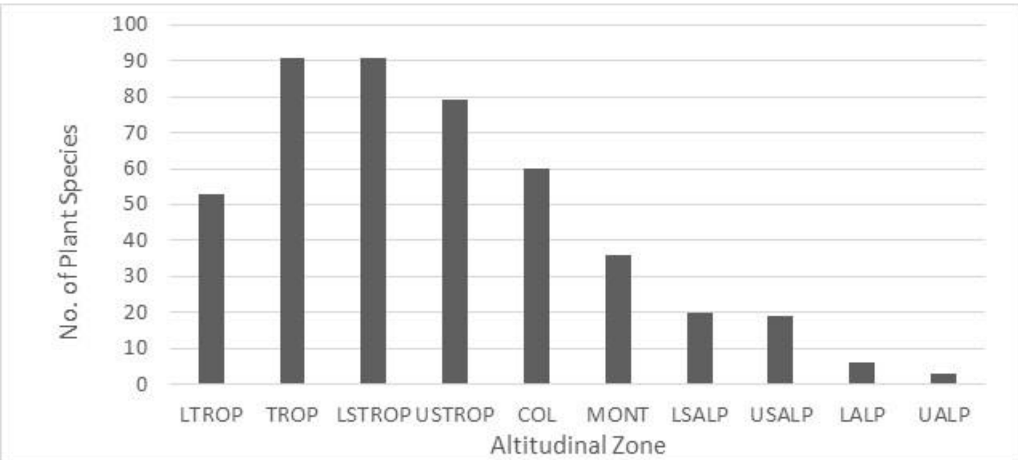


Vertical Zonation and Phytogeography

The vertical distribution range of the species (**Figure 5.27**) suggest that the species being reported from the T5 project area have wider geographic distribution range.

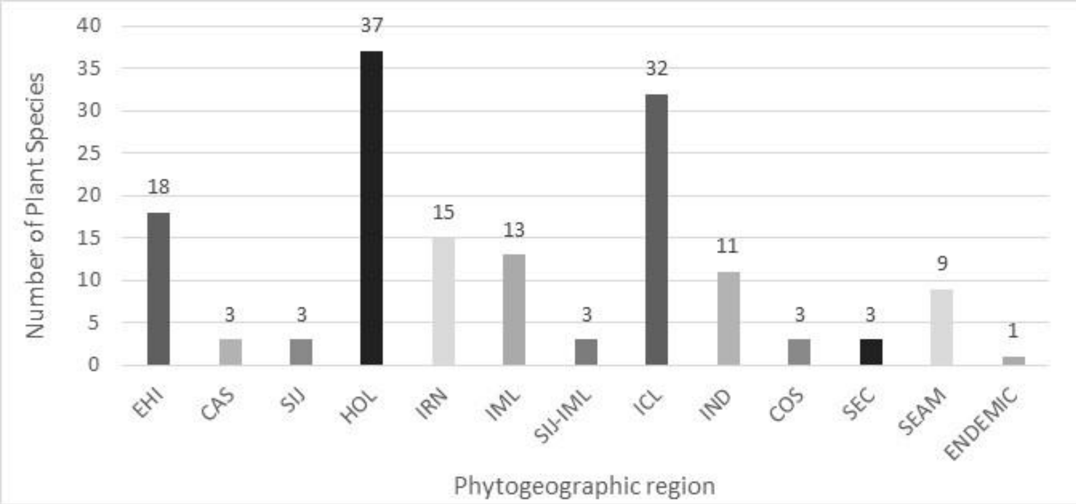
The phytogeographic analysis (**Figure 5.28**) suggest that majority species belong to the Holarctic bioregion (n=37) followed by 32 species under category of introduced or cultivated (ICL). There was only one endemic species that is *Otostegia limbata* (Benth.) Boiss. (**Figure 5.29**).

Figure 5.27: The Vertical Distribution Range of the Plant Species from the T5 Project Area



Key: L= Lower; U = Upper; TROP = Tropical; STROP = Sub-Tropical; COL = Colline; MONT = Montane; ALP = Alpine; SALP = Sub-Alpine; ALP = Alpine

Figure 5.28: The Phytogeographic Affinities of the Plant Species from the T5 Project Area



Key to Phytogeographical Affinities: EHI = East Himalayan; CAS = Centeral Asiatic; SIJ = Sino-Japanese; HOL = Holarctic; IRN = Irano-Turanian; IML = Indo-Malayan; ICL = Introduced/Cultivated; IND = Indian; COS = Cosmopolitan; SEC = Southeast Chinese; SECM = Southeast Chinese/Malayan; ENDEMIC = Endemic

Figure 5.29: Otostegia limbata (Benth.) Boiss. a regional endemic

HabitatTypes and Species Associations

The project area is located in a zone that can be interpreted as a transition between Sub-tropical scrub forests and tropical thorn forests(Champion et al., 1965). However, the forest cover has been variously transformed and converted to agricultural area. The broad leaved scrub land is dominated by the *Acacia modesta* along with admix of *Dalbergia sissoo*. There are a couple of water reservoirs in addition to Tarbela and various seasonal streams and Haro river as most prominent aquatic features in the area. Where the forest has been cut, the area is occupied by widely spread trees and dominant shrubs such as *Ziziphysnummularia*, *Gymnosporia royleana* and *Justicia adhatoda*. There is widespread occurrence of reeds like *Saccharum benghalense* in the area that is very often associated with ravines and seasonal stream beds. The built up areas such as settlements and road infrastructure is distributed throughout and have species associations of their own, mainly cultivated/introduced or weedy perennials. Due to high grazing pressure, the areas nearby settlements show stunted growth of trees and shrubs. The cultivated land (including agricultural embanks) and open areas accommodate the majority of the species reported from the project area.

In order to compile baseline information on the floral diversity alongthe transmission line, the habitats types were subjectively determined, which are described below and their represented photographs are provided in

Figure 5.30:

i). Aquatic habitat (AQ)

These include the habitats with standing water such as along springs or water channels.

ii). Cultivated land (C)

The cultivated lands are located in both north and west vicinity of the study area including villages Sandhian and Dhar Jawa. The major crops include wheat and maize that are in principal rain-fed.

iii). Scrub Land (Sc)

The dominant species in broadleaves or hardwood forests in the prefecture mainly include *Acacia modesta, Dalbergia sissoo.* In principal the class Sc occupies locations along the water channels or agricultural fields or as isolated patches or greater areas. The occasionally spread small patches of trees are also included in the same category.

iv). Open land (O)

The open land areas exist throughout the landscape and include areas such as rocky outcrops, grassy slopes or flat lands. Mainly these are a result of forest clearing.

v). Riverine (River belt, stream) (R)

The riverine habitat includes those in immediate vicinities of water channels or drains. It is hard to distinguish it from aquatic habitat; however, it refers most often to the habitats marked with flowing water or situations such as ponds and lakes.

vi). Shrubland / Shrubberies (S)

The shrubland includes the scattered shrubs resulting most commonly from forest clearing or invasion by *Lantana camara*. For purpose of landcover classification this class was merged with open lands.

vii). Urban / Settlement area (U)

Includes the residential areas as well as other built-up structures such as roads etc.

Wherever possible, these habitat types were sub-categorized based upon general conditions as discussed in fore coming section.

A summary of the species associated with various landcover/habitat types has been presented in **Figure 5.31**. A detailed overview of the species association with habitat types has been presented in **Annex3**.

Figure 5.30: Represented photographs, along with associated species, of Habitat types identified in the Project Area

i. Aquatic habitat	**(AQ)**	
Aquatic	AQ	1 species reported


ii. Cultivated land	**(C)**	
a. Non irrigated land (Barani/rainfed)	CB	46 species reported
b. cultivated crop	CC	8 species reported
c. Irrigated land	CK	13 species reported
d. planted for fodder, shade etc.	CP	14 species reported


iii. Scrub land	(SC)	
a. liana (woody climber)	FBL	1 species reported
b. open space/forest clearing	FBO	14 species reported
c. Rocky area inside forest	FBR	1 species reported
d. shady floor	FBS	9 species reported

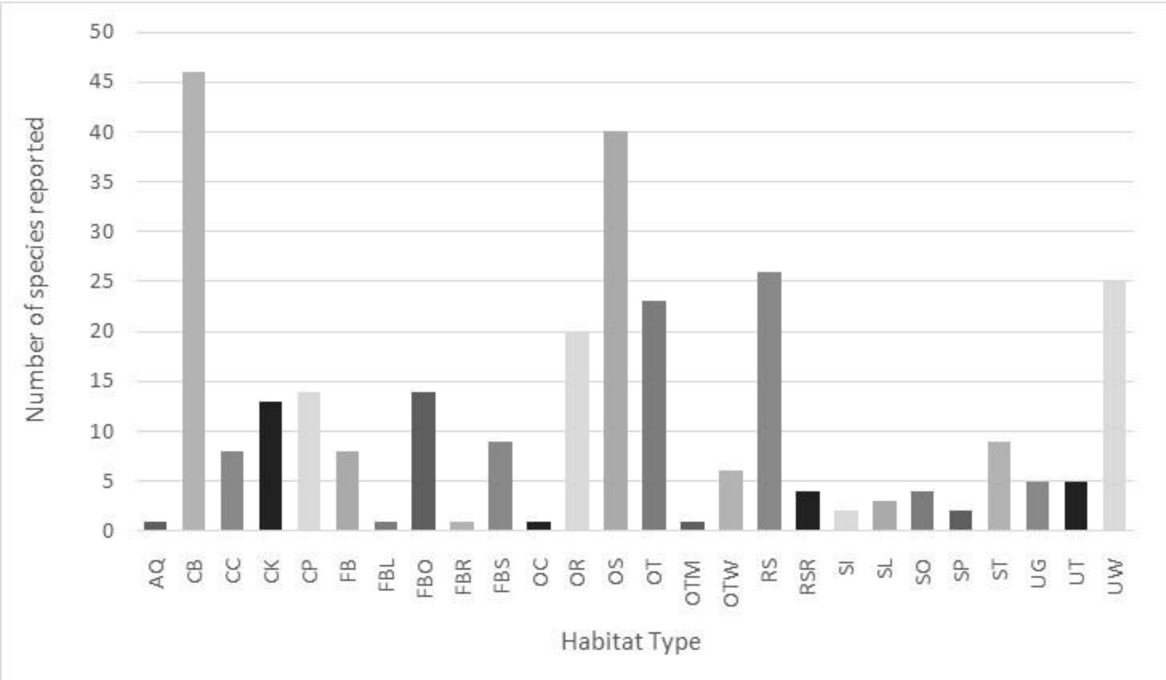

iv. Open land	**(O)**	
a. rocky/ landslide area/slope	OR	20 species reported
b. slope/ meadow/ridge	OS	40 species reported
c. terrace/flatland	OT	23 species reported

v. Riverine (River belt, stream)	**(R)**	
a. river/streamside	RS	26 species reported
b. RS rocky area	RSR	4 species reported

vi. Shrubland / Shrubberies	**(S)**	
a. Inside shrubberies	SI	2 species reported
b. Climber	SL	3 species reported
c. open shrubland	SO	8 species reported

vii. Urban / Settlement area	(U)	
a. garden/pot	UG	5 Species reported
b. walls, etc.	UT	5 Species reported
c. waste-land	UW	25 Species reported

Figure 5.31: Affiliation of Documented Plan Species with Habitat types identified in the Project Area



Landcover Map

A generalized landcover map for the project area has been documented in **Figure 5.32**and a summary of area covered by each of the landcover class are shown in **Figure 5.33**. The most dominant landcover category with respect to area covered was agriculture that accounts for 42.2% of the Buffer area followed by scrub land (37.6 %) and rangeland/open areas (13.6%). The rest of landcover types have minor contribution towards the overall landcover.

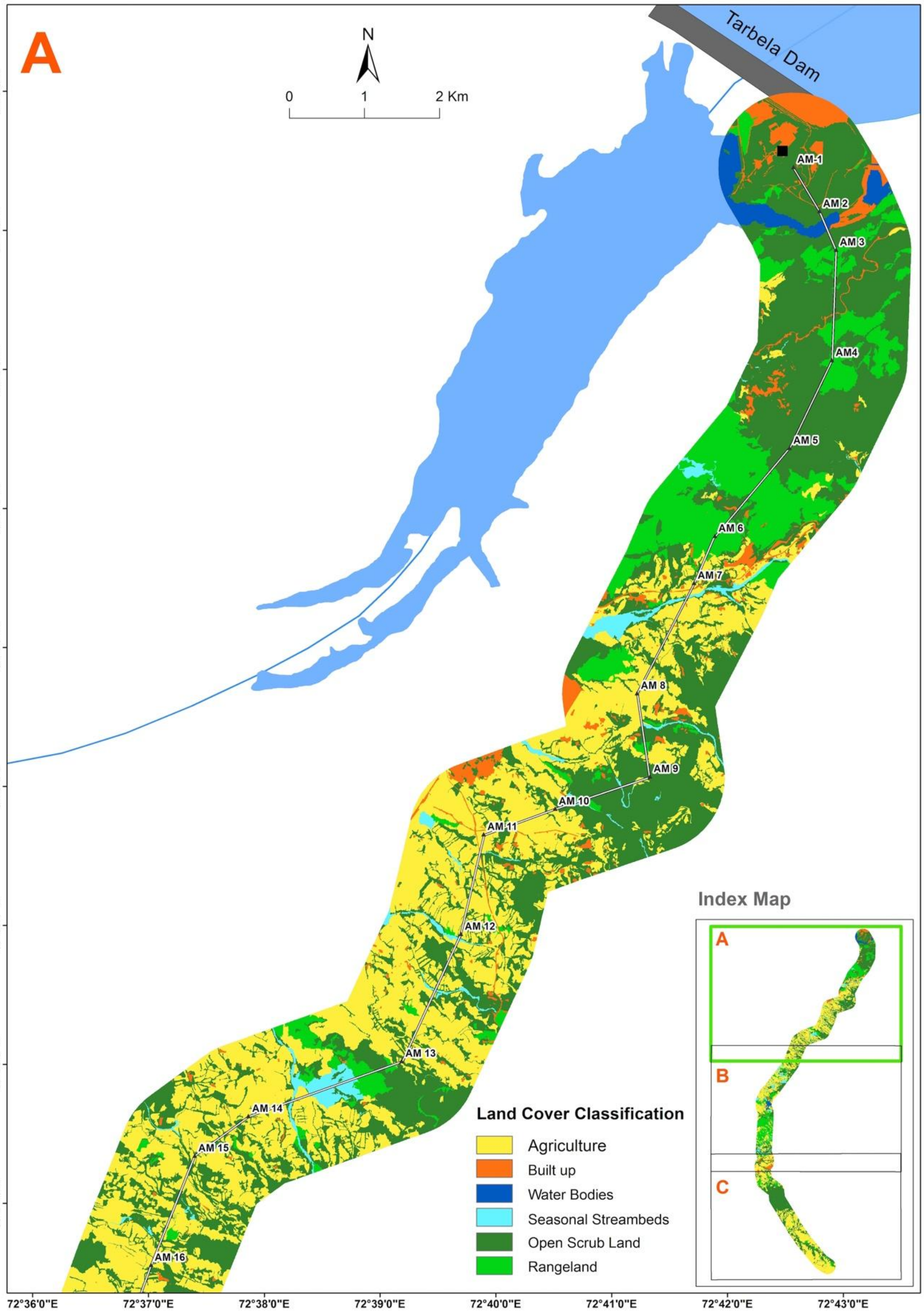
The grid station buffer of 1 Km occupies an area of 314.1 hectare that is mainly agriculture.

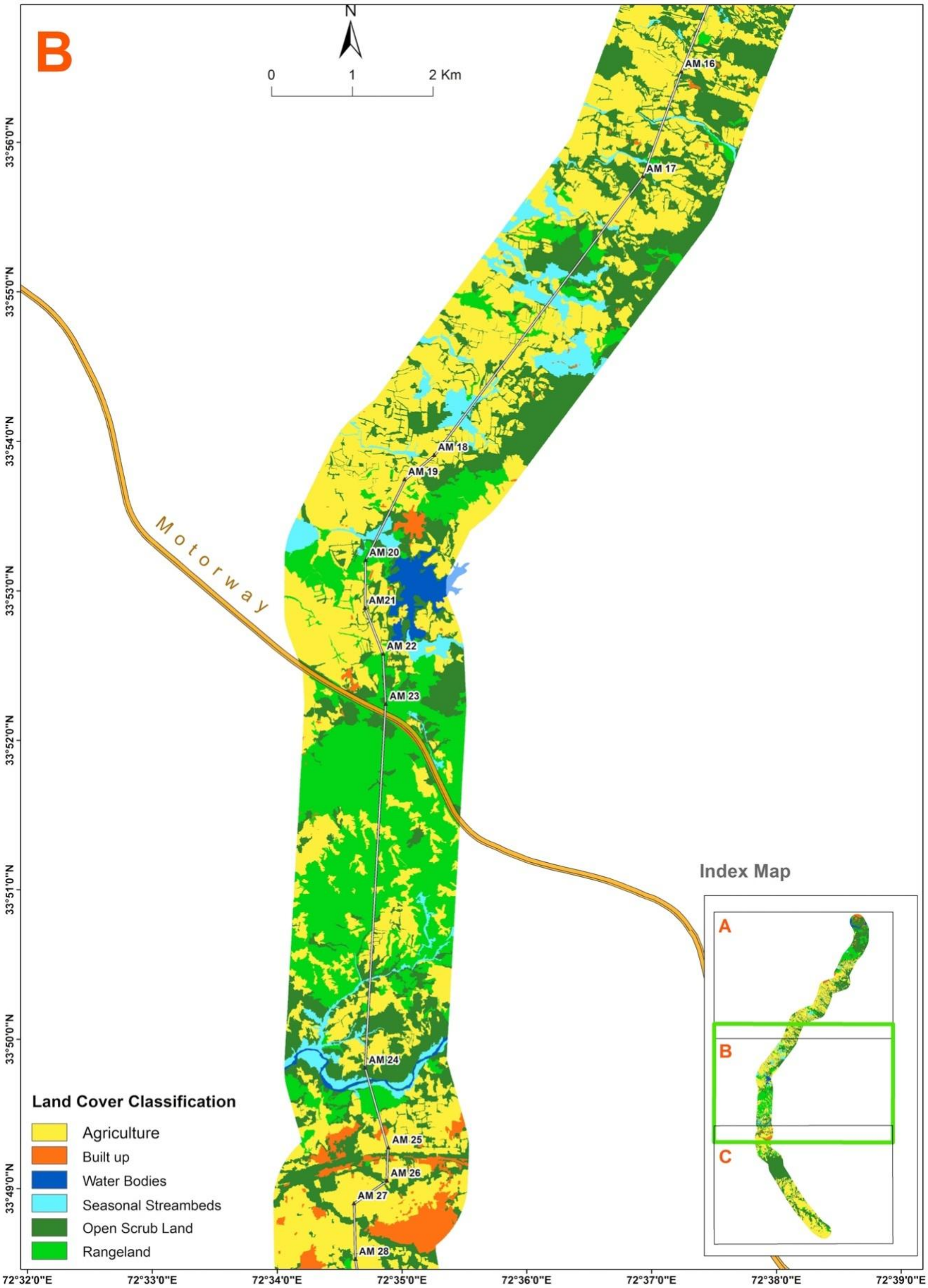
The northern edge of the project area is marked by the presence of a scrub land that culminates into an open area occupied by agriculture and associated Built-up/settlement areas. The remnant patches of forests are obvious throughout the length of transmission line. There are number of places where the plantations of *Eucalyptus camaldulensis* have been made and also included in category of forest. As a matter of fact, the category forest does include the linear plantations alongside agricultural areas and settlements. The most prominent trees that can be seen nearby settlements include *Acacia modesta, Dalbergia sissoo*, *Acacia nilotica*, *Eucalyptus* sp. and *Albizzia lebbek*. Heading across the Kherimar hill, the most obvious trees along agricultural areas are that of *Tamarix aphylla* and *Broussonetia papytifer* together with the native *Acacia* and *Dalbergia*.

Where the topography is heavily incised by ravines, the grasses dominate, particularly *Saccharum benghalens* and*Desmostachya bipinnata*. This species is also associated with dry stream beds as well where *Vitex negundo* and *Ipomoea carnea* are purposely planted to keep the banks against erosive power of water. Some plantations of *Eucalyptus* and occasionally *Populus sp.* can be seen growing along these dry stream beds.

The agricultural land is regularly interrupted by scattered houses and unproductive open areas with grass cover and often accompanied by invaded by *Lantana camara* that has been reported to decrease the grass production in the area. Nearby villages and agricultural areas the shrubby *Justicia adhotoda* (Bhekar) is a common sight, however, *Dodonaea viscosa* seems rare within the buffer area and reported to have higher density towards the higher reaches of Gandghar range.

Figure 5.32: Land Cover Map of the Project Area (Sections A, B, C)




B
N
0
1
2 Km
AM 16
AM 17
AM 18
AM 19
AM 20
AM 21
AM 22
AM 23
AM 24
AM 25
AM 26
AM 27
AM 28
Motorway
33°56'0"N
33°55'0"N
33°54'0"N
33°53'0"N
33°52'0"N
33°51'0"N
33°50'0"N
33°49'0"N
72°32'0"E
72°33'0"E
72°34'0"E
72°35'0"E
72°36'0"E
72°37'0"E
72°38'0"E
72°39'0"E
Index Map
A
B
C
Land Cover Classification
Agriculture
Built up
Water Bodies
Seasonal Streambeds
Open Scrub Land
Rangeland

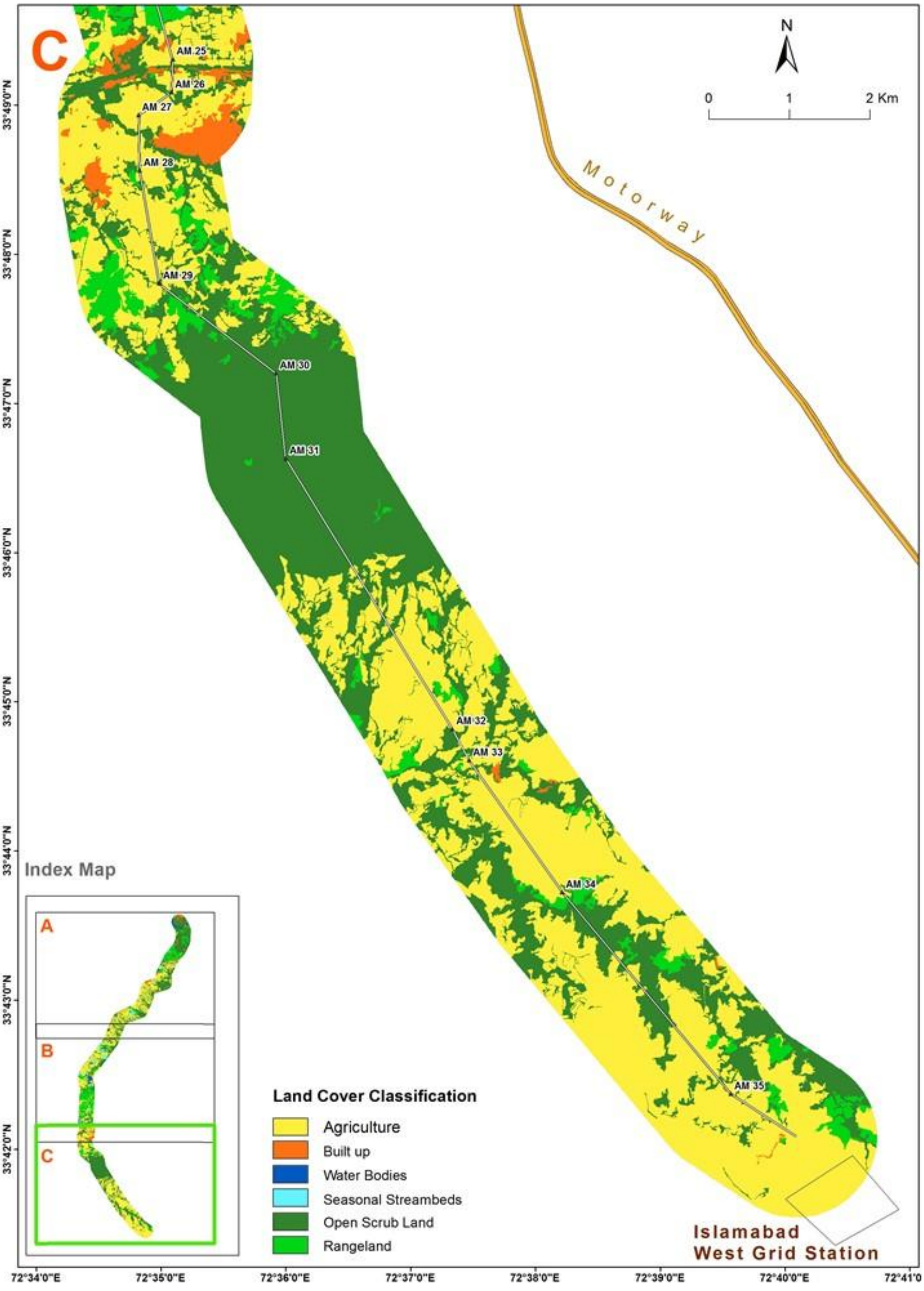
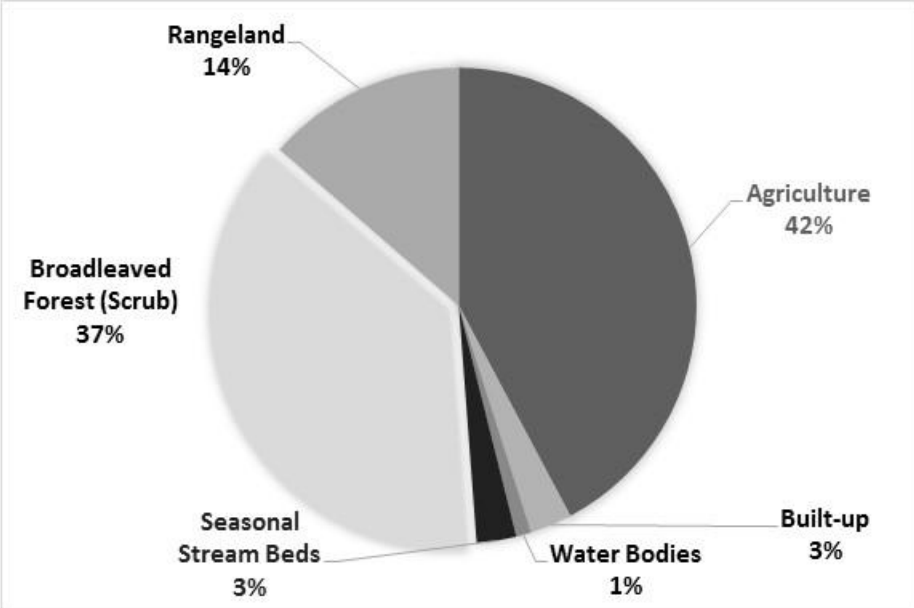

C
AM 25
AM 26
AM 27
AM 28
AM 29
AM 30
AM 31
AM 32
AM 33
AM 34
AM 35
N
0
1
2 Km
Motorway
Index Map
A
B
C
Land Cover Classification
Agriculture
Built up
Water Bodies
Seasonal Streambeds
Open Scrub Land
Rangeland
Islamabad
West Grid Station
33°49'0"N
33°48'0"N
33°47'0"N
33°46'0"N
33°45'0"N
33°44'0"N
33°43'0"N
33°42'0"N
72°34'0"E
72°35'0"E
72°36'0"E
72°37'0"E
72°38'0"E
72°39'0"E
72°40'0"E
72°41'0

Figure 5.33: Landcover statistics (hectare) of the Project area



5.3.4 Mammal Biodiversity of the Project Area

Large mammals, especially carnivores, are hard to grasp directly in the field. Therefore, it is challenging to study these animals particularly when their numbers are too small and populations are scattered. The best way is to explore these animals is with some indirect approaches like sign surveys and interviews from local people to get maximum information. A number of mammalian species including jackal, fox and wild boar were reported from the past in the study area (Akbar and Anwar 2011; Roberts 2005).

The mammalian study focused on collecting information on their presence and absence in the area, ongoing threats and spatial pattern of their occupancy in the area.

Methodology

Two methods were used; a standardized questionnaire survey to collect information on status of species and its conflict with local people while sign-based site occupancy surveys were used to measure the use of area by different species.

Human-Carnivore Interaction Survey

Human-wildlife interaction surveys were conducted to measure the human conflict with large and medium sized mammals found in the study area such as the jackal, fox and Indian wild boar. A total of sixty (60) respondents, each representing a separate household, were interviewed from different villages/localities, along the transmission line and in vicinity of the grid station and Tarbela Dam. People were asked about their previous record of sighting of different large mammals in past one year, status of mammals (large, medium sized and small mammals), their perception about different species of mammals, and intensity of danger of large mammals according to them. Information on killings of livestock and poultry by different carnivores in past one year, was also collected.

Site Occupancy Survey

Site occupancy surveys (MacKenzie and Nichols 2004) were conducted from November 13, 2015 to November 26, 2015 to assess the occupancy of different medium and large sized mammalian species in the study area. Each block (**Figure 5.22**)was accessed by Global Positioning System (GPS) and multiple points (repeats) in each block were selected on the basis of favorable routes of different species, habitats and topographic features(see **Figure 5.34,** for locations of occupancy survey points). Different points were surveyed depending upon the accessibility, settlements and disturbance. Signs were searched along ridges, valleys, draws, cliff bases, barren and agriculture areas. Signs of different mammalian species were recorded (**Figure 5.35)** on data forms along with the necessary information like species name, sign age (guessed by freshness of a sign), and substrate type. Signs were categories in three age groups; “fresh”= < 10 days, “old”= <30 days and “very old”= >30 days.

Detection or non-detection of species signs on each of the point was recorded as 1s and 0s in a matrix of sites vs. replicates (points) (McKenzie et al. (2002). Survey covariates like terrain brokenness (1-4), topography, habitat type, slope, altitude, distance from roads and distance from settlements at site level, calculated from GIS, were used as site covariates.

After preparing data matrix for detection/non-detection and appropriate survey covariates and site covariates, it was analyzed using software PRESENCE (Hines, 2006). Different combinations survey and site covariates were compared to find the model that best explains the variation in probability of detection and markability, and occupancy of the different species at the site level. The best fitting model was determined using the Akaike Information Criteria (AIC). The model that has the best fit (likelihood) and minimum number of parameters obtains the minimum value of AIC value (Akaike 1974; Burnham and Anderson 2002).

Figure 5.34: Map of the Study Area Showing Site Occupancy Survey Points

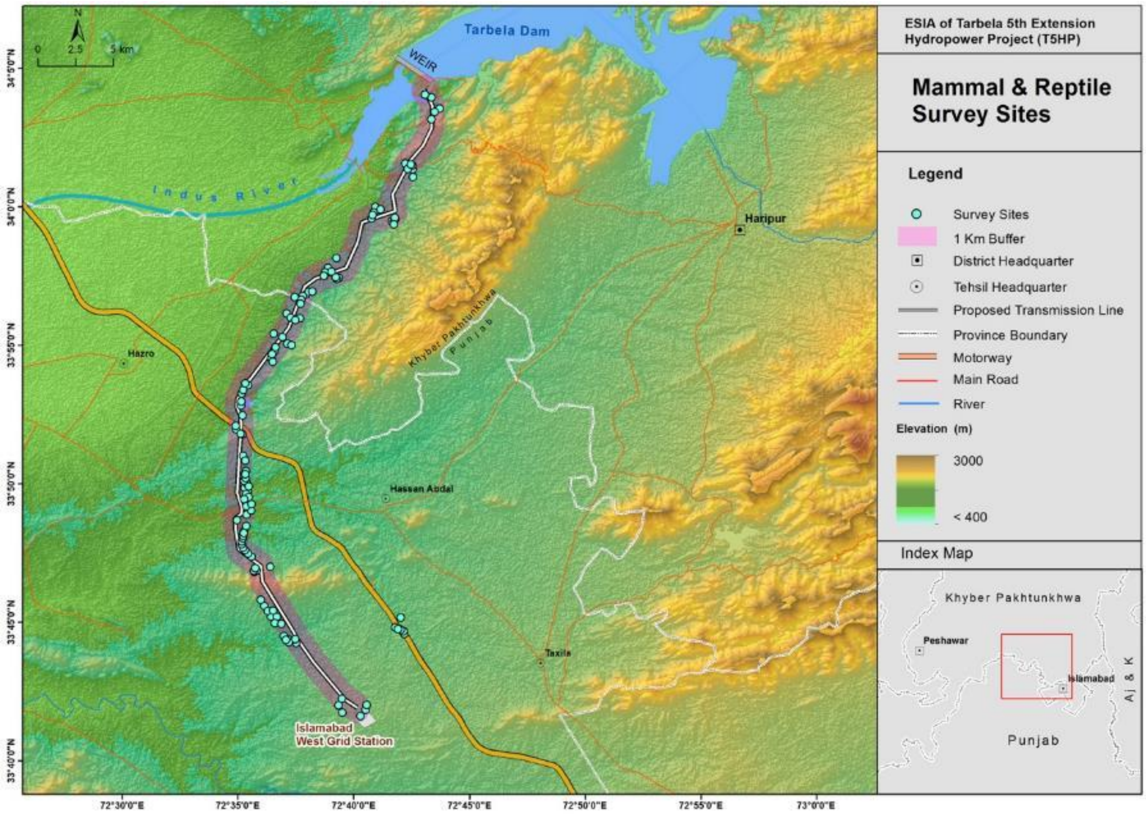


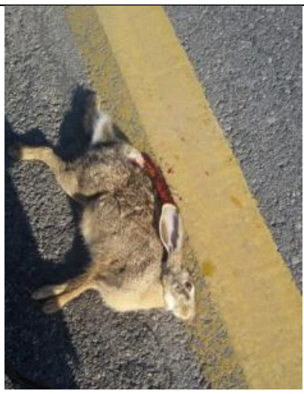
Figure 5.35:: Photographs of Field activities

a. Collecting information from local people

b. Interviews

c. Pug marks of Indian wild boar

d. Pugmarks of jackal



e. A road killed desert hare

f. Quills of porcupine

Live Trapping of Small Mammals

Sherman traps and Snap traps (**Figure 5.36**) were used for the present studies to collect the live specimens. A mixture of different food grains mixed with fragrant seeds was used as bait in Sherman Traps for the attraction of the small mammals. Wheat and rice were used as food grains while peanut butter, coriander, oats and onion were used for fragrance. For Snap Traps mixture of peanut butter and oats was used as bait.

Fifty traps were set at each location (**Figure 5.37**) in a grid of 10 X 10 m. The snap traps were set in line transect of 100 m setting each trap 2 m apart. The traps were checked on the next day. The trapped animals were carefully transferred one after the other into an already weighed transparent polythene bag. Utmost care was done to avoid direct handling and harassing of the specimens. The voucher specimens collected were subsequently preserved in 10% formaldehyde.

Figure 5.36: Traps used, and Small Mammal Survey Activities

Snap trap

Sherman trap

A Hedgehog sighted during survey

Collection of specimens

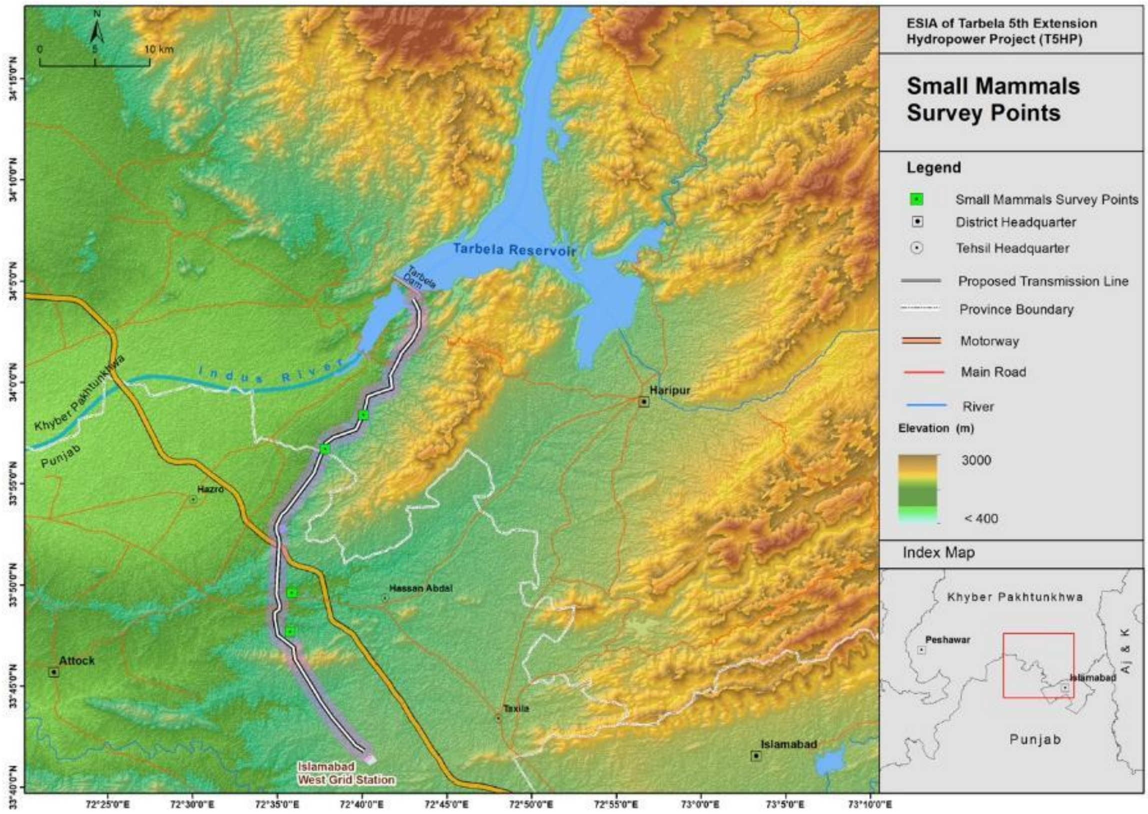
Ratus turkmaniticus

*Suncus Etruscus (*Shrew)

Small mammals sampling location

Small mammals sampling location

Figure 5.37: Small Mammal Trapping Sites



Direct Sighting

Some of the species were directly sighted in the field and whenever possible photographs were also taken.

Secondary data

Whenever necessary the records of specimens were verified from the already published literature or distribution maps of different species. The mammals' presence was also documented through indirect methods like burrows, footprints, droppings, and road kills. Some of the species were directly sighted in the field and whenever possible photographs were also taken.Whenever necessary the records of specimens were verified from the already published literature or distribution maps of different species.

Status of Mammals in the Area

The mammalian fauna of Khyber Pakhtunkhwa has been well documented in the monumental work of Roberts (1997, 2005), Menon (2003) and Sheikh and Molur (2004). Specific information on the faunal habitats, environment, mammalian fauna and biodiversity of Khyber Pakhtunkhwa has been reported by Ashraf, et al. (2004), Duke (1988, 1989a, 1989b, 1993), Duke and Walton (1988), Perveen and Rehman (2014), Haq (2011, 2012), Javed (2011), Naveed et al. (2014), Rahman et al.(2015), Raja et al.(1999), Shah (2011), Sher (2003, 2004) and Zaman (2008).

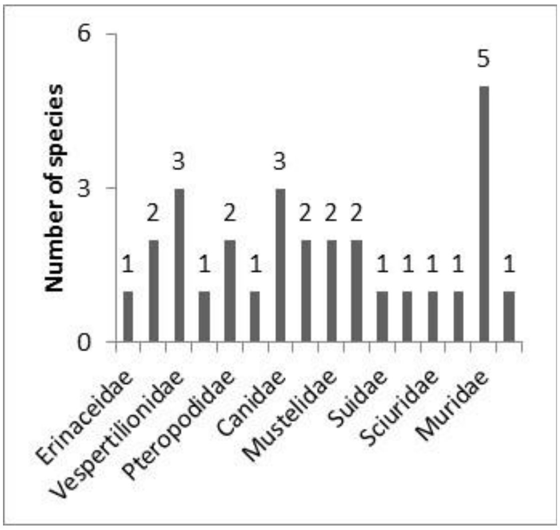
The information regarding biodiversity and general habitat of the project area are also highlighted in the Government reports and the EIA studies carried out on different projects carried out in the area time to time. Most important being the Government of Kyber Paktun Khawan (2015), Hussain and Khan (2008-2009), NTDC (2014, 2015), ADB (1995), and Zubair (1995).

A total of 29 mammalian species belonging to 16 families and 7 orders have been reported from the segment of the project area from Tarbela to Islamabad. It has two large mammals, eight meso-mammals and eighteen small mammal species (**Annex3,Figure 5.38**).

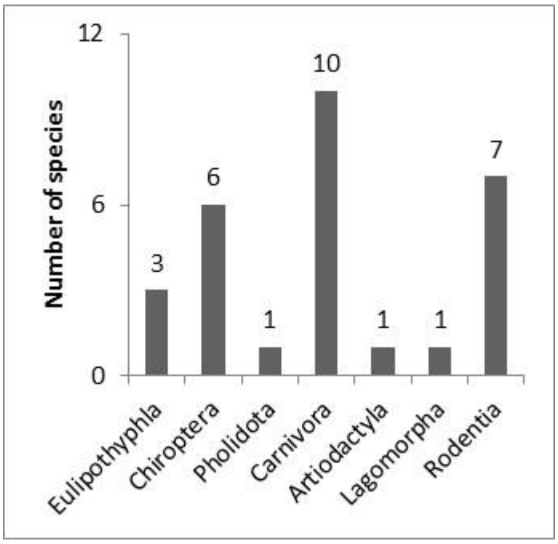
The species *Rattus rattus, Mus musculus,* and *Suncus murinus* are the dominant rodent and insectivore species, and Scotophilus heathii is the common chiroperan species in the study area. The species Herpestes edwardsi and Herpestes javanicus are included in the CITES APPENDIX III. These species have a trade pressure for their skins exported to different countries. These skins are used for manufacturing the purses and the decoration pieces. None of the other species of small mammals have any conservation status and are also common in the area. The species of fruit bats, viz., Rousettus leschenaultii (Fulvous Fruit Bat) is quite common in the area found hanging on the fig trees.

The area forms a transitional and overlapping zone between the fauna of plain areas in the south and that of the Himalayas in the North. This phenomenon is reflected from the distribution of many species in the project area. The small mammal species *Rattuspyctoris* (Turkistan Rat) is distributed in the Himalayas and the project area forms the southernmost distribution limit of this species. The area provides the first record of this species at this lower altitude of 400 m and the previous lowest altitude recoded for this species is 2300m. The direct sighting of the Jungle cat was made in the southern most part of the study area.

Figure 5.38: Family and order wise distribution of large, meso and small mammals found in the study area



Families

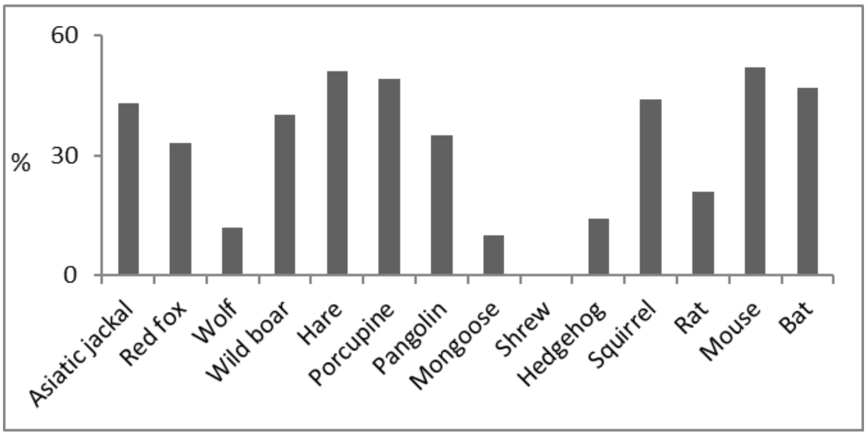


Orders

Public Perception on status of Large Mammals

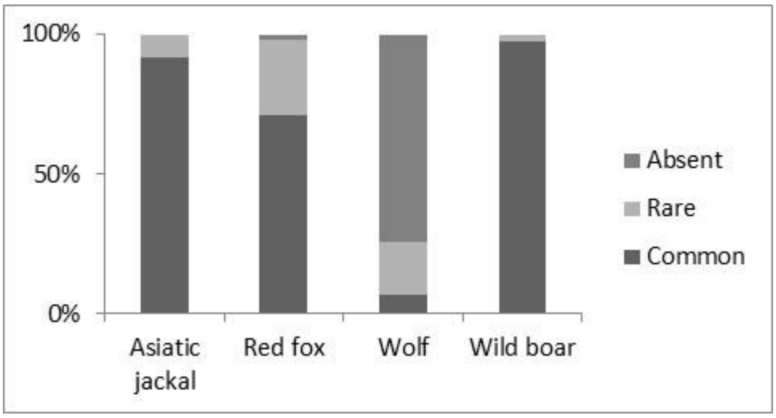
Local people were asked about the sighting/encounter rate of different mammalian species in the area in the past one year (2015) in terms of absence or presence. The Jackal had the highest encounter rate (43%) followed by the wild boar (40%) and the red fox (33%) where the wolf had the lowest sighting rate i.e. 12% (**Figure 5.39**).

Figure 5.39: Public Sighting of Mammalian Species in the Project Area (Expressed as % respondents encountered species in one year).



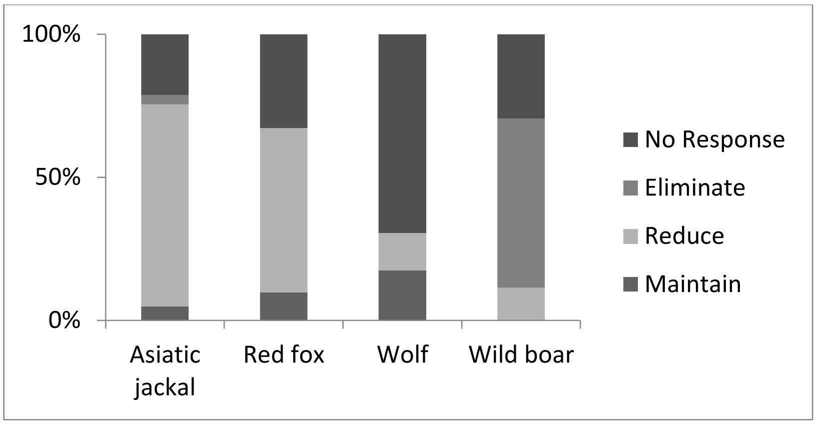
Public perception about the abundance of mammals in the area is summarized in **Figure 5.40**. Among the species questioned, jackal was considered as most common species of the area followed by the wild boar and red fox and wolf. Majority of the local people considered wolf as absent from the area.

Figure 5.40: Public Perception about Status of Mammalian Species in the Project Area.



Public tolerance towards the mammalian species was gauged through a question; whether they would like to maintain, reduce or eliminate any of the mammalian species in the area. The majority mentioned that they would like to reduce jackals from the area as they attack the domestic livestock such as goats occasionally. Further, the locals also want to reduce foxes from the area as these mostly attack poultry. Moreover, it was noticed that the locals want to eliminate the wild boar population from the area **(Figure 5.41)**.

Figure 5.41: Local People's Attitude towards Mammal's Presence In the Area.

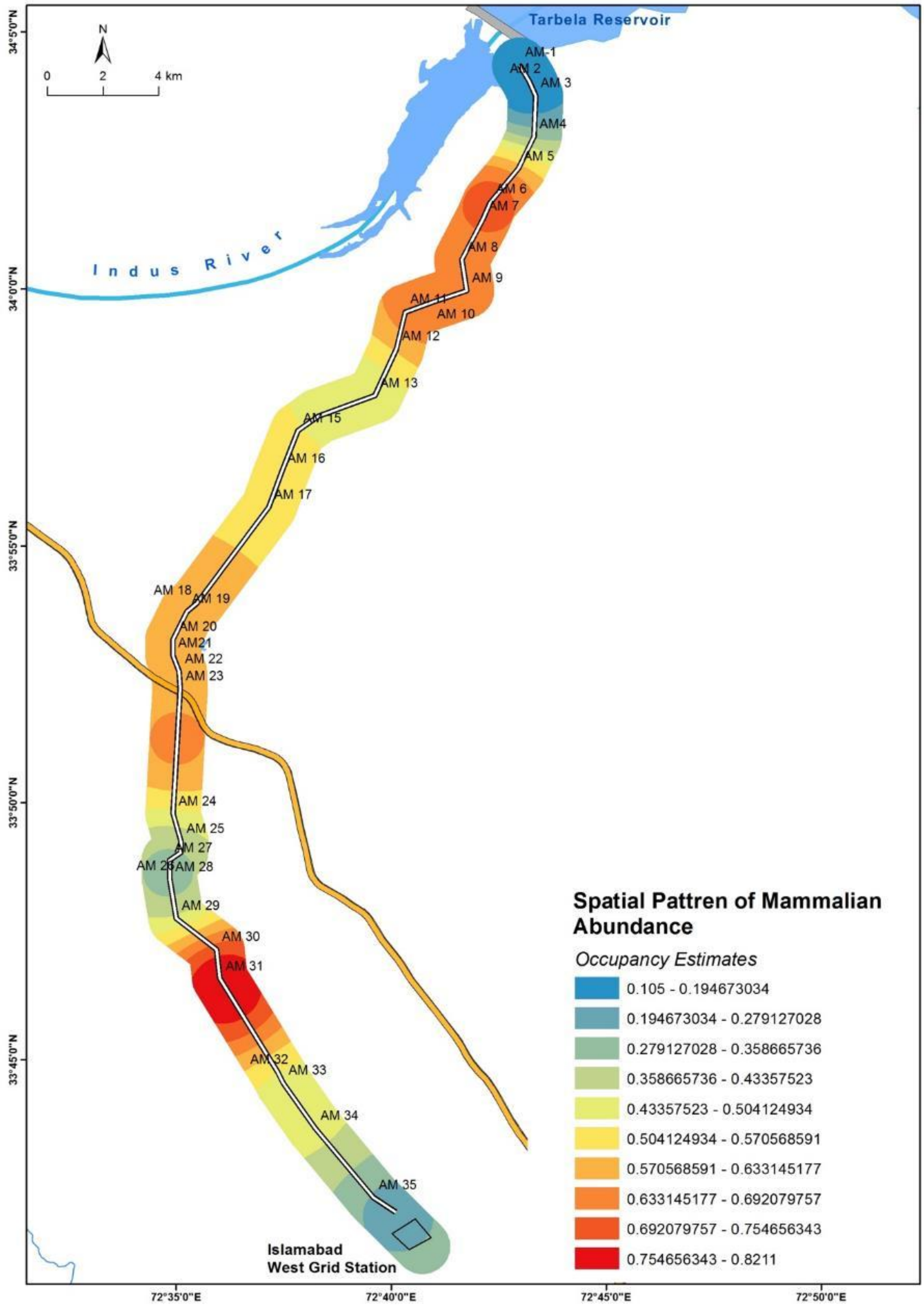


Mammalian Abundance Assessed through Sigh Surveys

Different types of signs belonging to different mammalian species were detected in the area. Fox and jackal were dominating in field signs, followed by small mammals and wild boar. No reliable sign or sighting of was recorded in the case of wolf.

The data obtained from field survey was analyzed in Presence 5.7 software, to determine the occupancy of fox, jackal, small mammals, and wild boar with respect to covariates of elevation, distance from roads, distance from settlements, slope and land cover classes.The overall occupancy estimates (at a scale of 0 to 1) were high (ranged 0.8-0.9) for adaptable species like fox, jackal, small mammals, and wild boar. The spatial occurrence of these species was also highly correlated (r=0.98), suggesting that they have similar response to environmental variables. Spatial Pattern of mammalian occurrence is provided in **Figure 5.42.**
The influence of environmental covariates of spatial occurrence of mammalian species is summarized below:
The **Built up**areas had negative effect on occupancy of jackal which got decreased by 0.6 times with increase in built up.**Water bodies** decreased the occupancy of wild boar and jackal by 0.53 and 0.54 times, respectively. While the effect water bodies on occupancy of small mammals and fox was minor. The **Seasonal stream bed** increased occupancy of Jackal by 1.96 times. It also increased occupancy of other species respectively.Increase in **agricultural land** increased the occupancy of wild boar, small mammals and fox, however the occupancy of jackal decreased 0.9 times. the increase in **elevation** increased occupancy of wild boar, while decreased the occupancy of fox, jackal and small mammals by 0.8 times. The **Rangeland** increased occupancy of species. The **Scrub forest** decreased the occupancy of fox, small mammals and wild boar by 0.6 times and that of jackal by 0.7 times.

Figure 5.42: Spatial Pattern of Mammalian Occurrence in the Project Area



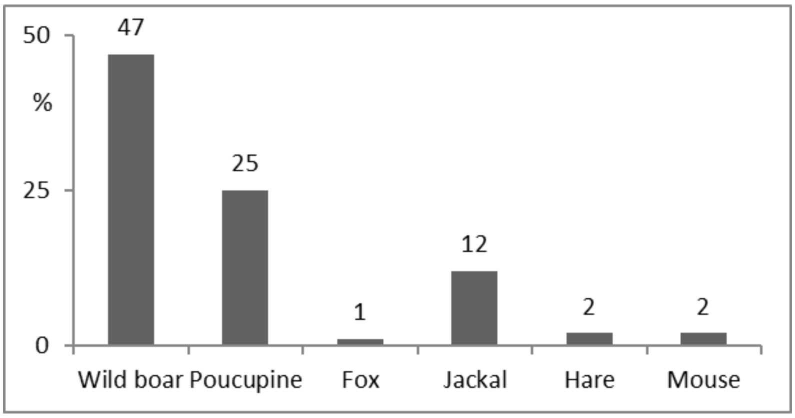
Human Wildlife Conflict

Only 3 cases of predation on livestock and poultry were recorded. Goats were killed while grazing and poultry was capture from cage most of the time. One respondent from village Ghaara reported killing of 11 goats by jackal while another respondent mentioned killing of goats by jackal as well **(Figure 5.43**). One case of fox attacking poultry was also reported.

Economic Loss by Mammals due to Crop Damage: Porcupine and wild boar are mainly responsible for the crop damages in the area. Majority of the community indicated these species as major culprit for the crop damage with minor contribution from hare and mouse as well. One respondent from village Sundki mentioned that they have stopped cultivating crops because of the wild boar. The estimated economic loss through crop damage by these animals' ranges from 2000PKR to 100,000PKR per season per household through maize crop damage in summer.

Killings of Large Mammals by Local People: Jackal poisoning was reported from village Sundki on daily basis where about 2-3 jackals are found dead in the wild area.

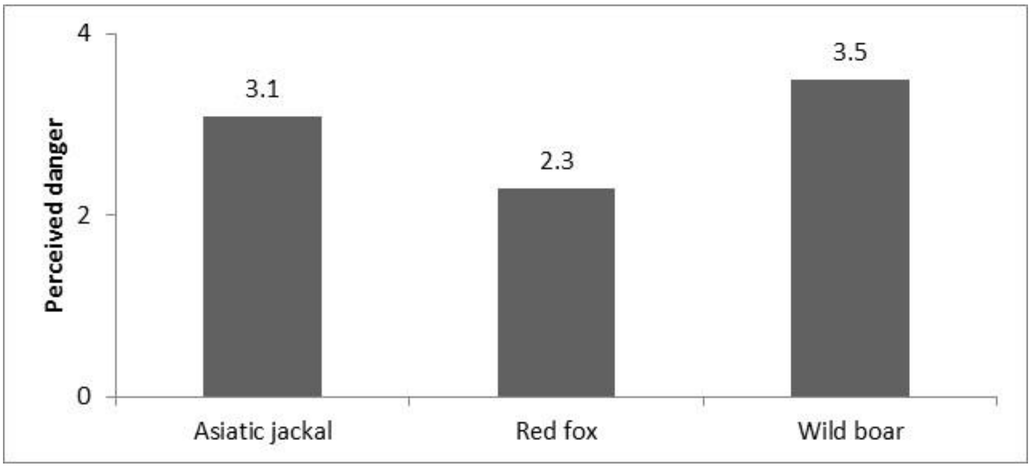
Figure 5.43: Crop Damage by Mammalian Species, reported in the Project Area



5.3.5 Perceived danger from wild animals

The perception of local people about the most and least dangerous animals in the area was taken and ranked 1-4 (from least dangerous to most dangerous). Results indicate that the locals consider the wild boar as the most dangerous animal followed by jackal, and fox (**Figure 5.44**).

Figure 5.44: Danger of wild animals perceived by respondents in the study area.



5.3.6 Reptiles and Amphibians

Methodology

The study area represents different types of habitats and terrains including cultivated lands, wild lands, broken areas and wetlands. Different direct and indirect methods were applied to study various groups of the herps in the study area. Survey locations of Reptiles and Amphibians are shown in**Figure 5.45.**

Secondary Data: To record every possible species in the study area, the available literature was collected and reviewed. The literature included published and unpublished reports and books of private and government conservation organizations, gazetteers, research articles, popular articles and newspapers. Based on the available literature, a checklist of different species was developed which was confirmed through observing different species during the survey. The reptilian fauna of the area has been reported in the many scientific endeavors including Baig (2001), Khan (2004, 2006, 2010), and Masroor (2012). For the field techniques adopted for the present studies, contributions made by EIAO Guidance Note No. 10/2004 (2004), Foster and Gent (1996), Hayek and Martin (1997), Heyer et al. (1994), HMSO (1996), Sutherland (1996 a, 1996b), and Wilson et al. (1996) were consulted.

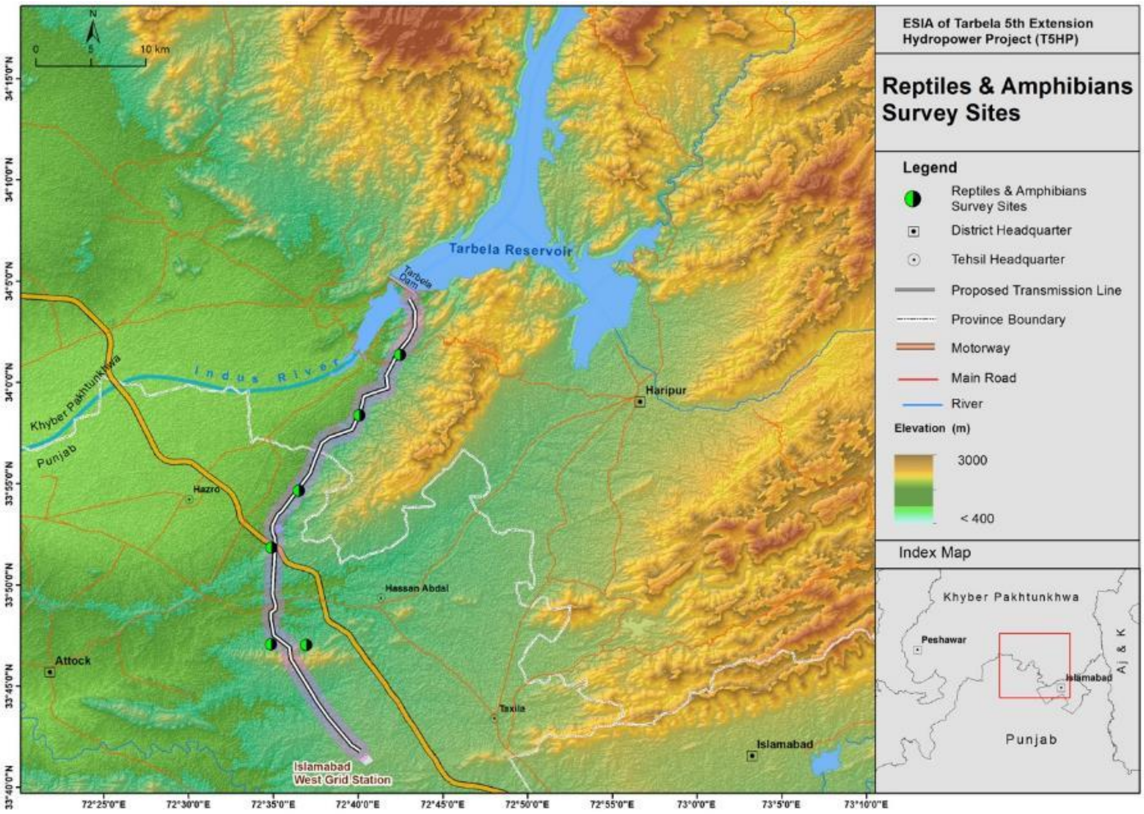
Interviews with Local Residents: Interviews with local residents are valuable not only for identifying the potential sites in the study area but also a good source of primary data about the existing wildlife of an area. This method was used for locating different amphibian and reptilian species in the study area. A questionnaire was also developed before interviewing different people for herpetological survey.

Active Search: This method is equally applicable for both nocturnal and diurnal species. The study area was actively searched for potential breeding areas of amphibians like small water pools, water channels, roadside ponds and puddles and suitable microhabitats for amphibians e.g. stones, pond bunds, crevices, leaf litter, debris, rotten logs etc. These places are deliberately uncovered to search the amphibians hiding under such covers. Active searching was carried out at all the sites with focus on suitable microhabitats. Search for the nocturnal amphibians was carried out in exposed areas of their potential habitats on the ground, along the path or the pond or stream bank.

Amphibians were also observed during day time as well around their feeding grounds i.e. under light posts etc. and around breeding sites like ponds, puddles and streams where they advertise their presence by their crocks. All the amphibian species found during the study, were identified at the spot and photographed to record the evidences of their existence.

Photography: A close up color photograph of the specimen in its natural habitat or a series of photographs or a short movie can contribute to understand morphology, breeding, spawning and feeding habits of the animal. Therefore, photographs of all the specimens were taken in their natural habitats not only for their identification purposes but also as an evidence of their existence.

Figure 5.45: Locations of Amphibian and Reptile Species Sighted in the Project Area



Reptiles and Amphibians Diversity

A total 35 species of herps belonging to 02 orders, 13 families and 30 genera are found in the study area including nine amphibians and 26 reptiles. Amphibians included three toad species and sixfrogspecies whereas; reptiles included 13 lizard species and 13 snake species (**Annex 3**). Five species out of the thirteen recorded snakes are poisonous (family *Viperidae* and *Elapidae*) while rest of the amphibian and reptiles are non-poisonous. According to a preliminary review of literature, no crocodilians, turtles and tortoises are found in the study area.

Most of the species were observed directly whereas some were detected through indirect evidences like tracks, burrows, molts and interviews with local residents. Some of the amphibians and lizards were observed directly. The existence of seven species including two lizards and five snakes (*Laudakia agrorensis,Laudakia melanura, Duboia russelii, Amphisema stolatum*, *Eryx johnii*, *Xenochrophis piscator* and *Naja oxiana*) was confirmed after interviewing a number of local residents including farmers and teachers.Some common and concerning species in this area and their diagnostic characters are described below.

Euphlyctis cyanophlyctis, Skittering frog(Schneider,1799)

Euphlyctis cyanophlyctis is a common *Dicroglossid* frog found in South Asia. It is known under numerous common names, including Indian skipper frog or skittering frog. *Euphlyctis cyanophlyctis* is lentic-profundal, prefers permanent ponds with little or no vegetation, confines it's foraging to the bottom of the pond, rarely comes into the upper layers, and is macrophagus detritivorous. It was sighted directly during the site survey.

Diagnostic Characters: Dorsum light gray, olive green or light brown, sometimes black, with irregular black spots. Thighs posteriorly dark with one or two yellow or white irregular longitudinal stripes; ventrum white, immaculate or with dark speckling or reticulation; vocal sacs light brown. Interorbital space is narrower then upper eyelid. Toes are completely webbed.

Paa hazarensis, Hazara Fast-flowing Stream Frog (Dubois and Khan, 1979)

This frog frequents quieter and clear water pools in the beds of fast flowing streams, feeding on water-visiting insects. It breeds from March to May, call is low pitched, barely heard away from the fast flowing streams. It was sighted during the site exploration and also pointed out by locals during interviews.

Diagnostic Characters:Head is longer than wide. Dorsal tubercles on short longitudinal folds. Fewer or no tubercles in the inter-orbital region. Forelimbs enlarged in breeding males, with nuptial spines on inner finger. Body dorsum grayish, superimposed with network of darker colour.

Eutrophis dissimilis, Striped Grass Skink(Hallowell, 1860)

The striped grass skink inhabit open moist grass fields and extends in the tilled land where it is killed in the large numbers. People believe it as "deadly poisonous". It is a tough terrestrial inhabitant and may climb on low bushes and go in water, excellent adaptation to survive in periodically flooded riparian system of Punjab. A number of times it is sighted during work along the transmission line in almost all the grids.

Diagnostic Characters:Supra nasals in contact with each other. Front nasals almost as broad as long. No postnasal scales. An undivided transparent disc in lower eyelid. Dorsum is light brown with 3 or more greenish white strips.

Varanus bangalensis, Bengal Monitor(Daudin,1802)

This large varanid frequents moderately dry forest, and extends into cultivated areas, where it inhabits the tracts of barren badlands. It often invades inhabited houses, attracted by poultry and rodents. It is a burrower and can also climb on trees. During the field work it was often sighted basking near the burrows and holes. Different local residents and farmers interviewed during the survey also pointed out its existence in the study area.

Diagnostic Characters:Naris is present nearer to orbit and tip of snout. Scales on the head are longer and not keeled. Tail is strongly compressed with a double toothed dorsal crest. Dorsum colour is olive to brown with dark spots. Ventrum colour is yellowish with or without dark spots.

Bungarus caeruleus, Common Krait(Schneider, 1801)

This snake is locally known as *Sang Choor* and considered a deadly poisonous snake. It belongs to the family *Elapidae* that includes all deadly poisonous snakes. Different local residents and farmers interviewed during the survey also pointed out its existence in the area.

Diagnostic Characters:Dorsal color is jet black to deep blue. A series of 3-9 light vertebral spots on anterior part of the body followed by a 38-56 narrow transverse bands usually in pairs. Ventral side of the body is white. This snake frequents open grass lands, semi deserts with alluvial soil. It is common in the marginal vegetation along tilled fields and extends into barns, farms, grooves and gardens. It lives in holes and crevices in the ground, piles of cut vegetation, bricks and debris etc. It is a nocturnal snake active just after sunset until dawn. Its food consists of toads, frogs, snakes, lizards and mice. A deadly poisonous snake in the area and killed by local residents whenever seen.

***Naja naja*, Black Cobra(Linnaeus, 1758)**

The Cobra frequents various habitats, grasslands, vegetation along tilled field, along watercourses, semi desert forests, and ruins with grassy growth and also along the settlements. Different local residents and farmers interviewed during the survey also pointed out its existence in the area.

Diagnostic Characters:Head is not distinct from body. Neck is dilatable into expended hood with two marks on the hood. No maxillary tooth is present. Body scales are smooth. Adults are jet black, dark olive or dark brown. Ventrum pale grey to yellowish.

Figure 5.46: Photographs of Reptile and Amphibian species recorded in the area

Common Krait (*Bungarus caeruleus*)

Brown Cobra (*Naja oxiana*)

Checkered Keeled back Snake (Xenochrophis piscator)

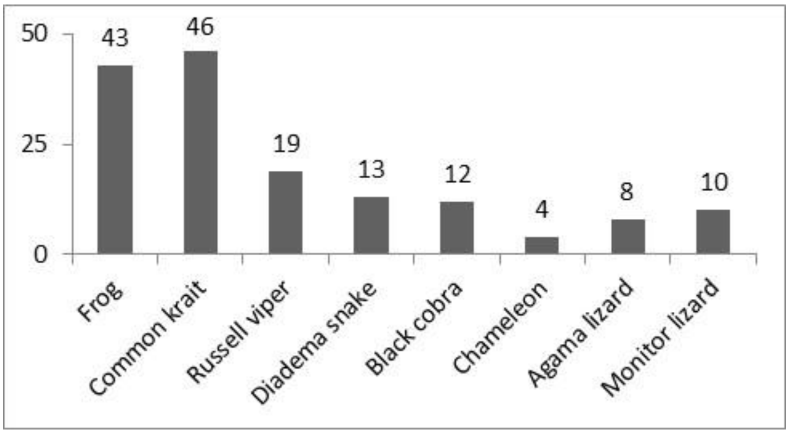
Skittering frog (*Euphlyctis cyanophlyctis*)

Hazara fast flowing stream frog (*Paa hazarensis*)

Striped grass skink *(Eutrophis dissimilis)*

Public encounter with the amphibians and reptiles in the study area: Local people in the study area were interviewed if they have encountered any amphibian and reptile species. The results indicate the highest encounter rate of the common krait followed by frog, russell viper, diadema snake, black cobra, monitor lizard, agama lizard and chameleon **(Figure 5.47)**.

Figure 5.47: Reptile and Amphibian encounters reported by local people



Conservation Status of the Recorded Species: All the species recorded during the survey were commonly found at all the study sites, with mostly Not Evaluated species according to IUCN 2015 or having Least Concern status with stable population trend (**Annex 3**). Only one species, Brown Cobra (*Naja oxiana*) was found Data Deficient with unknown population trend. None of the recorded species is protected under the AJK Wildlife Act 1975 or AJK Wildlife Ordinance 2013.

Eight of the recorded 35 species are CITES Species with two (*Varanus bengalensis and Python molurus*) enlisted in Appendix I, five species (*Hoplobatrachus tigerinus*, *Saara hardwickii, Ptyas mucosus, Naja*, *Naja oxiana*) are enlisted in Appendix II while one species (*Xenochrophis piscator*) is enlisted in Appendix III of the CITES category 2015.

Species of Special Concern

Out of 28 species of mammals, only one species of mammals viz., *Manis crassicaudata* (Thick-tailed Pangolin, Indian Pangolin) is considered as Endangered (EN).*Manis crassicaudata* (Thick-tailed Pangolin, Indian Pangolin) is included in Appendix II. Similarly *Canis lupus* (Wolf) is included in CITES Appendix I. The species *Canis aureus*

(Jackal), *Paguma larvata* (Masked Palm Civet), *Herpestes edwardsi* (India Grey Mongoose), *Herpestesjavanicus* (Small Asian Mongoose) are included in Appendix III as proposed by India and Pakistan to control their illegal trade and maintain a stable population of these species.

Among the Reptiles and Amphibians, the *Varanus bengalensis* (Monitor Lizard) and *Python molurus* (Indian Python) are, both, included in the CITES Appendix I while *Hoplobatrachus tigerinus* (Tiger Frog), *Naja oxiana* (Central Asian Cobra), *Ptyas mucosus* (Dhaman), *Saara hardwickii* (Spiny Tailed Lizard) in Appendix II and *Xenochrophis piscator* (Checkered Keel back) in Appendix III (India) to control illegal trade of these species of Reptiles and Amphibians.

5.3.7 Birds

The Indus River is located in the region of one of the important international flyways for bird migration known as “the Indus Flyway”.

Regular annual movement of birds between their breeding areas and wintering areas is called bird migration; It is of two types in Pakistan: a). Long distance migration from higher latitudes to lower latitudes in Pakistan i.e. from Siberia, Central Asia, Eastern Europe, Tibet. b). Short distance migration from higher altitudes in Himalayas to the deep valleys and the plains of Pakistan. There is also local migration within the Indo Pakistan sub-continent, which is again of two types: a). north – south (Pakistan) migration. b). east-west (Indo-Pak sub-continent) migration.

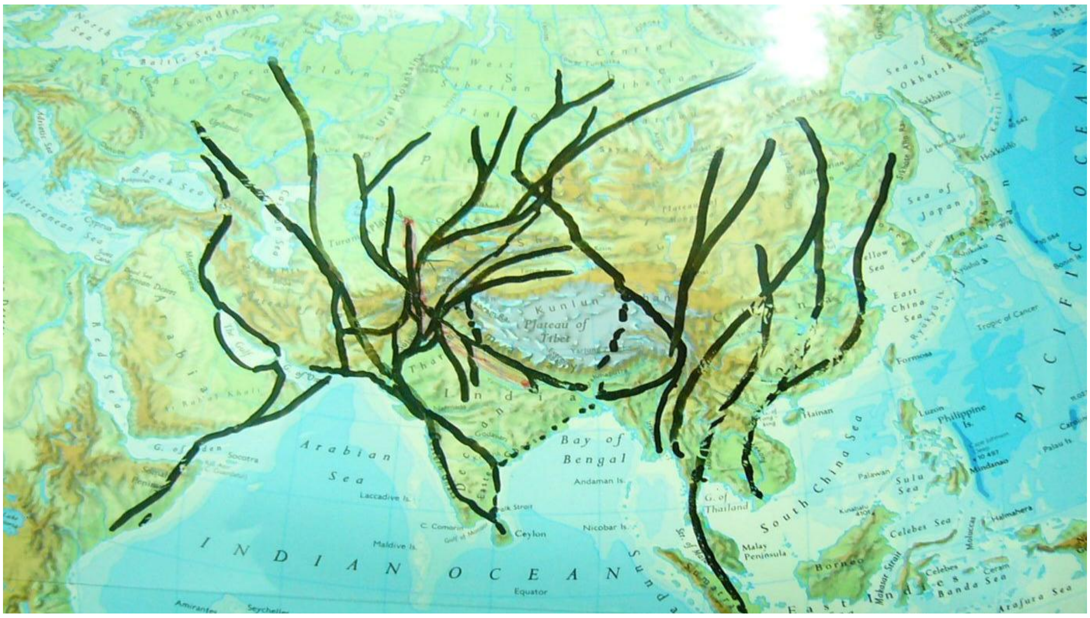
Migration is required for some birds to meet and face annual adverse weather conditions during the winters in their breeding areas in the north. So they migrate to areas of favorable climatic conditions during the winters in the south. They fly back to their breeding areas in spring. In the same way, birds living in Himalayan heights, descend to valleys and the plains as the cold weather starts prevailing by the end of summer, at higher altitudes. In spring they ascend from their wintering areas to their breeding sites at various heights

Long Distance or Latitudinal Migration Routes

The birds which breeds in northern latitudes need to travel long distance to reach their wintering destinations in tropical areas of the southern latitudes. These birds fly in large flocks, and follow land marks. Each year they arrive and go back on the same routes or flyways. Based on the observations and other scientific evidences the ornithologists, including the author of this report, have marked their routes on the maps. Flyways to Pakistan map is pasted in this report.

Figure 5.48: Waterfowl Migration Routes

Migration of Waterfowl based on ringing records & Z B Mirza's personal observations



Some examples of long distance migrants wintering or passing through Pakistan are given here: Northern wheatear from Siberia; Spanish Sparrow from Eastern Europe; Short-toed Lark from Siberia to Pakistan and India; Ruddy Shelduck Ringed in Kirghizstan was shot near Lahore. Also breeds in Laddakh and Tibet; Common Shelduck is a winter visitor to the coastal areas of Pakistan from coasts of Caspian Sea; Two Bar-headed Geese ringed in Kirgistan were shot in Gilgit and D G Khan. They breed in Tibet and China. Large flocks enter Pakistan from Kashmir along Chenab River; Pintail Ducks ringed in north Siberia and northern coast of Caspian Sea were shot in Gujrat, (India) and also in Sindh in Pakistan; Common Teal Ringed in North Siberia was shot near Calcutta. Another one was ringed near south eastern Caspian Sea was shot near Delhi; Mallard ringed in west Siberian plains was shot in Sindh; Gadwall ringed in West Siberian plains and Uzbekistan, were shot in Sindh; Shoveler duck ringed in north-east Siberia was shot near Calcutta; Black-necked Stork 'transmission-chipped' in northern part of central Siberia was traced up to Chilas.

Altitudinal Or Short Distance Migrants

At the end of summer season as cold spell starts prevailing the higher heights and descends further down to lower elevations insects hibernate and soft vegetation dries up, so there is shortage of food. The insectivorous birds and the seed-eaters start descending to lower height. During the winter they reach the plains. Some examples are: Kashmir Redstart; Grey-headed Flycatcher; Woodcock; Orange-flanked Bush Robin; Niltava; long-tailed Minivet; a variety of tits; Blue Whistling Thrush; Chiff Chaff; Ground Thrush, Tree-creeper; Wall-creeper; a variety of tits, finches, buntings.

North-South Migration (Within Pakistan)

Some birds living throughout the year in warmer areas of Pakistan in the almost southern half of Pakistan, in spring they disperse to northern plains and foothills for breeding space and more food availability in summer. At the end of summer season as the cool starts prevailing, these migrate to southern Pakistan where weather is milder and more food is available. Some examples are: The Koel, Purple sunbird, Golden Oriole Paradise flycatcher, Baya, swallow.

East-West Migration (Within Indo-Pak Sub Continent)

There are a few bird species which arrive from India just ahead of monsoon rains and go back after the end of summer rainy season. Examples are: Rain quail, pied Crested-cuckoo

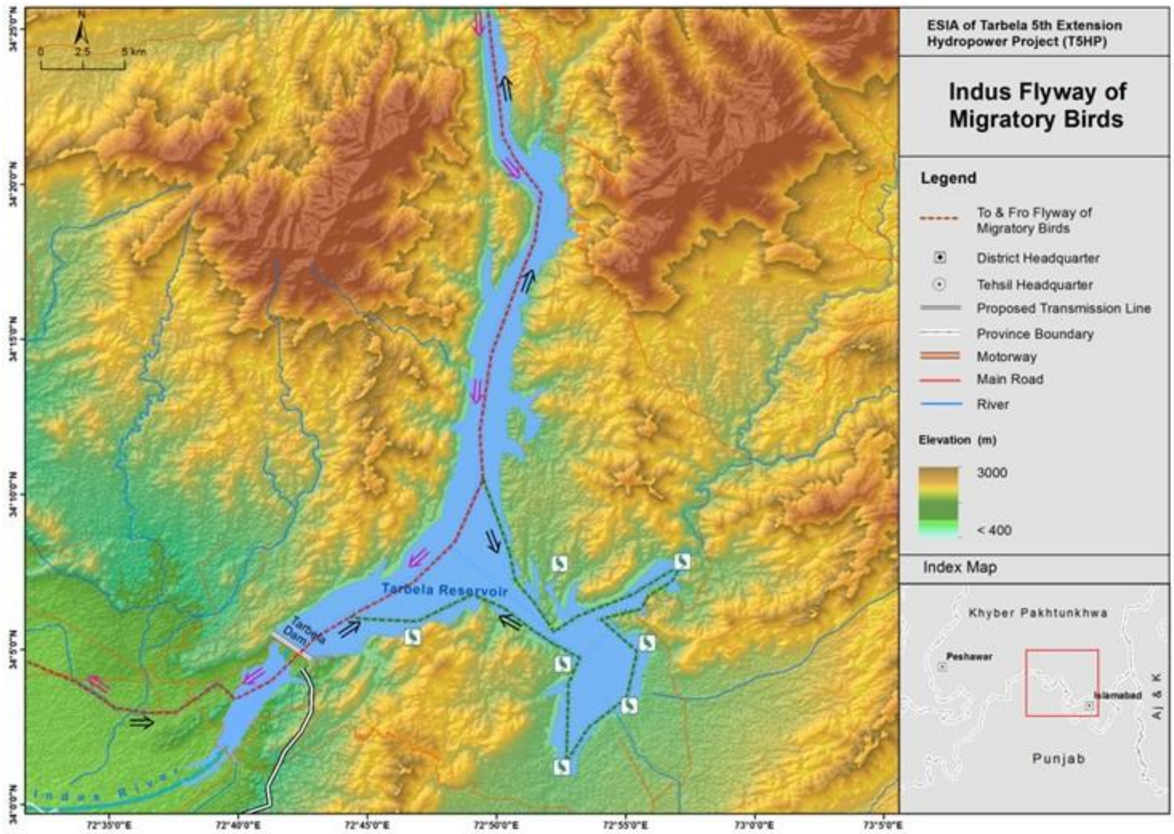
Migratory birds behaviour over Indus at Tarbela

The flight director of migratory birds over Indus at Tarbela is shown in

Figure 5.49. The flight behaviour of migratory birds that fly pass over the Indus river at Tarbela:

- Long-distance migratory birds follow land marks that are roughly placed in direction towards birds' destination. These land marks for aquatic birds are big rivers. In case of birds passing over Tarbela river Indus is the land mark for the migrants.
- During migration in mountainous areas, the birds fly high.
- The migrants follow the center of the valley thus avoiding mountains.
- The water birds after 6-8 hours of flight look for wide and slow moving water to recoup their energy for further journey. However, if the water is almost stagnant and food is available in it or at its edges or in near vicinity and if the habitat provides shelter, the birds often tend to stop over for few days.

Figure 5.49: Flight direction of migratory birds over Indus at Tarbela

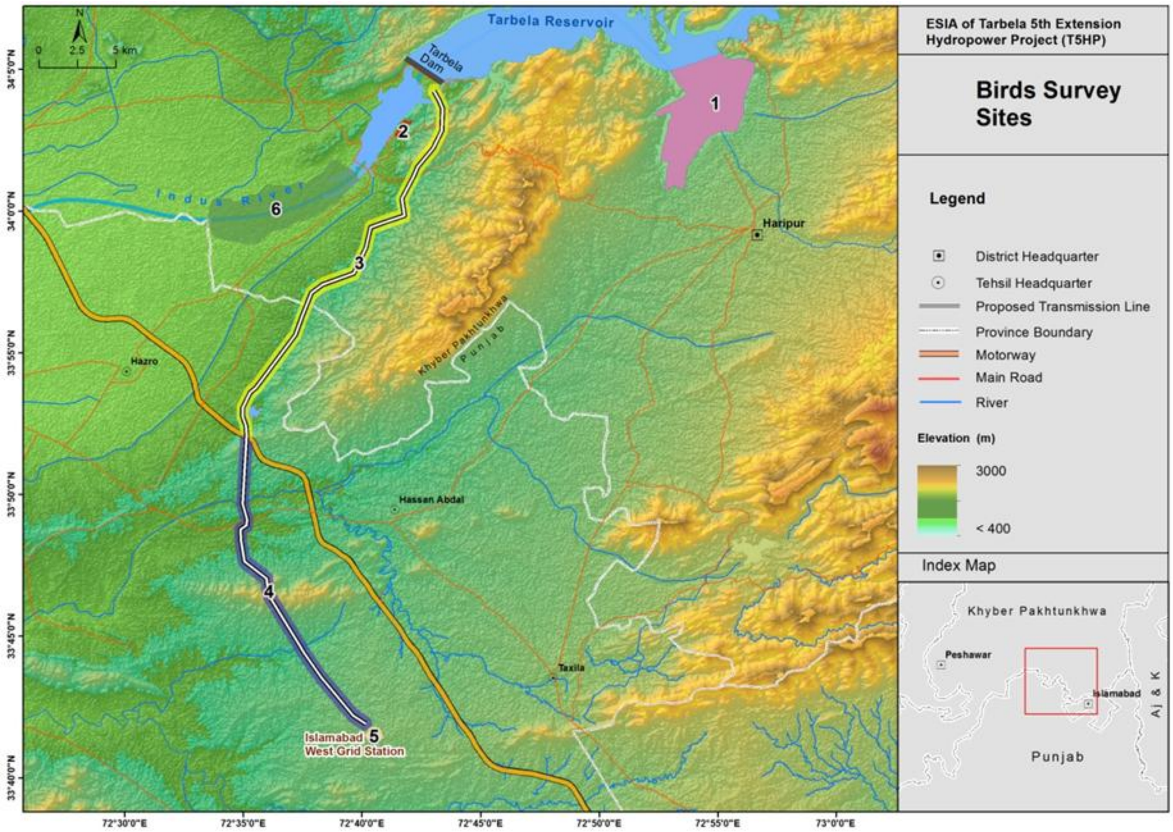


Birds Habitat in the Project Area

There is a variety of habitats in the study area, which have richness of bird species, adapted these habitats. These habitats are marked on**Figure 5.50**which are placed in the relevant text. These habitats are:

- Dam water reservoirs (marked on **Figure 5.50**).
- Urban habitat of Tarbela hill top colony (Roughly between sites 1 and 2).
- Habitat of east marginal hill from Tarbela reservoir 72.760 E- 34.1o N and to its south-western end at Jhamra village 72.64° E – 33.88⁰ N. (Roughly between sites 1 and 6).
- Habitats along the proposed sites of transmission towers and the 500 m. wide linear strip all along under the transmission line up to the west Islamabad grid station.
- Habitats of the area proposed for West Islamabad Grid Station 72,6° E -33.75° N., sketched on google imagery.
- The spill water flow in the river bed, downstream; and
- Along Ghazi-Barotha canal

Figure 5.50: BirdS Survey Sites and Habitats in the Project Area



Birds Recorded in the Project Area

Detailed list of bird species recorded in the project area are given in **Annex 4**.

The Birds of the Wetlands of Tarbela: The large water reservoir of the main dam & its east side bay and the lesser water reservoir for Ghazi-Broth canal. The aquatic birds that are enlisted in **Table 1 of Annex 4**are 89 species. This list is mainly based on author's three recent field visits to the wetlands site in November 2015, the field observations for his book "A Field Guide to the birds of Pakistan" (published by WWF Pakistan) and many bird watching trips to various bird sites in Potowar. In this list there are only 12 resident aquatic bird species, six irregular year round aquatic bird visitors, three winter aquatic bird visitors and 68 aquatic birds on transit migration through Indus valley over the river. Some of which, may stage for short period at the wetlands at Tarbela. The migratory birds tend to fly in the valley, over the river and do not fly closer to the Side Mountains. They also fly high. The birds that are considered endangered are also enlisted below separately.

The birds and their ecolinkages with the dam water main reservoir & its east side bay habitats: there are four categories of water birds by way of their behaviour in finding food from the wetlands of Tarbela: a). the swimmers and water divers; b). Waders; c). divers from air and e). Insect feeders, from air close to the water surface, which are enlisted and explained in **Table 1 of Annex 4**.

The birds of the spill water flow, in the river bed Downstream and their ecological linkages with the Habitats: Categories of feeding behaviour: a). the swimmers and water divers; b). Waders; c). divers from air and e). Insect feeders, from air close to the water surface have been enlisted in**Table 2 of Annex 4**.

Birds along the Ghazi-Barotha canal and their ecological linkages with the habitats: These are mostly the birds that perch on branches of the trees growing on the sides of the canal. The are some birds that also breed under the bridges are explained in **Table 3 of Annex 4.**

Birds of east marginal hill from Tarbela reservoir: 72.76^0 E- 34.1^oNand to its south-western end at Jhamra village 72.64^o E – 33.88^0 N. (Roughly between Sites 1 and 6 of **Figure 5.50**).

This hill is placed more or less in north-east and south-west direction along the eastern side of Indus, downstream of Tarbela dam. Its south-eastern slope is more high and steeper than its north-western slope, which is gentler and its watershed is towards the Indus. It is grown over by natural flora. Its north eastern part, which is almost one fifth of the total area of the hill, is well protected and has taller trees and better undergrowth than the remaining hill. So this part of the hill has good concentration of local birds as well as the migrants in winter from higher altitudes in the north. This is also night communal roosting area of crows, Common myna, Bank myna and sparrows in large numbers, which come from almost all directions from their diurnal feeding localities. The birds are enlisted in **Table 4 of Annex 4.**

The birds of the urban habitats of Tarbela colony (Sites between 1 and 2 in Figure 5.50): This colony has many large trees where many bird species roost and nest. These birds include those species which form urban avifauna as well as the birds of agricultural areas. During winters, Himalayan birds also arrive in this habitat, such as like thrushes, tits, flycatchers, chats, spotted dove and more. These are explained in **Table 5 of Annex 4.**

The birds of the rural habitats along the transmission line corridor (between sites 6 and 10 of **Figure 5.50**): It was observed that in the agricultural lands through which the transmission line will pass, had the early winter vegetables such as cabbage and peas. Cabbge leaves attract white cabbage butterfly to breed. Soon huge number of butterflies is produced. The larvae attract large number of insectivorous birds in the area. During the winters and early springs there is abundance of 'Brassica, crops in the area. Brassica is a preferred host plant of White butterflies. So huge number of larvae, which are cherished food are available to insectivorous local as well as high altitude wintering birds. In spring these butterflies migrate to higher altitudes, where these again breed and become available to the insectivorous birds. These birds are explained in **Table 6 of Annex 4.**

Birds at Grid Station at their ecological linkages with the habitats: This area is barani agricultural and it is mostly flat land. Wheat, Brassica, Millets, fodder crops, vegetables like cabbage, peas, turnips and even Radish are commonly grown in the fields. These birds are explained **Table 7 of Annex 4**.

International Threatened Bird Species in the Project Area

The following bird species of Pakistan in the Project area are in the IUCN red list of threatened birds (also shown in **Figure 5.51**):

- Black Stork Ciconia nigra;
- White-necked Stork Ciconia episcopus;
- Black-necked Stork Ephippiorynchus asiaticus;
- Peregrine falcon (Falco peregrinus)
- Sociable Plover Chettusia gregaria and
- White-tailed Lapwing Chettusia leucura.

Figure 5.51: Threatened Bird Species in the Project Area

Black-necked Stork

White-necked Stork

Black stork	Sociable Plover
	
White-tailed plover	Peregrine falcon

5.3.8 Aquatic Fauna

There are currently greater than 200 fish species known to occur in Pakistan[10], 180 of which have been reported from the Indus River in published literature[11]. During the 2015 specialist fish surveys, 26 species of ten fish families were identified over the four survey areas; namely the families Bagridae, Belontidae, Channidae, Cichlidae, Cobitidae, Cyprinidae, Nemacheilidae, Notopteridae, Schilbeidae and Sisoridae.

One of the fish species identified in the Study Area is of international conservation concern, namely the Mahasheer (*Tor putitora)*, listed as Endangered on the IUCN Red List of Threatened Species. Populations of this species are known to inhabit the montane and sub-montane regions in Pakistan, in fast-flowing streams and rivers with rocky bottoms[12]. It is a widely distributed species in south and south-east Asia, with a restricted area of occupancy. This species is estimated to have declined by more than 50% in the past and literature suggests that if the current trends continue, the population may decline even up to 80% in the future[13]. The species is therefore assessed as Endangered by IUCN.

The overall status of Mahasheer in water bodies of Pakistan is rare and there is a great need to conserve this species. Kulkarni (1991)[14] and Ogale (1997)[15]described that the declining trend in the population of Mahasheer needs immediate attention for *in situ* conservation and rejuvenation in natural waters. In Pakistan, there is no legislation to protect *Tor putitora*.

Although *Tor putitora* was recorded at two sites in the 2015 surveys: within the Tarbela Reservoir and downstream of the weir in the Dal Dara channel, only one individual of this species was recorded at each site. The waterbodies present in the AoI are considered unsuitable to support viable populations of this species; they are unnatural and heavily modified, and contain significant structures which inhibit migration. The typical fast

[10]Rafique, M. (2001). Fish fauna of the Himalayas in Pakistan with comments on the origin and dispersal of its high Asian elements Pakistan Journal of Zoology, 33(4): 279-288
[11]Mirza, M.R. & Sandhu, A.A. (2007). Fishes of Punjab Pakistan. Polymer publication Lahore
[12]Jha, B.R., Rayamajhi, A. (2010). Tor putitora. The IUCN Red List of Threatened Species. Version 2014.3. www.iucnredlist.org (accessed 29 June 2015)
[13]Jha and Rayamajhi, 2010
[14]Kulkarni, C.V. (1991). Role of aquaculture in the conservation of Mahseer
[15]Ogale, S.N. (1997). Induced spawning and hatching of golden mahseer Tor putitora (Hamilton) at Lonavia, Pune District (Maharashtra) in Western Ghats. Fishing Chimes, 97: 27-29

flowing streams and rocky substrate favoured by this species is not present in the AoI, and the reservoir is steep-sided creating a steep temperature gradient within. Therefore, it is considered that that the two *Tor putitora* individuals recorded during the fish surveys in 2015 represent isolated individuals only, and it is not likely that there is a significant or critical population of this species present in the AoI. Populations of this species are known to be successful in areas further downstream of Tarbela and downstream of the Mangla Dam, it is believed that this species migrates to breed over gravel and stones and returns to perennial ponds after breeding (Fish base, 2015).

Common carp(*Cyprinus carpio*)was also recorded downstream of the weir in the Dal Dara channel in the 2015 surveys. This species is listed as Vulnerable on the IUCN Red List, but it should be noted that this is an exotic species which is widely distributed and introduced in Pakistan. It is very common and probably invasive, inhabiting warm, deep, slow-flowing and still waters, such as lowland rivers and large, well vegetated lakes[16].

Fish cultivation and a fisheries industry have been established at Tarbela reservoir[17], with stocking of non-native species such as *Cyprinus carpio* considered to be of high commercial value, as well as other high commercial value species recorded in the 2015 surveys, i.e. *Channa marulia, Tor putitora*, *Ctenopharyngodon idella*and*Hypophthalmichthys molitrix*. It is therefore understood that *Cyprinus carpio's* listing as a Vulnerable species of conservation concern on the IUCN Red List refers to areas where this species is native only. *Cyprinus carpio* will therefore not be considered further as a sensitive species with regards the impact assessment of this ESA. No other species of international concern was recorded in the 2015 surveys.

The most common species recorded across all four sites are introduced cyprinids species i.e. common carp (previously mentioned), as well as silver carp (*Hypophthalmichthys molitrix)* and grass carp (*Ctenopharyngodon idella*). A summary of all the fish species recorded in the 2015 surveys is provided in **Table 5.27**. The table includes an assignment of commercial value to each species also.

Table 5.27: Fish species recorded in the Tarbela 5 AoI in 2015

Species	Local Name	Family	International Conservation Status (IUCN)	Commercial Importance
Mystus tengara	Kingar	Bagridae	Least concern	Low
Trichogaster lalius (Colisia lalius)	Kanghi	Belontidae	Least concern	Low
Channa punctate) Channa punctatus	Dola	Channidae	Least concern	Low
Channa marulius (Channa marulia)	Saul	Channidae	Least concern	High
Oreochromis niloticus	Toffee	Cichlidae	Not yet assessed	Low
Botia dayi	Chipper	Cobitidae	Not yet assessed	Low
Salmophasia bacaila (Salmostoma bacaila)	Chalwa	Cyprinidae	Least concern	Low
Barilius vagra	Chalwa	Cyprinidae	Least concern	Low
Schizothorax plagiostomus	Swati	Cyprinidae	Not yet assessed	Average
Garra gotyla	Pathar chatt	Cyprinidae	Least concern	Low

[16]Freyhof, J. & Kottelat, M. (2008). *Cyprinus carpio*. The IUCN Red List of Threatened Species. Version 2014.3. www.iucnredlist.org. (accessed 29 June 2015)
[17]WAPDA, 2011

Cabdio morar (Aspidoparia morar)	Goloo	Cyprinidae	Least concern	Low
Crossocheilus latius diplocheilus	Poonngh	Cyprinidae	Least concern	Low
Bangana dero (Labeo dero)	Pahari rohu	Cyprinidae	Least concern	Average
Tor putitora	Mahasheer	Cyprinidae	Endangered	High
Puntius sophore	Chiddu	Cyprinidae	Least concern	Low
Pethia ticto (Puntius ticto)	Chiddu	Cyprinidae	Least concern	Low
Ctenopharyngodon idella	Grass Carp	Cyprinidae	Not yet assessed	High
Hypophthalmichthys molitrix	Silver Carp	Cyprinidae	Near threatened	High
Cyprinus carpio	Common carp/Gulfam	Cyprinidae	Vulnerable (introduced to Pakistan)	High
Nemacheilus choprai	Zebra	Nemacheilidae	--	Low
Nemacheilus botia	Zebra	Nemacheilidae	Least concern	Low
Nemacheilus corica	Zebra	Nemacheilidae	Least concern	Low
Notopterus notopterus	Pari	Notopteridae	Least concern	Average
Clupisoma murius naziri	Naziri Bachwa	Schilbeidae	--	Average
Glyptothorax punjabensis	Chotat Khagga	Sisoridae	--	Low
Glyptothorax platypogonoides	Chota Khagga	Sisoridae	--	Low

5.3.9 Hotspots and Species of Special Concern

The northern edge of the project area is marked by the presence of a scrub land mixed with agriculture and associated settlement areas. The dominant species in this area mainly include *Acacia modesta* and *Dalbergia sissoo*. As land from major part of the project area is transformed to cultivation or degraded to barren land, the scrub land appears to be relatively semi-natural. These are the areas where higher signs of mammalian species and bird activity was observed. However, scrub land is low in diversity, as well as, density of plant species. These are heavily invaded by the weedy species like *Lantana camara*. Human settlements are spread across the scrub land and impart heavy grazing pressure, which is evident in the form of stunted growth. Floral investigation indicated that majority of plan species documented in this area are common and have wide geographical range.

Dominant tree species (*Acacia modesta, Dalbergia sissoo*) are sparse and not tall enough to interfere with the transmission line. Therefore, vegetation clearing during construction is required at a limited scale, while the dense forest is affected least as such areas are located well away from the project impact area.

Overall diversity of large mammals is much lower in the project area. Both questionnaire survey and sign based site occupancy revealed the rarity of the most of the species. Low sighting and sign detections were mainly because of small populations, and disturbances imposed by numerous human settlements in the area. Consequently, the project area is dominated by adaptable species like fox and jackal, while the species which either pose danger (e.g., wolf) or have economic value (ungulates) seems to be locally extirpated. One endangered mammalian species (Indian Pangolin *Manis crassicaudata*) is also present in the area. Its population is presumably low and facing extreme hunting pressure due to commercial value of its skin. It therefore finds refuge in thicklets of forests or rugged terrain away from the project area.

Mahseer fish (*Tor putitora*) is an endangered species, and it was recorded at two sites in the project area, by only one individual at each site. The waterbodies present in the project area are considered unsuitable to support viable populations of this species; as they are unnatural and heavily modified, and contain significant structures which inhibit migration. Consequently, a healthy population of the species is not expected from the area, neither it is expected to be affected from the project. Silver carp (*Cyprinus carpio*) is also a near threatened species, however its population in Tarbela reservoir is cultivated and not a natural one.

5.4 Socioeconomic Baseline

5.4.1 Data collection

Primary data for assessment of socioeconomic baseline has been collected through site visits, focus groups and stakeholder consultations undertaken between December 2014 and May 2015 for the power generation components and in November/December 2015 for the power evacuation components. Secondary data from the T4HP ESA undertaken in 2011 has also been used. The consultations with individuals, authorities, and non-governmental organizations as well as public consultation activities that have contributed to the chapter results are detailed in **Chapter 12**. Further, detailed socioecomoinc surveys were conducted for 49 households using structured questionnaires for power evacuation component.

5.4.2 Tarbela Dam

The Tarbela Dam Project (TDP) on the Indus River was conceived in the 1960s and commissioned in the early 1970s and its primary function was to store water for irrigation purposes. This remains its main purpose today. The scheme was originally designed to also generate 2,100MW of hydro power from the irrigation releases with 700MW installed on Tunnels 1, 2 and 3 that pass through the right abutment of the dam. However, as the power demands in the country increased the generating potential of Tarbela was also raised and currently a total of 3,478MW is installed on Tunnels 1-3.

T4HP is under construction. Construction began in August 2013 and is scheduled to be completed in June 2017. It will provide an additional 1410MW installed capacity. A breakdown of peak manpower hired to date for T4HP is presented in **Table 5.28**.

Table 5.28: T4HPP employment data

Labour aspect	Details
Total manpower	Pakistani – 1551 Chinese – 73 (Including engineers/ technical and non-technical staff)
Break down of local manpower by location	Local to districts Swabi and Haripur – 1044 Other districts – 507
Breakdown by local skilled/ unskilled workers	Unskilled – 412 Skilled – 981

Local technical staff/ engineers	112
Local staff working in office management	46

The TDP acquired about 82,000 acres of land for construction and the large reservoir submerged 120 villages, creating an unprecedented 96,000 project displaced affectees spread over a vast geographical area. Resettlement planning for TDP was based on the Pakistan Land Acquisition Act (1894 and its subsequent amendments), before the existence of international guidance, donor safeguards, or Pakistan's 2002 draft resettlement policy.

In the mid1990s, the World Bank and the Asian Development Bank (ADB) made the settlement of TDP outstanding social issues a pre-condition for the loan requested by GoP for the Ghazi Barotha Hydropower Project (GBHP). During feasibility studies of T4HP, a mechanism for resolution of pending cases of both TDP and GBHP was included. A report on remaining legacy resettlement issues from TDP and GBHP was prepared which suggested different ways to resolve these issues.

The proposal of Resettlement Claim Commissioners (RCC) was taken forward to resolve the issues out of courts. A revised Resettlement Action Plan (RAP) was prepared and to date (May 2015) progress on resolution of these issues includes

- 80 applications were received from the claimants of GBHP/TDP covering more than 375 petitioners who were willing to resolve their cases by RCC. The consultation process is on-going
- Legal sections of TDP/GBHP were requested by the General Manager and chief engineer/project director of T4HP to provide the details of their pending resettlement cases
- WAPDA was planning to hire the social mobilizers to coordinate with the affectees of TDP/ GBHP.

This recent resettlement claim resolution efforts by WAPDA with World Bank support appears to be highly appreciated by the litigants as a means to get solution of their pending legacy matters out of courts. WAPDA with technical support plans continue using the RCC for the best interest of the affectees whose cases are pending in different courts.

A social impact management framework (SIMF) was prepared during the T4HP ESA and various community development assistance programs are under implementation. The purpose of the social assistance plan is to provide direct benefits to the local area. The schemes proposed in SIMF and current status are presented in **Table 5.29**. . These Community Development Assistance Programs will also be implemented under T5HP and will target the communities located around Tarbela, transmission line and grid station. The works to be covered under this program will be identified through community consultations but are likely to include schemes such as construction of vocational training institutes, separately for boys and girls; maternity clinics, drinking water treatment, drainage and sewerage facilities, access to Sui gas facilities, etc.

Table 5.29: Activities proposed in SIMF and current status

Activities	**Updated Status**

Dispensaries at: • Darra Mohat • Ghari Mera • Pontian.	Darra Mohat: Civil and electrical works of the dispensary are completed. External power supply connection is required. Door and windows paint work and distemper of the building is under progress. After completion of this work, a handing and taking over process will be completed with the Health Department. Ghari Mera: Construction activity is completed. External electrification is in progress. However, the project is complete as reported by Civil Works Department WAPDA/Contractor even though the power connection is required. Pontian: The Health Department did not issue a no objection certificate (NOC) for establishment of the dispensary in Pontian as a Basic Health Unit (BHU) exists in a nearby village. Villagers of Pontian have requested to replace the project with the rehabilitation of an existing primary school (two additional class rooms and two washrooms). WAPDA has approved the request and civil work has been started on the project.
Drinking water schemes (filtration plants) at: • Darra Mohat • Kukar Chawa • Ghazi Hamlet • Topi Area.	Darra Mohat: The filtration plant is installed and functional. WAPDA is planning to ensure the necessary handing/taking over of the filtration plant to the Ghazi Tehsil Municipal Administration. Ghazi Hamlet: The project is completed and has been handed over to the Ghazi Tehsil Municipal Administration for operation and maintenance. Topi Area: Project is completed and functional at Ghazi Hamlet. Kukar Chawa: According to WAPDA this project is still not included in package 2 of the SIMF project as there is no reliable water and power source for the establishment and running of a filtration plant. WAPDA has asked T4HP consultants to organize a consultation program in Kukar Chawa to identify the site for filtration plant and arrangement of a water pump.
Rehabilitation of Pehure Irrigation Channel	A NOC has been granted by the Provincial Irrigation Department. Survey work and plotting of cross sections are completed. After evaluation of tender documents, the contract was awarded on 16 February 2015 and rehabilitation work is under progress.
Construction of primary school at Pehure Hamlet	Land for the school was identified by community members and consent of the community was obtained in writing. The Provincial Education Department issued the NOC for the construction of school at Pehure Hamlet. The contract was awarded on 16 Feb 2015 and construction is in progress.
Construction of class rooms for boy's high school at Pehure Hamlet.	The project is completed, functional and handed over to education department.
Procurement of furniture for: • Government Boys High School Pehure Hamlet • Government Girls Middle School Pehure Hamlet.	The furniture has been procured and distributed in schools. This project is completed.
Sewerage schemes for: • Ghazi Hamlet • Pehure Hamlet • Topi Area.	Ghazi Hamlet: Although locals of Ghazi Hamlet wanted an underground sewerage system with treatment plant, according to the Civil Work Directorate this was beyond their budget. Instead the community requested to utilize the same budget for construction of a boundary wall around the graveyard. Evaluation of the tender documents was completed and the contract was awarded on 16 Feb 2015 and construction works are in progress. Pehure Hamlet: The project was completed. Topi Area: The community requested for the rehabilitation of existing wastewater drain in the outskirts, from Topi to Irrigation canal Topi/ Pehure

	Hamlet. The Civil Works Directorate of WAPDA surveyed the existing storm/wastewater drain that runs in the outskirt of Topi for design purposes. The construction contract was awarded on 16 Feb 2015.
Procurement of equipment for: • Civil Hospital Ghazi • Civil Hospital Topi.	The initial tender was deficient of requisite criteria/specifications so another tender was opened in January 2015.
Procurement of equipment for the girls' vocational school at WAPDA Right Bank colony	Furniture and sewing machines were supplied and their installation is on-going.

Source: T4HP

5.4.3 Demography and Population

Population

The Tarbela Dam is under the administrative jurisdictions of Haripur and Swabi districts. **Table 5.30** presents basic characteristics of the population in the Project AoI. The estimated total population of the Project AoI is 110,600 with 16,070 households. Average household size is 6.88.

Table 5.30: Estimated households and population in the Project AoI

	Settlements	Households	Estimated Population
Right Bank			
01	Burj (Khabbal)	40	350
02	WAPDA Right Bank Colony	900	7500
03	Mohallah Zakoo, Topi	500	2800
04	Pehur Hamlet,Topi	1300	14500
05	Pontian	270	2200
06	Batakra	1500	8000
07	Beesak	1200	7000
08	Gandaf	8000	50000
09	Galla Hamlet	400	2400
Left Bank			
10	Darra Mohat	200	1500
11	Kukar Chawa	60	350
12	Ghari Meera	800	6000
13	Left Bank Colony (Sobra City)	300	2000
14	Ghazi Hamlet, Ghazi	600	6000
Total		**16,070**	**110,600**

The transmission line alignment falls in to 22 villages in the districts of Haripur (Khyber Pakhtunkhwa) and Attock (Punjab). 12 villages fall under district of Attock and 10 fall in Haripur district. Details of villages along the TL alignment and grid station are shown in **Table 5.31**.

Table 5.31: List of villages along the TL alignment and grid station

S.No	Name of Village	District	Angle Tower Number
Grid Station			-
1	Kamalpur Miyan	Attock	-
Transmission Line			-
2	Bahtar Mera	Attock	34 & 35
3	Katariyan	Attock	31, 32 & 33
4	Dhok Khaliq Dad	Attock	29 & 30
5	Islamgarh	Attock	28
6	Burhan	Attock	26 & 27

7	Noorabad	Attock	25
8	Dhok Mughal	Attock	24
09	Dhok Ghar	Attock	22 & 23
10	Narcey	Attock	21
11	Qibla Bandi	Attock	18, 19 & 20
12	Qutab Bhandi	Attock	16 & 17
13	Pakki Ban	Haripur	14 & 15
14	Harbara	Haripur	13
15	Dhamrai	Haripur	12
16	Bera	Haripur	11
17	Piplian	Haripur	10
18	Ghara	Haripur	9
19	Barwasa	Haripur	8
20	Umer Khana	Haripur	5, 6 & 7
21	Gahri Mehra	Haripur	3&4
22	Minar Kot	Haripur	1&2

Population of Attock district: The Population (2015) of the district Attock is estimated 1,852,993 which give population density of 271 persons per square kilometers. The total population of the district was 1,274,935 in 1998 with the density of 186 persons per square kilometer. According to 1998 censes the urban population was 21.3% of the total population and 78.70% population was reported rural. As per 1998 censes the male population was 49.50% and female population was 50.50% of the total population. The annual growth rate of the district is 2.23%.

Population of Haripur district: The Haripur has the population growth rate of 2.10 % as per latest Population Census (1998), which is slightly less than the provincial average (2.81%).The population of Haripur district wasreported 692,228 as per latest population census 1998. Given the population growth rate and using 1998 as the base year for arithmetic growth method estimation, the population of district is increased to individuals 985,569 (year 2015). The rural population is representing 88% of the district population. The population is spreading over an area of 1,725 sq. km, resulting in a density of 401.3 persons per km². As per 1998 censes the male population was 49.9% and female population was 50.1% of the total population.

Demography of Surveyed Households

Household surveys were carried as part of the ESA studies through structured questionnaires to understand the demographic and socio-economic characteristics of the population in the project area. 49 households were surveyed for this purpose. These 49 sampled households were selected randomly along the transmission line corridor and in the grid station area. About 30% of these households are directly affected and remaining 70% are located near the transmission line corridor. According to socioeconomic survey of sampled households, the female population is high as compared to male population in the project area. On average the male population is 3.6 while the female population is 3.5 in a sampled household. Field investigation also reveals that on average each household has 1.63 children, aged less than 10 years. The children population is distributed 0.87 males and 0.76 females.

Household size may also affect the economic situation of the household. A bigger household may mean more hands to do farm or non-farm work but it also means more mouths to feed. The field investigation also reveals that the average household's size comprised of 7.1 persons. The family size clearly indicates that the existence of extended family system is still dominating in the Project Area.

The presence of vulnerable population is 4.3 % of the total surveyed households in the project area. The vulnerable includes one Widow/women headed household and orphans.

Age is another important demographic characteristic which has a bearing on the employment and mobility. A study of distribution of heads of households by age will throw some light on the type of strategies which may be helpful in raising their income and employment.The data regarding the distribution of head of household by age categories are presented in **Table 5.32**.47percent of the head of household are41 - 60 years age. Conversely, higher age of household's heads is noticeably less, i.e., 24%. Relatively higher proportion of old heads of households may attribute to the positive impact of transmission line and grid station project. Moreover, the proportion of young household heads (below 40 years) was 29% but the young can play active role in the project activities. Field study reveals that average age of sample respondents in the study area is 51 years.

Table 5.32: Age Distribution of Head of Households

Respondent Age Distribution	Number	Percent
Below 40 Years	14	29
41 - 60 Years	23	47
Above 69	12	24
Total	49	100

Source: Sample survey

Education and Literacy: The overall literacy rate in the Haripur district is 31.3% and 56.55% in Attock. The female literacy rate in Haripur & Attock District is only 17.35% & 41.1% compared to male literacy rate of 44.35% & 71.75% respectively. **Table 5.33** indicates that on the whole 27percent respondents are illiterate and 73 percent are literate. Table shows that in term of education distribution, 14percent of the respondents are primary (five years of schooling), 18 percent are middle (8 years of schoolings), and 29percentof the respondents are matriculates. However, intermediate, graduate and diploma holders are 12% (4%, 6% and 2% respectively). Notably, all the respondents have the Deeni (religious) education, i.e., can read the Quran.

Table 5.33: Percentage Distribution of Respondents Regarding Education Level

	Number	Percent
Illiterate	13	27
Primary	7	14
Middle	9	18
Matriculation	14	29
Intermediate	2	04
Graduate	3	06
Diploma	1	02
Total	49	100

Source: Sample survey

Ethnicity, tribes, language and religion

The main tribe in Swabi District is Yousaf zai an off-shoot of Pathans. The following tribes are residents of the district: Razars, Rajars, Utman, Jadoon, Gadoon and Khatak. In Haripur District, Punjabis and Kashmiris are in majority as compared to Pathans. Major lineage groups and castes include Tareen, Dilazak, Tarkheli, Gujar, Awan, Mishwani, Pathan, Gakhar, Jadoon, Sayyed, Tanoli and Turks. Most of the people in the Project area are Pakhtun. Other lineage groups and castes in the Project area are Awan, Yousaf Zai, Syed, Mughal, Mashwani, Bafanda and some working classes.

Pushto is the dominant language, spoken in the Swabi District by 96% of the population. The mother tongue spoken in Haripu District is predominately "Hindko". Punjabi, Sraiki and Urdu are other languages spoken to a lesser extent in the districts. In the AoI, a majority of the people speak Pashto and Hindko. On the right bank, people also speak Urdu and Saraiki.

The main religion practiced in both districts is Islam (97%) followed by Ahmadis, Christians, Hindus and other scheduled castes. People in the AoI belong to Muslim Sunni school of thought. There are many religious institutions in Swabi where students from all over the province are seeking religious education.

5.4.4 Economic Conditions

General economic context

The gross domestic product (GDP) per capita of Pakistan (2014 estimate) was USD4,700. In comparison, the GDP per capita of its neighboring countries for the same period was: Iran- USD16,500; Afghanistan- USD2,000; Tajikistan- USD2,700; China- USD12,900; and India- USD5,800. Agriculture accounts for more than one-fourth of output. Textiles are a major export. Remittances from abroad contribute greatly to the national economy.

In 2014, the national unemployment rate was estimated to be 6.8%. There is considerable underemployment, extensive export of labor (mostly to the Middle East) and use of child labor. Agriculture provides two-fifths of national employment. In KP, only 31% of total agricultural wage laborers are female. This is a lower proportion than other parts of the country and may be due to cultural reasons which restrict the women in KP from working outside their houses.

Local occupations and livelihoods

Like the majority of districts in KP, land in Haripur and Swabi Districts is mainly used for agricultural purposes on both small and large scale for domestic and commercial purposes. A vast majority of survey respondents when asked for their main occupation identified farming. They explained that farming was their main source of income for sending children to school and looking after their families.

The main occupation of the inhabitants of the Swabi district is agriculture production and livestock rearing; mostly people are landless tenant. A few educated people are engaged in Government/private service. Unemployment, lack of potable water, basic health and education facilities, electricity and roads are development challenges for Swabi District. In Haripur District, agriculture is also the main occupation of inhabitants. The proportion of people with employment is higher due to the existence of the telecommunication industry as well as the Hazara Fertilizer Factory. People are also serving in the armed forces.

Although farming is highly practiced in the AoI, farmers face challenges. Because families practice subsistence agriculture on small plots of land, often the yields are not enough to feed the family until the next harvest leading to food shortages in homes. This has been attributed to the lack of rain, tools, and poor farming methods, prolonged droughts, pests and diseases. Since agriculture is the source of income, food and general livelihood for these rural farmers, sometimes they are faced with situations where they have to sell part of their produce to cater for emerging basic needs such as access to health facilities, payment of school fees or rent. In many cases they sell their produce at very low prices because the market is not readily available. Middlemen exploit them when they are desperate to sell.

The majority of the people in the AoI are working in nearby cities, Gadoon industrial estate, Karachi and abroad as there is little agricultural land available within hamlets and the right bank colony. Small businesses, shop keeping, private or government services are the other occupations of the people in the project area.

Income and poverty

Under the prevailing socio-economic conditions in the districts, income of an average household is very low. However, a small number of the social survey respondents with family members living abroad had a large income. According to the survey, the majority of the people in the Project, belong to the low income group. Average monthly income ranges between Rs.8000 to PKR.10000, so the majority are living below the poverty line.

Livestock as an economic commodity

Livestock is the symbol of prestige and additional source of income for farming community besides providing milk, ghee and meat. Among milk animals, cattle and sheep are higher in quantity in Swabi District, while buffalo and goats are higher in Haripur District. Among loader animal's, donkeys are mostly used, while horses and mules to a much lesser extent. Poultry keeping is also common.

Industry

The industrial estate situated at Gadoon in Swabi District was established in 1988. However, with withdrawal of incentives available in the industrial estate, a large number of buildings have been abandoned. The main industries are cement, cigarette, tanneries and flour mills. There is no important industry in the Project AoI.

In Haripur District, Hattian Industrial Estate was established in 1985. Industrialization has mostly brought positive changes in the socio-economic conditions of the district including establishment of a large number of chemical businesses, cotton, fiber, textiles, telephone companies, and brick plants

Haripur District is comparatively more industrialized than other districts of KP province. There are many big industrial units here like Telephone Industries of Pakistan, National Radio Telecommunication Corporation, Hazara fertilizers, Razzaq Blanket Industry, Ali Hussain Poultry, Khwaja Children Home, Pak-China fertilizers, Tarbela Cotton Mills etc. Furthermore, the Hattar Industrial Estate situated in Kot Najibullah was established in 1985–1986 on a total area of 1,032 acres (4.18 km²) of land. There are around 117 operational unit that are mainly composed of food and beverage, textile, crockery, paper printing, chemical, cement, publishing, chemical, rubber and leather products. In addition, the district provides good quality fruit and vegetables not only to Peshawar but also to Islamabad and Punjab.

A large number of industrial units manufacturing cements, textile, engineering goods and glass, and mostly located along G.T road, existed in Attock. In addition, Kamra Aeronautical complex and Sunjwal ordinance factories are also located in the district and have provided employment opportunities to the local residents besides providing defense equipments, services and ammunition to the Pakistan Army and Air Force.

Credit availability and banking facilities

Credit plays a role in the lives of poor and lower middle class families in project area. There are two major source of credit, institutional and non-institutional. The availability of institutional credit is very limited in the project area mainly due to lack of knowledge and secondly high rate of interest charged on loans. The main sources of non-institutional credit are shop keepers, relatives and well-off families in the settlements. These loans are mainly used for domestic and social needs such as marriages, birth ceremony, deaths, health and education.

Banking services are available in Tarbela Dam colonies on the left bank for WAPDA employees. The residents of surrounding areas have to go to Topi and Ghazi for banking services. However, sufficient banking facilities are available at these places.

5.4.5 Socioeconomic Conditions of Surveyed Households

Livelihood Sources

It is useful to study the household’s economic pattern, ultimately facilitate in better planning and execution of the project. Numerous income generating activities are practiced in the study area. These includes: farming, employment in government and private sector, Wage labor, operating own business such as running a grocery, livestock rearing and working abroad. The details are given in **Table 5.34**. Table indicated that farming is most dominant profession in the area, as 86% of the households have their affiliation with the farming practices (43% have sole farming profession and other 43% combined with other professions). The 21% respondents have the job in government and private sector. The occupation like, labor work, driving, retired government officials and working abroad are 22% while the non-farming activities are done by the 7 persons.

Table 5.34:Details of Respondents Occupations

S.NO	Occupation	No. of Respondents	Percentage (%)
1	Employee in Government	4	08
2	Employee in private sector	6	13
3	Labourers	3	06
4	Driver	3	06
5	Retired Person	4	08
6	Farming (sole occupation)	21	43
7	Abroad	1	02
8	Non-forming*	7	14
9	**Total**	**49**	**100**

*Non-farming include, 3 are shopkeepers, 1 labor, 1 livestock rearing, 1 working in abroad, and one retired from government department.

Household Income

According to survey, the monthly average income of the household is Rs.39212/-. As per **Table 5.35**, majority (37%) of the households fall in the income category (PKR17378 - PKR. 30,000), whereas, 24% of the households are falling in the 2nd high income category with their monthly income up to PKR. 50, 000/- and 20% are earning more than PKR50,000-.Contrary to this, 19% of the households have no regular income flow, simply live in hand to mouth due to meager monthly income, less than PKR 17378. These people are living below the poverty line.

Table 5.35: Monthly Income Category and Households

Sr. No.	Income Level (Rs./Month)	Number of Households	Percentage (%) of households
1	17378 and below	9	19
2	17378- 30000	18	37
3	30001- 50000	12	24
4	Above 50000	10	20
Total:		49	100

Source: Sample survey

Survey shows **(Table 5.36**) that 2.3 are the average household members involved in economic activities. Field investigation also reveals that 59% of the population has multiple sources of income. Similarly, 41%, 31%, 10% and 18% of the households have one, two, three and more source of incomes respectively.

Table 5.36: Participation of Households Members in Economic Activities

Average Household Members involved in Economic Activities	Household Members having one Source of Income		Household Members having two Source of Income		Household members having 3 Source of Income		Household members having 4-7 Source of Income	
	Nos.	Percent	Nos.	Percent	Nos.	Percent	Nos.	Percent
2.3	20	41	15	31	5	10	9	18

Source: Sample survey

Household Expenditure

The average monthly expenditures are calculated as PKR.27,877. These expenditures include food and non-food items like fuel, education, health, clothing, utility charges, and other miscellaneous expenditures. Table 5.37shows that the households with higher income have more saving capacity than the poor who hardly meet their expenses with meager income than the poor with the lowest income category: 14% have the saving capacity.

Table 5.37:Detail of Household Expenditures

Sr. No.	Description of Expenditure (PKR)	No. of Households	Percentage (%) of Households
1.	17378 and below	9	19
2.	18358- 30000	25	50
3	30001- 50000	11	23
4.	Above 50000	4	8

Total:	49	100

Source: Sample survey

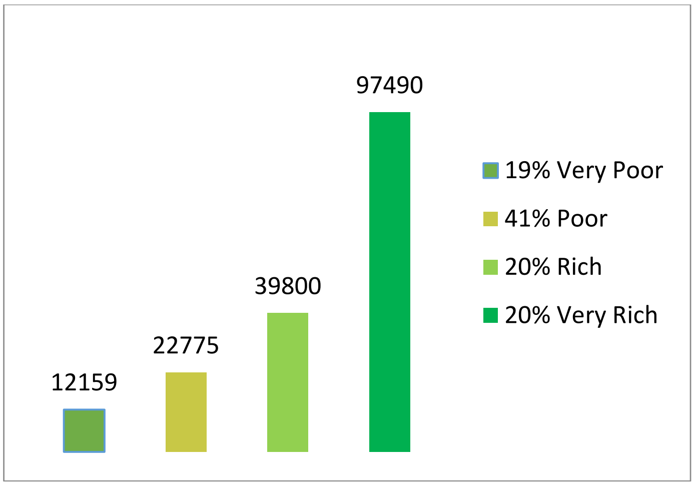
Poverty Levels

The concept of poverty line is developed in 1962 and it is not constant varies from country to country and time to time. It is calculated based on the nutrition intake, availability of urban infrastructures and minimum wages fixed by the government. However, in the project area, the official poverty Line (OPL)of PKR 1745 per capita was developed by the government(Pakistan Economic Survey, 2010–11).The latest estimate of inflation–adjusted poverty line is PKR 2,447.59, (source: Chapter 15, Poverty and Social Safety nets, 2013). Hence, the poverty line established for Project area is PKR 17,378 per household.

Poverty is wide spread in Pakistan and is particularly pre dominant in rural areas. Nearly two third of population, and 80 per cent of the country's poor people, live in rural parts of the country.In Pakistan more than 40% of the total populations are living below poverty line. The unemployment, law and order situation, increase in the inflation and power crises are the main cause of poverty in the country. According to SDPI's (2013) study on poverty in Pakistan revealed that every third Pakistani is living his life below the poverty line and Punjab which is considered as the urban area also having 19% population which is living below the poverty line. However, as per field survey, 19% of the households in Project area are also living below the poverty line.

Figure 5.52indicates that four different income groups are existed in the project area 60% of the households are reported poor including 19% very poor living below the poverty line in term of low income. Contrary to this, 40% are the rich people including the 20% very rich, surprisingly; the average monthly incomes of these very rich people are Rs. 97490/-, which make 57% of the total households income while the very poor are having only 7% of the total earning of the respondents, shows inequality between rich and poor, eventually creates a sense of deprivation among the poor and leave a long terms consequence on the life of the poor people. Therefore, the need is to design the project keeping in view these poverty issues.

Figure 5.52: Household Poverty Level



Household Possessions

Possession of durable consumer goods is another useful indicator of household socio-economic status. The possession and use of household durable goods have multiple effects and implications. For instance, access to dish or television exposes household members to update daily events, information, and educational materials. Similarly, a refrigerator prolongs food storage and keeps food fresh and hygienic. Ownership of transportation allows greater access to services away from the local area and enhances social and economic activities. **Table 5.38**presents the percentages of households that possess various durable commodities, means of transportation.

Table 5.38shows that electric iron and fans emerged as the main needs of the households as all the respondents have these items at their houses. Televisions and mobile telephones are common devices possessed by most households for information and communication. Approximately 92 percent of households possess mobile phones. The households have a television (86 percent) and possession of a radio is 6%. Another indicator of household socioeconomic status is ownership (27%) of a computer and availability of an Internet connection, yet the trend is growing slow, perhaps the people are more affiliated with religion, so accept the change slowly.

A refrigerator is available in 84% of the households. About 4% of households possess anAir condition, and 72% have a washing machine. Motorcycles and car are the most common means of transportation in the project area and53% percent of households own a motorcycle, 10% own a car and pick up van also owned by 10%. However, 5% have the bicycle using for communication purpose but is replacing with Motorcycle now. 14% have the tractors used for agriculture purposes. Geyser is the least used item of the area; only 3% households owned it.

Table 5.38: Possession of Household Goods

Items	Households	Items	Households	Items	Households
Television	86%	Washing Machine	72%	Car	10%
Geyser	3%	Refrigerator	84%	Motorcycle	53%
Sewing Machine	55%	Mobile Phone	92%	Air conditioner	4%
Computer	27%	Bicycle	5%	Fan	100%
Radio	06%	Elect. Iron	100%	Pick up/ Van	10%
Tractor	14%	-	-	-	-

Credit

There are two types (Institutional and non-institutional) of credit source found in the project area. The survey revealed that 33% sampled household’s took the loan from formal and informal sources. Formal sources mean Khushali bank, Akhuwat and money lender while the informal sources mean relatives. The loan was obtained for marriages, construction of the houses, buying of the motor cycle, business development and agriculture purpose. The amount of loan ranged from Rs.10000 – Rs.300, 000/-.

Land Holding

Land is the major determinant of farm income and big holding size is the symbol of dignity and honor in the rural set up. Though, the holding size is decreasing due to inheritance fragmentation and urbanization of the area but still have the value in the rural area. According to agriculture censes 2000, 15% Households have less the 1 acre land, 26% HHs have 1 to 2.5 acres,23% HHs have 2.5 to 5 acres,15% HHs have 5 to 7.5 acre,11% HHs have 7.5 to 12.5 acres,7% HHs have 12.5 to 25 acres, 1% HHs have 25 to 50 acres According to field survey, the average land holding size of the area is 70 Kanal. However, the detail is discussed in the below **Table 5.39**.

Table 5.39: Detail of Land Holding Size of the Respondents

Sr. No.	Land Holding Size (Kanal*)	No. of Households	Percentage (%) of Households
1.	0.1 – 5	9	22
2.	5.1 - 25	13	31
3	25.1 - 50	11	26
4.	50.1 – 100	6	14
5	Above 100	3	07
	Total:	42	100

*1acre = 8 Kanal, Source: Sample survey

Table 5.39shows that majority of the respondents are having very small holding size, as only 7% are having more than 100 kanal of holding size. Hence, to maintain their livelihood, the respondents are doing the multi-tasking or rented in the land either on lease or share cropping basis.**Table 5.39**reveals that 22% of the respondents are very small land holding size (up to 5 kanal), followed the 31% having the holding size up to 25 kanal. Survey also shows that 26% and 14% are having the maximum holding size, 50 Kanal and 100 Kanal respectively.

Field investigation reveals that 98% farmers are self operators, 19% (out of 98%) are owners cum tenant and only 2% area is operated by the tenant farmers. The tenancy is discouraged due to small holding size. However, those people have given their land who are either big holding size or absent from the area and settled in the main cities.

Crops

The major crops of the area are wheat, fodder and vegetables, especially onion and cabbage, however, few others crops like gram, maize, ground nuts, oil seeds, lentil are also grown. The wheat is grown at larger scale due to having rain fed area and few Tube-wells have also been installed to irrigate the vegetables and fodder crop mostly.**Table 5.40** indicates that total cultivated area of Wheat is 270 acres, Maize 23 acres and vegetables grown area is 38 acres with the total income of Rs.8,290,560, Rs. 533,600 and Rs. 2,939,907 respectively. However, cost of production for wheat crop is Rs. 6,350,577, maize is Rs. 533,600 and for vegetables the cost of production is Rs. 2,228,000 and got the net income from wheat Rs. 1,939,983, Maize Rs. 66,600 and net income for vegetables is Rs.711,706. Notably, vegetables are the most profitable crops of the project area. Field investigation also reveals that on seeing the market trend, people grow the vegetables.

Table 5.40: Detail of crops grown and income

Type of Crop	Total Area sown (Acre)	Average Yields/ Acre (Kg)	Total income (PKR)	Total cost incurred (PKR)	Net income (PKR)
Wheat	270	1024	829,0560	6,350,577	1,939,983
Maize	23	928	533,600	467,000	66,600
Vegetables	38	554	2,939,907	2,228,000	711,706

Livestock

Livestock rearing is considered to be an important source of income. Like other areas of Pakistan, people do practice of rearing livestock, as an economic source. A general problem in the areas is the increasing milk deficit due to growing population. The expanding population is also causing farm sizes to shrink. The free grazing of cattle is not possible anymore as the land is too densely populated in the grid station; however, it is possible in the mountainous area of transmission line. Other problems seen by the Livestock is the increasing prices for inputs, like feeds; the high costs of fodder production; and the tendency to use fertilizer for food production. According to key informants, the number of cattle per household is decreasing.

According to field survey, buffalos, cows, goats, sheep and donkey appear to be the common livestock species in the areas. On average each household has 1.89 buffalos, 2.69cows and 3.4 goats. In term of costing of the animals, buffalo cost varies from Rs. 70,000 to 175,000 per head, cow cost is Rs. 50,000 to Rs.150, 000 and goat per head cost is reported as Rs. 20,000 to Rs. 80,000/-

5.4.6 Social Infrastructure and Services

The District administrations are headed by a District Coordination Officer (DCO), assisted by district heads of department. Main departments are judiciary, police, education; health, communication and works, agriculture, forest, irrigation, telecommunication, livestock and fisheries. Each Department is headed by a Deputy Director or District Officer. Key sectors affecting the well-being of the local population are discussed below.

Access to Infrastructure

Access to safe water and sanitation is believed to be essential for health, security, livelihood, and quality of life, and is especially critical for women and children. Improved water supply and sanitation interventions could thus provide a wide range of benefits like longer lifespan, reduced morbidity and mortality from various diseases, and low health costs. However, **Table 5.41** depicts the picture of available social amenities in the project area.

Table 5.41: Access to Social Amenities in the Project Area

S.NO	Social Amenities	Available	No Access
1	Electricity	100%	0
2	Sui-Gas	25%	75%
3	Water Supply	25%	75%
4	Sewerage/Drainage	10%	90%
5	Hospital	94%	06%

S.NO	Social Amenities	Available	No Access
6	School	100%	0
7	Road	80%	20%

Table 5.41indicates that all the houses in the project areas are electrified. However, the people are not satisfied over the power supply. They complained for the frequent power failure and low voltage; eventually leave the adverse impact on the daily life.

Sui Gas is only available to 25% of the houses, however, it is emerged as the need of the entire Project area, it is ranked as the top priority demand of women in the project area.

Potable drinking water supply is available to only 25% of the households and still the 75% are deprived of this precious water resource eventually facing with the water borne diseases. Field investigation reveals that the people are practiced to have the small well in their houses and extract the water through the electric pumps and in case of power failure, the wells are operated manually.

In addition, 10% of the houses have the access on sewerage and drainage system while 90% are still looking to have this facility.

Health

Access to health care is an important factor and prominent concern in KP Province. The health and life expectancy in the Province is amongst the worst in the country. Facilities available within Swabi and Haripur districts are presented in **Table 5.42**.

Table 5.42: Health facilities in Swabi and Haripur districts

Facility	District	
	Swabi (#)	Haripur (#)
District Head Quarter Hospital	1	1
Type D[18] Hospitals	2	3
Civil Hospitals	3	3
Basic HeaAlth Unit	39	39
Dispensaries		12
Rural Health Centers	5	6
Sub Health Centers		5
Mother and Child Health Centers	0	2
Civil Dispensaries	9	6

Source: http://www.haripur.financekpp.gov.pk/index.php?option=com_content&view=article&id=68&Itemid=82(Accessed in June 2015); http://www.swabi.financekpp.gov.pk/index.php?option=com_content&view=article&id=68&Itemid=82(Accessed in June 2015)

Swabi District has a greater number of basic health centers while Haripur District has a greater number of dispensaries and rural health centers. It is evident from the above mentioned information that hospitalization, rural health centers and mother/child centers are rare in both districts.

The AoI health care services are not at their best. Survey respondents have access to health care facilities; however there are problems such as an inadequate supply of drugs, very few health personnel, lack of modern facilities for proper diagnosis and the distances to the health center being far away from their homes. Health facilities can be accessed at nearby cities. Although dispensaries are available at Pehure and Ghazi hamlets, there is a shortage of staff, medicine and equipment. Similarly, health facilities in civil hospitals at Ghazi and Topi are not well equipped with medical manpower and related infrastructure. Khabbal, Darra Mohat and Kukar Chawa do not have any access to either medical practitioners or any basic health unit. The existing health facilities in the Project AoI are given below in the **Table 5.43**.

Table 5.43:Availability of health facilities in the AoI

Sr. #	Village	Facility	Status
Right Bank			
1	Burj (Khabbal)	NIL	NIL
2	WAPDA Right Bank Colony	Hospital	Lack of Laboratory facilities.
3	Mohallah Zakoo, Topi	Civil Hospital	Lack of Laboratory facilities.
4	Pehure Hamlet, Topi	Dispensary	Lack of medical staff and Medicines.
5	Pontian	Nil	Nil
6	Batakra	Civil Hospital	Lack of Laboratory facilities.
7	Beesak	Civil Hospital	Lack of Laboratory facilities.
8	Gandaf	Civil Hospital	Lack of Laboratory facilities.
9	Galla Hamlet	Dispensary	Lack of medical staff and Medicines.
Left Bank			
10	Darra Mohat	Nil	Nil
11	Kukar Chawa	Nil	Nil
12	Ghari Meera	Nil	Nil
13	Left bank Colony (Sobra City)	Hospital	Adequate facilities are available in the hospital
14	Ghazi Hamlet	Dispensary	Lack of medical staff and Medicines.

Source: ESIA survey 2015

[18] Type D Hospitals: Facilities includes: OPD, Indoor services, Dental services, immunization services, X-ray services of all kinds and small laboratory.

A WAPDA dispensary exists at right bank colony facilitated with medicines, qualified doctors and other related facilities. Outdoor treatment facilities are provided to WAPDA employees while the patients requiring intensive care are referred to WAPDA hospital at left bank. There is a need for improvement in laboratory and other medical facilities, especially during night.

Table 5.44indicates that above 50% of the women focus group participants avail health facilities at government health centers including indoor hospitalization facilities. However, the availability of professional, semi-professional, occupational medical staff and quality of related services remained as an open question: a small 6.5% were in favor of relying on private medical facilities including paramedical practitioners.

Table 5.44: Health facilities availed by women in last year

Health Centre	Response	Percentage (%)
Basic Health Unit	13	28.2
Dispensary	15	32.6
Private Doctor	3	6.5
Hospital	7	15.2
Hakeem / Practitioner	8	17.3
Total	46	100

Unhygienic living conditions and lack of potable water in the Project AoI are root causes of many diseases. Women in four focus groups were asked about the most common diseases prevalent in the AoI. From their perspective they are diarrhea, typhoid, eye diseases, skin diseases, measles and pneumonia. See **Table 5.45**for details.

Table 5.45: Most common diseases prevailing in the AoI

Disease	Response (#)	Percentage (%)
Diarrhea	42	34.1
Typhoid	15	12.1
Malaria	15	12.1
Eye diseases	12	9.7
Skin Diseases	11	8.9
Measles	9	7.3
Pneumonia	8	6.5
Hepatitis	5	4.1
Tuberculosis	3	2.4
Chickenpox	3	2.4
Total	123	100.0

*There were multiple responses.

The NGO sector has made enormous contribution to development in Pakistan. Ghazi Barotha Tarqiati Idara (GTBI) and Sungi Development Foundation are still working in the TDP area. GBTI was project NGO for Ghazi Barotha hydro power project. In addition they are working with communities in health and education sectors. Pakistan and provincial (KPK) Rural Support Programs are also working in Haripur and Swabi districts. The GBTI is currently providing small loans to women's in Tehsil Ghazi to purchase animals and sewing machines and the Sunji Development Foundation is currently working on a small afforestation project in Swabi District.

Education

Education is a prerequisite for good governance and sustainable national development because it transforms people into good citizens, equipped to contribute to the social-economic transformation of the nation. In general, literacy levels in the province have improved and continue to be a priority among development strategies. The introduction of new policies means a majority of parents are taking their children to school. Although education has improved, a lack of literacy is still a one of the largest causes of poverty in province households especially in rural areas, as it leads to reduced income generating opportunities, particularly for women. However, the government has pursued policies to expand access to all levels of education system, with a special emphasis placed on primary education because it directly benefits the rural poor.

Swabi District is blessed with a higher standard institution of engineering science and technology, the Ghulam Ishaq Khan Institute of Engineering Science and Technology (GIKIEST) situated at Topi. There is also a polytechnic institute and a commerce college in the district. Haripur District has Haripur University, Post Graduate College, Poly Technique Institute and Commerce College. The overall picture of education facilities in the AoI can be judged from**Table 5.46**.

Table 5.46: Education facilities available in the project AoI

	Village	Facility	Gender
Right Bank			
1	Burj (Khabbal)	Primary school	Boys
2	WAPDA Right Bank Colony	High school	Boys and Girls
3	Mohallah Zakoo, Topi	Primary school	Boys and Girls
4	Pehur Hamlet ,Topi	High school	Boys and Girls
5	Pontian	Primary school	Boys and Girls
6	Batakra	High school	Boys and Girls
7	Beesak	High school Middle school	Boys Girls
8	Gandaf	Degree Collage High school	Boys Girls
9	Galla Hamlet	High school Middle school	Boys Girls
Left bank			
10	Darra Mohat	Primary school	Boys and Girls
11	Kukar Chawa		None
12	Ghari Meera	Primary school	Boys and Girls
13	Left Bank Colony (Sobra City)	Degree Collage	Boys and Girls
14	Ghazi Hamlet	Inter collage High school	Boys Girls

Source: ESIA survey 2015

Better education facilities are available at the left bank colony. There is a degree college with qualified staff in a proper building. Science and computer laboratories are also available. Although high school for boys and girls exist at both Ghazi and Pehure and in the Topi area, there is a shortage of proper staff, furniture, science and computer labs. Buildings are old which do not match with the requirements for the existing numbers of students. A degree level education facility is available in Ghazi and Topi area.

A person who can read and write statements with understanding in any language prevalent in Pakistan is considered as literate. The literacy rate is measured as number of literate people among the population of 10 years and above. The historical (1998) literacy rate in Swabi District was very low at 36% and Haripur District was higher (54%). The literacy rate in the Project AoI is lower compared to the national level.

In term of availability of educational infrastructure, people are not satisfied for the higher education centers. They have to travel maximum 15km away for higher education. Hence, it becomes difficult to provide the education for the girl as due to lack of security they can't send their daughters alone for education purposes. However, all the people have the access on lower education center, i.e., till primary and middle as reported in **Table 5.41**.

Housing

In the districts, most of the houses are made of brick and stone. The house generally consists of two or three rooms with veranda. Each cluster of houses has a hujra (guesthouse) where male members gather for socializing. Separate kitchen, bathroom and latrine are available in most housing units in both districts.

Permanent structures are made of brick, are roofed with iron rods and are mostly residences and institutions. Institutional structures, mainly schools, are built of permanent brick material and roofed with concrete. Semi-permanent buildings are mostly residential and support structures such as latrines, kitchens and livestock structures are evidenced as one goes deeper in the villages. The mud and wattle structures are a typical village setting characterized by scattered settlements.

There is mixture of pacca, semi-pacca and kacha houses in the AoI except the right bank colony, where all the houses are pacca. Eighty percent (80%) of the surveyed households in the AoI are pacca. The remainder is a mixture of kacha and semi-pacca. It was observed that all the people were living in self-owned houses except the right bank colony, where the houses are the property of WAPDA.

Among the 49 surveyed households, 84% are pucca, 10% are katcha and 6% are some pucca. Pucca houses are constructed with bricks cement and concrete having wooden and steel doors and windows. Semi pucca houses are made of bricks (joint with mud) and their roofs are mostly of wood, and partially bricks, whereaskacha houses are made of mud and other local material such as sticks, reeds and iron sheet. The average numbers of rooms are3.61.The field investigation shows that 43% of the houses are valued between PKR 500,000 – PKR 1,000,000/-. However, 47% respondents reported the value of their houses between PKR 1.1 – 3 million and only 10% have the value of their houses more than 10 million. The average cost of the respondents house is Rs.1,560,204/-. Surprisingly, 37% of the households are living in small house, comprised on the 1-2 rooms.

Water and sanitation

Water is a key strategic resource, vital for sustaining life, promoting development and maintaining the environment. Access to clean and safe water and improved sanitation are very crucial to health and therefore have a direct impact on the quality of life and productivity of the population. Residents of Swabi District have much better access to clean drinking water as 109 tube wells have been installed at various locations across district from which 106 are in operation. Residents of Haripur District living in urban settlements mostly have access to drinking water within the house although a minority still has to fetch water from outside the house.

Tapped water supply is considered to be the most hygienic source of drinking water, which is available only in WAPDA colonies and to a limited number of people in the AoI. Water supply system was partially available in hamlets but was dysfunctional at the time of the ESA survey. At the right bank Topi area, the drinking water was polluted due to a severe seepage problem. Most of the people in the AoI use untreated water. The ground water is contaminated by sewage, especially in Topi.

Access to improved sanitation facilities refers to the percentage of the population with at least adequate access to excreta disposal facilities that can effectively prevent human, animal, and insect contact with excreta. Improved facilities range from simple but protected pit latrines to flush toilets with a sewerage connection. To be effective, facilities must be correctly constructed and properly maintained. The sanitation conditions in Haripur District are relatively better than Swabi District, especially in the rural areas. Urban settlements have drainage facilities, but they are improperly functioning. A sanitation system is available only in the WAPDA colonies with no proper environmentally safe disposal system. In hamlets in the Topi area, an open drainage system is available but there are no arrangements for the disposal of solid waste and sewage. People drain out used water in open places. Similarly, open dumping of solid waste is normal practice in the AoI.

Electricity and telecommunications

All of the T5 ESA socio-economic survey respondents indicated their houses had electricity for lighting. The AoI is connected to the national grid system. However, shortage of electricity and load shedding is normal practice in the area like other parts of the country.

Telecommunication services are available in and around the AoI. Services of all the mobile companies are available and the Pakistan Telecommunication Company Limited is also providing land lines and wireless telephone services in the area.

Road network

Tarbela Dam is about 110 km away from Islamabad. The project area is linked by road directly with Islamabad and Peshawar via Motorway (M1) and Grand Trunk (GT) Road. One can use the Ghazi/ Tarbela/Swabi existing motorway to reach TDP via a link road. The same link road also leads to GT road after crossing motorway overhead bridge.

There is a chain of national, district and rural roads available in Swabi District. Farms are linked with markets by roads network. Completion of the M1 motorway project has also improved the linkages of the district with other cities.

Attock & Haripur districts are easily accessible by road from Peshawar and Islamabad. The main road link to the district is the Karakoram Highway (N-35) which passes from Haripur city. Pak-China trade is carried out through this highway. In addition to this, a number of pacca and katcha tracks off take from this road and led to a number of villages and settlements. Major mode of transportation in the Project area includes Minibuses, Cars, Vans, Jeeps, Tractor Trolleys, Passenger Buses and Trucks. Out of all these transportation modes, mainly jeeps, cars and vans are used to travel to settlements along the proposed project. However, in the project area, 80% respondents have access on the road infrastructure and 20% are deprived of this facility as given in **Table 5.41.**

5.4.7 Land Use and Natural Resources

Land use

Haripur District is divisible into four types of land regions. The first, Maidan-e-Hazara, consists of a plain surrounded by the Tanawal mountains. The second region, Tanawal, mainly consists of mountains. The third region is Khanpur Punjkhata which is a well-watered plain lying in the south eastern corner of the district. The last region is Chhachh in the west of Haripur city. This entire tract was sub-merged by the reservoir of the Tarbela Dam. The notable minerals in the District are sandstone, limestone and dolomite and these are explored in Ghazi Tehsil.

The ADI is owned by WAPDA and is part of the existing Tarbela Dam complex. The land is not used and has little productive value for other uses because it is adjacent to existing dam infrastructure. The ADI has no ecosystem service potential because of its location. Any ecosystem services in the AoI will have already been affected by, and adjustments made for, the historical presence of the dam.

Tangible cultural heritage, tourism and recreation

Personal communication from people at Pehure Hamlet indicated that during past digging on local hill tops, some utensils of old age had been found. However, a request was made during the T4HP ESA to the archaeological department for investigation but after their detailed survey they did not find any site of archaeological importance. At present there is no known archaeological or cultural site that exists in the ADI or the AoI.

The scenic beauty of the area and the Tarbela Dam attract local and foreign tourists. In the past, WAPDA had developed viewpoints for visitors at the dam site. However, currently tourism activities in the AoI are very limited due to security reasons. The present wave of terrorism does not allow tourist activities in such a nationally important and therefore sensitive area. There is no tourist access to the Tarbela Dam.

WAPDA has provided recreation facilities to employees in its residential colonies. These included play grounds, supports gymnasium, ladies and gents club and community centre in the right bank colony. Playgrounds and others sports facilities are very limited in Ghazi and Topi areas. Communities have indicated an interest in recreational facilities in the districts, particularly for women and children.

5.4.8 Gender Issues

Table 5.47presents some gender indicators from the national perspective that will affect the women living in the AoI.

Table 5.47: Gender analysis

Gender equality element	Gender indicators and analysis
Education	19.3% of adult women have reached at least a secondary level of education compared to 46.1% of their male counterparts.[19]
Economic activity	Female participation in the labor market is 24.4% compared to 82.9 for men. The GNI for women is USD$1,707 and for men is USD$7,439[20]. Amongst women who do work in non-agricultural jobs, most of them work in the government sector or work as teacher/professor or maid servant.[21] Most female run enterprises sell their product within their village. In many rural areas of Pakistan, construction jobs are not common for women due to cultural reasons.[22]
Agriculture production	Women participate in planting, weeding and harvesting crops but not fertilizer or chemical application, irrigation or tree pruning. Men participate in all of the aforementioned activities. [23]

[19] Human Development Report, 2014
[20] Ibid
[21]Pakistan Rural Household Panel Survey 2012 (Round 1): Household Characteristics
[22] Ibid
[23]Pakistan Rural Household Panel Survey 2012 (Round 1): Household Characteristics

Family roles and time utilization	Average hours spent by women per week on household chores: less than 2 hrs on shopping and house maintenance; 2 to 5 hours on collecting water; 5.1 to 7.5 hours on washing and pressing clothes, preparing dung cakes, stitching and craft work for her own house; 7.6 to 10 hours on collecting firewood and fodder, washing and cleaning utensils, household agricultural activities; 10.1 to 15 hours on cleaning own house, cooking food for home; and over 15.1 hours on helping and caring children and elders[24]
Health	In Pakistan, for every 100,000 live births, 260.0 women die from pregnancy related causes; and the adolescent birth rate is 27.3 births per 1000 live births.
Mother's Index Rating	In 2015, taking into account 5 criteria (lifetime risk of maternal death, under 5 years of age mortality rate, expected years of formal schooling, gross national income per capita, and participation of women in national government, Pakistan ranked 149 of 179 countries.[25]

In general, the Project AoI reflects a male dominated society. In the villages, women face difficulties to get an education and are excluded from most of the decision-making processes. The gender situation is affected by early marriage of girls, restriction on women's mobility, long working hours and many household chores. Gender issues are important in development initiatives because female members of the community are generally under represented or neglected while designing, assessing and implementing such projects. Females are generally more vulnerable than male members of the society. For the Project, a gender study was undertaken.

Four focus group discussions involving 52 influential women from four villages were organized to collect data from women in the AoI. All the women in the focus groups were within the age group of 20 to 60 years with an average age of 40 years. Of the total women, 80% were married, 18% unmarried and the remaining two percent were widows. On average the married women had 3.5 children.

Table 5.48 shows overall a higher level of education achievement and propensity of getting education among the literate and influential women of the AoI.

Table 5.48: Level of formal education of literate respondents

Education Level	**Respondents**	**Percentage (%)**
Primary	8	15.4
Middle	10	19.2
Matric	9	17.3
Higher secondary school certificate	10	19.2
Bachelor of Arts (BA)	9	17.3
Masters of Ares MA	6	11.5
Total	52	100

Table 5.49shows that about half of the consulted women are housewives and remain engaged on a full time basis in household chores including food preparation, cleaning / housekeeping, caring and rearing of children and taking care of old and sick members of

[24]Pakistan Rural Household Panel Survey 2012 (Round 1): Household Characteristics
[25]Pakistan Rural Household Panel Survey 2012 (Round 1): Household Characteristics

the family. About one-fifth of the women were contributing in household income through both indoor and outdoor activities, such as teaching, dress making and shop keeping. Forty percent (40%) of the women possessed skills including embroidery and stitching, which are minor household income generating activities. These numbers are likely indicative of the roles women play in the AoI. Women are also engaged in the informal rural economy through the rearing of animals.

Table 5.49: Occupational status of women respondents

Activity	Respondents (#)	Percentage (%)
Housewife	26	50
Teacher	7	13.4
Student	9	17.3
Dress maker	5	9.6
Shopkeeper	1	1.9
No occupation	4	7.6
Total	52	100.0

Of the total women involved in the focus groups, 51.2% were involved in decision making process regarding important issues of sale and purchase of property, for schooling and marriages of their children. However, a vast majority of women (83.3%) were of the view that beside all the discussions regarding decision making, final decision power lies with the male head of the family. A small number of respondents (5.2%) had the right of ownership of the property. These findings are indicative of the conditions for other women in the AoI.

The women participation in different activities was also assessed as part of transmission line surveys. The views of all the sectors of women including the housewives, service lady (government and private sectors), headed household and other vulnerable groups were obtained so that the true feelings can be captured for the project implementation. The participation level is discussed as in **Table 5.50**.

Table 5.50: Women Participation in the Various Activities

S.NO	Activities	Physical Participation Level
1	Household	72%
2	Child caring	74%
3	Farming	21
4	Livestock	30
3	Business Activities	04%
4	Employment	03%
5	Sale & Purchase of properties	35%
6	Social obligations (marriage, birthday & other functions)	56%
7	Local representation (councilor/political gathering)	40%

Table 5.50. reveals that women are participating in the daily life however; their participation level is varied in various activities. The women participation (74%) in the child caring is comparatively high, eventually the child care is perceived more women related job and they can care the children comparatively in a better way. Similarly, the women participation is more (72%) in the household activities; it is trend that women are usually responsible for the household activities. The women participation is high (56%) in social obligation, though the participation is not encouraging as women prefer to take part in social obligation.

Surprisingly, the women participation in the farming and livestock is low (21% and 30% respectively) although it is quite normal in the rural set up that women are mainly participating in these activities. Women participation in the local representation is disappointing, although the 2001 local government ordinance (2001) enhances the women representative in the political system, eventually a cultural barrier in women development. Similarly, the women participation is low (35%) in the sale and purchase of the items, usually, sales and purchase required the sudden and bold step and women perhaps are reluctant to take these step.

In addition, the women participation is low in term of business and employment activities, revealed that women have less income earning opportunities.Notably, the field investigation shows that majority of the men encourage the women job if they can find preferably in the government sector. Both are opined that the employment is essential for both the sexes to meet the requirements of daily life.

The women of the project area reported the following issues during the survey which are prioritized as under;

- Availability of Sui Gas facility
- Employment
- Access to medical treatment
- Access to education/skill
- Road infrastructure
- Availability of potable water
- Improved sewerage and solid waste system

6 Climate Change and Other Risks

This chapter discusses the risks of climate change related impacts, net greenhouse gases emissions from T5HP and earthquakes on T5HP.

6.1 Climate Change Risks on Tarbela Dam

6.1.1 Overview of Climate Change in Northern Pakistan

During the last decade substantial research is carried out to study the effects of long-term climate change on precipitation, air temperatures, and droughts. Some of the main conclusions of these studies (GCISC, 2009[26], Planning Commission, 2009[27]) are:

- between 1980 and 2005 the frequency of heat waves (T >40 °C) has been increased in north-western Pakistan. It is expected that there will be more frequent periods with extreme drought;
- based on predictions in scenarios of the International Panel on Climate Change (IPCC) estimates have been made by the Pakistan Meteorological Service of the increase in maximum daily temperatures, which ranges from 2.8 °C to 4.2 °C in the year 2080 for northern Pakistan;
- more heavy rainfall events during monsoon season will occur over north-western Pakistan instead of over the north-east of the country. Some models calculate 25 percent more rainfall during monsoon. As a result, areas along the western rivers of the country (Indus and Kabul) will be more vulnerable to flood episodes similar to the one experienced during 2010;
- water availability might increase considerably (during kharif) but not when it is required for agriculture (rabi season);
- a shift has been observed in the rainfall pattern with monsoons starting 1-2 weeks earlier and winter rains confined towards February. The predictions of changes in precipitation however are much less certain than those in temperature. A general conclusion is that precipitation in the form of rainfall and snow is likely to increase in summer (2- 7 percent) and decrease (2-4 percent) in Northern Pakistan in the year 2080 (GCISC, 2009).

Other studies (World Bank, 2005[28], Rees and Collins, 2004[29]) have been concentrated on the effects of glacial melt, especially on the Hindu Kush-Karakorum or the Western part of the Himalaya. Major issues to be investigated are amongst others:

- the importance of the contribution of snow and glacial melt on the hydrology of the Indus;
- the observed changes in the extent of the glaciers;

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[26] GCISC (2009): Ali, G., S. Hasson, and A.M. Khan, Climate Change: Implications and Adaptation of Water Resources in Pakistan, Research Report No.GCISC-RR-13, Global Change Impact Studies Centre, Islamabad.

[27] Planning Commission 2009, Pakistan’s Climate Change Policies and Actions, Task Force on Climate Change, Planning Commission, Planning and Development Division, Government of Pakistan.

[28] World Bank 2005.Pakistan's Water Economy Running Dry

[29] Rees, G. and D. N. Collins (2004), An assessment of the Potential Impacts of Deglaciation on the Water Resources of the Himalaya, Technical Report, DFID KAR Project No. R7890: Snow and Glacier Aspects of Water Resources Management in the Himalayas (SAGAR MATHA), Centre for Ecology and Hydrology, Oxfordshire, UK

- the effects of climate changes on the amount of melt-water.

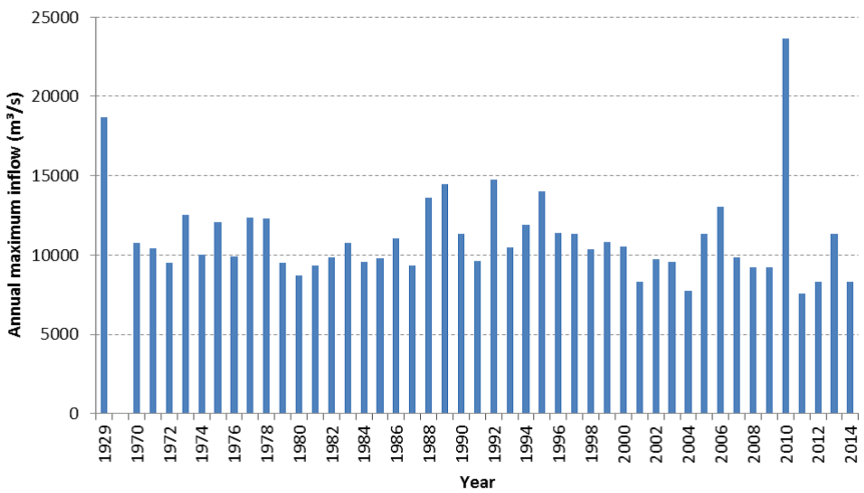
From these studies it has been concluded that glaciers in the Himalaya and Karakorum are receding faster than happens in any other part of the world. From digital terrain models and satellite observations it might be concluded that the reduction of the thickness of ice in the Western Himalayan glaciers ranges between 0.50 to 0.90 m per year, although in some areas in the Karakorum an extension and increase of glaciers has been reported. A recent study (Immerzeel et al, 2010) suggests that 60 percent of the discharge in the Indus catchment is fed by melting of glaciers and snow. This is a very high percentage as compared to other major rivers originating in the Himalayas, such as Brahmaputra, Ganges and Yellow River. In a likely scenario of global warming based on IPCC predictions the reduction of the share of melt-water in the Indus discharge has been estimated at 8.4 percent. However, this could be (over) compensated by an expected increase of precipitation in the downstream areas (in the NW of the country) which are under influence of the monsoon.

The relation between climate change and hydrology is extremely complex. This is especially the case, since the high variability in data on climate and hydrology, requiring long time series and proper monitoring. Moreover, regional circumstances might vary considerably, especially in high mountain areas. This often leads to conflicting data. More studies and more reliable data should be collected in the coming years.

6.1.2 Climate Resilienceof Tarbela Dam

Tarbela Dam itself is designed to withstand a PMF event which was assumed to include maximum snow melt, maximum storm flood and simultaneous natural dam breach (landslide or glacier), and had a spillwaydesign discharge of 42,000 m^3/s. Based on the historical record of last 85 years (**Figure 6.1)**, the maximum flow recorded so far at Tarbela site is 23,645 m^3/s (in 2010), but this was considerably below the design discharge of 42,400 m^3/sec. Tarbela dam could therefore relatively easily cope with these high floods. Through operation of the reservoir the peak outflow at Tarbela even could be reduced with some 28 percent. The conclusion is that although the risk of flooding in the Indus Basin might increase in the coming years due to climate change. the risk of flooding and related damage in the Tarbela area is very low.

Figure 6.1: Annual maximum inflows to Tarbela reservoir



6.1.3 Climate Change Adaptation for T5HP

The rise in flows of Dal Dara channel due to increase release of flows from spill ways (because of climate change) might affect the T5HP powerhouse and tailrace structures. The 2010 flood inflow was 23,645m^3/s and this is estimated to have a return period of approximately 1,000 years (calculated using the GEV Type III distribution). The resulting maximum discharge in Dal Dara channel as a result of this flood was 11,500m^3/s and the water level at service spillway plunge pool (adjacent to the proposed powerhouse) was measured to be at approximately 362m.

The power house and tailrace structures of T5HP are designed to withstand extreme flood events in Dal Dara channel, well in excess of any flood event recorded to date. The design flood level of the powerhouse, has been set at 370m which coincides with a s flow of 25,000m^3/s which has an estimated return period of more than10,000 years. The maximum operational level of the powerhouse (i.e. the turbines will not operate when the water in the channel is above this level) has been set to 365m. This would occur with a spillway channel flow of 15,700m^3/s which has an estimated return period of more than 1,000 years.

6.1.4 Climate Change Monitoring Under Dasu Hydropower Project

The relation between climate change and hydrology is extremely complex. This is especially the case, since the high variability in data on climate and hydrology, requiring long time series and proper monitoring. More studies and more reliable data should be collected in the coming years. Some research and monitoring in these aspects will be taken up as part of Dasu Hydropower Project (DHP). These include:

Support to Glacier Monitoring and Research Centre (WAPDA)

Continued monitoring of glaciers is crucial for the water security of the country, and useful for developing the knowledge base for the operation of the dam and for planning future hydropower investments in the Indus Basin. A glacier monitoring program was recommended in DHP. This program would support the Glacier Monitoring and Research Center (GMRC) under the WAPDA General Manager Planning for monitoring and research on the Upper Indus Basin (UIB) glaciers. The program is intended to examine and monitor the characteristics and movements of these glaciers with the help of satellite data and also to provide early warning for glacial lake outbursts. The proposed GMRC would have four sections: (a) a field investigations section responsible for establishing and managing field stations. The office is proposed to be established in the upper catchment of the Indus; (b) a remote sensing and modeling section located in Lahore to carry out remote sensing and modeling studies; (c) a forecasting section; and (d) a data management section to maintain and upgrade data management systems and carry out data analysis and research activities. It would also link up with the high altitude meteorological network, surface water hydrology and WAPDA's hydro-meteorological network. DHP contributes with USD 4.0 million to support the program of GMRC.

Telemetric Network

A flood warning telemetry network is proposed by WAPDA to be developed for the Indus basin. Such a system would strengthen the flood forecasting system in the country and complement the above Glacier Monitoring Program. Floods in Indus basin were worst in the country's history with large amount of damages in human lives, livestock and agricultural destruction. For safety of public and better management of flood waves and safe operation of hydropower projects in the country, it is imperative to have an early warning system for these hydropower catchments. WAPDA has proposed the installation of 18 telemetry stations, most of them in the Indus catchment area. Under DHP currently a budget of USD 2.5 million is proposed for the installation and operation (10 year) of these telemetric stations, including the training of staff. The works will be implemented by the Hydrology and Research Directorate under the administrative control of the Chief Engineer, Hydrology and Water Management, WAPDA.

6.2 Net Greenhouse Gases Emission from T5HP – Power Generation Facilities

Net greenhouse gas (GHG) emissions from implementation of T5HP are estimated using the World Bank "Guidance Note: Greenhouse Gases Accounting for Energy Investment Operations, Version 1.0, June 2013 (hereinafter "Guidance Note") and IPCC 2006 guidelines. The emissions from the Project and baseline emission of the nearest least-cost alternative (CCGT) estimated over 30 years.

6.2.1 GHG Emissions from T5HP Generation Component

Three sources of emissions are considered for accounting GHG from the Project. The sources and the estimates are given below.

Reservoir Emissions.

When a river is dammed, the flow dynamics are changed, riverine sediment and organic material are trapped, and terrestrial ecosystems are flooded. This alters the previous cycle and fluxes of CO_2 and other GHGs within the reservoir area. The main contributions to emissions are decomposable parts of flooded soil and vegetation in terrestrial zones and removed sinks from cleared biomass growth. GHG emissions from new aquatic systems will occur during the full lifetime of the reservoir, but will exponentially decrease as the flooded organic material is decomposed and as biochemical conditions change.

The T5HP will not create any additional reservoir and will not contribute to any additional reservoir emissions, and hence emissions from T5HP can be assumed to be zero.

Emissions from Land Clearing for Civil Works.

Construction of power facilities, tail race, switch yard and some other project facilities such as spoil disposal require permanent land clearing. Emissions from land clearing can be calculated as a one-time emission of CO_2 based on the available dry biomass carbon for the total cleared areas for construction, according to IPCC guidelines. According to IPCC guidelines, Temperate dry climate has 100 tons/ha of dry biomass, of which average carbon content is 47 percent. Total land clearing emissions for 3 km^2 are 0.05 million tCO_2e.

Embodied (Life Cycle) emissions in construction materials*.*

The construction of Project consumes about 1.3 million tons of concrete, 40,000 tons of steel, metals, and other electro mechanical equipment. All of these materials have embodied emissions as a result of the energy used to produce them, meaning that the implementation of the Project creates some upstream emissions in the manufacture of the materials used. The Guidance Note recommended a mean value of 2.9 kg CO_2e/MWh per hydropower as a default factor if no other information is available. Total Embodied (Life Cycle) Emissions are 0.16 million tCO2e.

6.2.2 Baseline Emissions

Two sources of emissions are considered for estimations of baseline emissions.

Baseline Generation Emissions.

These are GHG emissions resulting from same amount of electricity generation using other alternate feasible energy sources. This feasible alternative should be realistic in terms of economic, technical, financial, legal and regulatory aspects. The economic and least cost analysis of the Project described CCGT is the most feasible alternative to the Project. Emission Factor for CCGT in Pakistan is 367.56 g CO_2/kWh. Total Baseline Generation Emissions for 50 years are 20.13 million tCO2e.

Baseline Construction Emissions.

According to the 'Guidance Note', the default value for one-off emissions for thermal gas power is 503 kgCO2e/kW of installed capacity. The corresponding plant factor is 85 percent. For the installed capacity to produce 12,225 GWh/year requires 250 MW of thermal gas power. Total baseline construction emissions are 0.12 million tCO2e. Therefore, the total baseline emissions from above two sources are 20.26 million tCO2e.

6.2.3 Net Emissions

The net emissions (Project Emissions - Baseline Emissions from CCGT) of T5HP are minus 20.05 million tons of CO_2 equivalent. A summary of the calculations are given in **Table 6.1**.

Table 6.1: Net GHG Emissions (tCO_2) from T5HP – Power Generation Component

	Emission Type	T5HP - Generation	Baseline (CCGT)	Net
1	Reservoir emissions	0		0
2	Generation Emission		20,134,937	-20,134,937
3	Land clearing	51,700		51,700
4	Embodied Emissions	158,862		158,862
5	Energy emissions in Construction (optional)	0	123,352	-123,352
	Total Emissions	210,562	20,258,289	-20,047,727

6.3 Net Greenhouse Gases Emission from T5HP – Power Evacuation Facilities

6.3.1 GHG Emissions from Transmission Line and Grid Station

The GHG emissions from T5HP power evacuation component (Tarbela to Islamabad West transmission line and grid station) are given in **Table 6.2**.The losses in the transmission are estimated as 2%. The direct generation emissions associated with these losses (emission factor 0.6545 tCO2/MWh) is estimated to be 0.7 million tCO2e. Land clearing will be required at the grid station (200 acres) and tower locations (approximately tower will be required for every 300 m and a clearance required for each tower is 20m X 20m), and emissions associated with the clearing are estimated to be 14,938 tCO2e. Circuit breakers containing SF6 will be used in the grid station and the S6 emissions are estimated to be (emission factor is 0.119 gSF6/MWh) 155,800 tCO2e. Embodied emissions and construction emissions have not been calculated since the information will be known only at the construction stage. The total Project emissions from evacuation component are 0.89 million tCO2e.

6.3.2 Baseline Emissions

Baseline emissions for power evacuations are also estimated and presented in **Table 6.2**. The existing Tarbela – Rewat transmission line has been considered as baseline since this will be the feasible and least cost alternative. The generation emissions from loses associated with the baseline will be similar to the Project. However, no land clearing will be required since the existing towers and right of way will be used.

6.3.3 Net Emissions

The net GHG emissions (Project Emissions - Baseline Emissions) of T5HP power evacuation are 0.18 million tCO2e. If the baseline scenario is considered similar to T4HP, where the power is connected to an existing switchyard and existing transmission lines, the baseline emissions would be zero, and the net emissions would be 0.89 million tCO2e.

Table 6.2: Net GHG Emissions (tCO_2) from T5HP –Power Evacuation Component

	Emission Type	T5HP – Evacuation	Baseline (Tarbela – Rewat TL)	Net
1	Generation Emissions from losses in the project	717,070	717,070	0
2	Emissions from Land Clearing	14,938	0	27,001
3	SF6 Emissions	155,800	0	155,800
4	Embodied Emission (Optional)	0	0	0
5	Energy Emissions in Construction (Optional)	0	0	0
	Total Emissions	887,808	717,070	170,738

6.4 Risk of Earthquakes

The Project area is located in a part of Pakistan where earthquakes frequently occur, though usually these are not of an exceptional magnitude. Tarbela is situated in the foothills of the Himalaya and Karakorum mountains. These mountain ranges were uplifted through the collision of the Indian and Eurasian tectonic plates. The zone of the main trust between the plates is located northeast of the project site at a distance 100- 200 km in Kohistan and Kashmir. However, the influence of associated local tectonic fault breaks can continue until the project area as far as the Potwar (or Potohar) plateau, which is situated south of the project area. High incidence of seismic activity through tectonical movements of local faults can be responsible for rupture of ground surface, ground acceleration, failures of natural slopes, and ground liquefaction.

The largest recent earthquake in the area was the 2005 NWFP/Kashmir earthquake with a magnitude of 7.6 on the Richter scale. More than 73,000 people were killed through this earthquake and 450,000 people made homeless. The epicenter was located at a distance of about 100 km northeast from Tarbela. The major earthquake was followed by a large number of aftershocks. The magnitude of 7.6 is exceptional (calculated frequency of once every 330 years). Most earthquakes in the area have a magnitude up to 6.4. As long as the process of mountain uplifting continues in the northern areas the project should be spared from major earthquakes with magnitudes in excess of 7. However, there is no guarantee that a local fault does not break and causes an earthquake. There is an active tectonic fault (the Darband fault) at the site which may displace by about 1.2 m. This makes the risk of failure of slopes and liquefaction of near-surface soil quite high, unless appropriate engineering measures are implemented to reduce these risks.

Seismicity of the region was studied for as part of Tarbela 4Extension Projects. The results of T4 study was reviewed and included in T5HP design also. The seismic accelerations used in the design of T5HP are:

- Operating Basis Earthquake (OBE) Horizontal Acceleration: 0.21g
- Maximum Design Earthquake (MDE) Horizontal Acceleration: 0.55g

A committee of international panel of experts recruited by WAPDA have reviewed and approved the T4HP design. This was done in accordance with World Bank Policy OP 4.37 Safety of Dams. A seismic monitoring program will be established at the dam site for continuous monitoring.

7 Assessment of Environmental Impacts

This Chapter identifies the potential impacts of the project on various aspects of physical and biological environment. Potential impacts on people and communities are covered in the subsequent Chapter. This Chapter also presents the overarching methodology used to identify and assess potential environmental and social impacts associated with the Project.

7.1 Methodology of Assessment

7.1.1 Assessment of Significance

Overview

For each impact the likely magnitude of the impact and the sensitivity of the receptor are defined, quantitatively to the extent possible. Generic criteria for the definition of magnitude and sensitivity are summarized below.

Magnitude Criteria

The assessment of magnitude is undertaken in two steps. Firstly the key issues associated with the Project are categorized as beneficial or adverse. Secondly, impacts are categorized as major, moderate, minor or negligible based on consideration of parameters such as:

- Duration of the impact - ranging from 'beyond decommissioning' to' temporary with no detectable impact'
- Spatial extent of the impact – for instance, within the site boundary to district, regional, national, and international
- Reversibility - ranging from 'permanent requiring significant intervention to return to baseline' to 'no change'
- Likelihood – ranging from 'occurring regularly under typical conditions' to 'unlikely to occur'.
- Compliance with legal standards and established professional criteria - ranging from 'substantial non-compliance with national standards or Good International Industry Practice (GIIP)' to 'is compliant with standards'

Generic criteria for determining magnitude (for adverse impacts) are presented in **Table 7.1.** These criteria have been used to generate aspect specific criteria for the detailed assessments. The magnitude criteria used for the detailed assessments are presented in the relevant sections in this chapter.

Table 7.1: Criteria for determining magnitude

Categorization	Description (adverse impacts)
Major	Fundamental change to the specific conditions assessed resulting in long term or permanent change, typically widespread in nature, and requiring significant intervention to return to baseline; Would violate national standards or GIIP without mitigation.
Moderate	Detectable change to the specific conditions assessed resulting in non-fundamental temporary or permanent change.
Minor	Detectable but minor change to the specific conditions assessed.
Negligible	No perceptible change to the specific conditions assessed.

The project will be constructed and operated to meet standards. In addition to the thresholds in **Table 7.2**, any violation of standards would be considered a major impact.

Sensitivity criteria

Generic criteria for determining sensitivity of receptors are outlined in **Table 7.3**. Each detailed assessment will define sensitivity in relation to the topic.

Table 7.2: Criteria for determining sensitivity

Category	Description for adverse impacts
High	Vulnerable receptor (human, physical or biological) with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.
Medium	Vulnerable receptor with little capacity to absorb proposed changes or limited opportunities for mitigation.
Low	Receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation
Negligible	Receptor with good capacity to absorb proposed changes or and good opportunities for mitigation

Impact evaluation and determination of significance

Impacts are identified and significance attributed taking into account the interaction between magnitude criteria and sensitivity criteria as presented in **Table 7.4**.

Table 7.3: Impact evaluation matrix

Sensitivity	Magnitude						
	Adverse				*Beneficial*		
	Major	Moderate	Minor	Negligible	Minor	Moderate	Major
High	Major	Major	Moderate	Negligible	Moderate	Major	Major
Medium	Major	Moderate	Minor	Negligible	Minor	Moderate	Major
Low	Moderate	Minor	Negligible	Negligible	Negligible	Minor	Moderate
Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

In this ESA, major and moderate impacts are considered as 'significant' and minor and legible impacts are considered as 'non-significant'.

7.1.2 MitigationMonitoring Measures

Mitigation and Enhancement Measures

Where feasible the following hierarchy of mitigation measures will be applied:

- Avoid and reduce impacts through design (embedded mitigation)
- Abate impacts at source or at receptor
- Repair, restore or reinstate to address temporary construction effects
- Compensation for loss or damage.

Enhancement measures are actions and processes that:

- Create new positive impacts or benefits
- Increase the reach or amount of positive impacts or benefits
- Distribute positive impacts or benefits more equitably.

Monitoring Measures

It is best practice to establish a program of monitoring to determine the success or otherwise of mitigation and enhancement measures for a Project and also to verify impact assessment conclusions (which are typically subject to a level of uncertainty). In the event that monitoring demonstrates that mitigation or enhancement measures are ineffective, monitoring results provide a basis for adaptive management.

Monitoring parameters are presented in ESMP. WAPDA and NTDC will ensure monitoring obligations and recourse to adaptive management are committed through the Project contracts.

Residual Significance

The relevant section in this Chapter include an assessment of the significance of impacts before and after the application of mitigation or enhancement measures. Significant impacts that remain after the application of mitigation or enhancement measures are referred to as residual impacts. A statement of residual significance is included for each impact.

Uncertainty

Uncertainties associated with impact prediction or the sensitivity of receptors due to the absence of data or other limitations are explicitly stated in the relevant sections in this Chapter. As appropriate, recommendations for management and / or monitoring measures to address these limitations are also included here and compiled in the ESMP.

7.2 Soils, Geology, and Seismicity

This section considers the potential impacts to ground conditions associated with construction and operation of the Project. The assessment framework is set out in **Section 7.1** and the assessment of potential impacts is based on the description of the Project provided in **Chapter 3**. Specific objectives of the assessment are to assess:

- Potential impacts of the project on soils and sub-soils from the construction and operation phase
- Potential impacts on soils and sub-soils from contaminated land if present in the Project AoI, and future contamination as a result of the Project
- Potential secondary impacts from these contamination sources on other sensitive receptors such as human health, ecology and water
- Appropriate mitigation measures and provide specific measures to avoid or reduce any identified significant impacts identified in the assessment.

Each phase of the Project has the potential to impact on soils, with potential implications on soil quality and land use, and in addition, to groundwater quality if mobilization of contamination occurs. The geology and soils of an area can also impose constraints on the construction, particularly the presence of contaminated and unstable land. Such constraints will be considered in the Project design as well as in construction and operational procedures.

There is also potential for sensitive receptors associated with ground conditions such as designated (regionally, nationally or internationally) important geological sites and agriculturally or ecologically valuable soils.

For this assessment, the AoI covers the Project ADI and a buffer zone of approximately 500m. Geology and soils further away are unlikely to be significantly affected by activities associated with Project.

Assessment of geology, landslides and seismic risks is based on combination of desk based review of available information and survey work, limited to areas directly impacted by construction activities and project structures. The aim of the assessment is to generally characterize the potential risks of landslide hazards associated with project activities.

7.2.1 Assessment Methodology

The potential impacts of the project on geology, landslides and seismicity are identified through consideration of:

- The site investigation data
- The geomorphological mapping and landslide hazard mapping assessments
- Micro–seismic network information
- Influential construction activities such as tunnel excavation (blasting / tunnel boring machine)
- Operation of the project.

Table 7.4presents the criteria for determining the sensitivity of geological receptors and the sensitivity of current landslides and slope receptors. The sensitivity is in relation to the effect that the construction and operation of the Project could have on geology, landslides and / or seismicity. High sensitivity reflects existing conditions with little capacity to absorb proposed changes or conditions that present minimal opportunity for mitigation. The opportunity for mitigation of slopes or landslides is also affected by the extent of the affected feature, with many more mitigation options being available for small scale features.

Table 7.4: Criteria for determining sensitivity

Category	Description
Major	Vulnerable receptor with little or no capacity to absorb proposed changes or minimal opportunities for mitigation e.g. • Geological site of international importance • Slope in a condition at or close to failure – existing soil slope failure in area of deep superficial subject to ongoing degradation, highly weathered materials in steep slopes subject to ongoing weathering, rock slopes with inclined low shear strength discontinuities where excavations are proposed, moisture sensitive poorly consolidated materials in reservoir side slopes. Failure may occur regardless of mitigation • Agricultural Land (soil of excellent quality with no limitations; can support a very wide range of agricultural crops.)
Moderate	Vulnerable receptor with limited capacity to absorb proposed changes or limited opportunities for mitigation, e.g. • Geological site of regional importance • Slope condition worsened by construction works but not increased to failure, potentially small local failures manageable with standard mitigation approaches • Agricultural Land (soil of good quality with minor limitations; can support a wide range of agricultural crops).
Minor	Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation, e.g. • Sites locally important for its geology

	• Slope condition with minimal mitigation would not be affected by the construction / operation • Agricultural Land (soil of good to moderate quality with moderate to moderately severe limitations, can sometimes support a wide range of agricultural crop or cereals, pasture and scrubland).
Negligible	Vulnerable receptor with high capacity to absorb proposed changes or numerous opportunities for mitigation, e.g. • Areas of no geological importance • Slopes that will not be affected by the works, and will not require mitigation to support i.e. fresh un-weathered rock slopes with favourable joint orientations, relatively flat gravel terraces, shallow well drained soil slopes • Agricultural land (soil of poor quality with severe limitations; supports mainly scrubland).

Table 7.5 presents the criteria for determining magnitude of impacts on geology and soils.

Table 7.5: Criteria for determining magnitude

Category	Description
High	Long term (>35 years) fundamental change to the specific environmental conditions assessed resulting in long term or permanent change, typically widespread in nature (regional national and international), would require significant intervention to return to baseline; exceeds national standards and limits.
Medium	Life span of the project. Medium term (10-20 years) spatial extent beyond immediate project components, site boundaries or local area. Detectable change to the specific environmental conditions assessed resulting in non-fundamental temporary or permanent change.
Low	Less than the project lifespan. Spatial extent of impact within the project areas. Meets minimum national standards and international guidelines. Detectable but minor change to the specific environmental conditions assessed.
Negligible	Temporary duration with no detectable impact. No perceptible change to the specific environmental conditions assessed.

7.2.2 Potential Impacts of the Project

The main Project components/activities which may impact on soil quality are considered to be:

- Site preparation including levelling ground preparation within the Project area
- The construction of T5 powerhouse, switchyard and associated infrastructure.
- Construction of foundation for transmission line towers
- Construction of grid station
- Construction and operation of construction camps
- Operation and maintenance of T5 power house and associated facilities
- Operation of grid station
- Residential colonies at TDP and grid station.

The following assessment also covers seismic risk in relation to potential contamination impacts. Potential impacts relating to the above components are discussed separately in the following sections.

Based on an initial assessment for this Project, the principal potential impacts to soil during all phases of the Project include:

- Storage and handling of soils, and subsequent loss or degradation of soils via erosion as a result of ground works
- Contamination of soil quality as a result of leaks and spills of hazardous materials (including waste) during their transport, storage, handling and disposal.

Soil is potentially at risk of contamination from the construction activities of all of the Project facilities, including the management of wastewater and other fluids generated by the Project and the storage and handling of other hazardous materials. There is also the potential for secondary impacts to human health as a result of soil contamination.

The potential for impacts to soil from contamination resulting from construction of the Project are discussed below. For all aspects of the construction and operation there is the potential for secondary impacts to construction and site workers from the handling of hazardous materials including contaminated soils. Where relevant, these impacts are also discussed in the sections below.

Construction Phase

Soil erosion and contamination. Construction of the Project and associated infrastructure will be undertaken on previously modified land.There will be no significant change to the present land use of the area. The proposed sites for temporary and permanent Project infrastructure are all located in the vicinity of the existing Tarbela site and the land has been heavily modified. Although the total area affected is limited there will be some activities that have potential soil erosion and contamination impacts as below:

- The construction activity may trigger soil erosion due to clearing of land
- Operation of construction equipment may pollute the soil with spilling of oil, and grease
- Spoil generation from excavation works
- Spoil disposal at designated sites
- Rerouting of small portion of approach roads is proposed under the project. The construction of approach requires cutting of land and is likely to cause soil erosion
- Extraction or the re-use of fine and coarse aggregates
- Construction camp operation may contaminate the soils.

Soil erosion also has the potential to impact water quality in the Dhal Dara Channel and water bodies along the transmission line route. Primary containment for TDP facilities will however be in place in the form of the coffer dam. High rainfall events can also potentially cause accelerated erosion particularly in excavated areas. This erosion can seriously affect the slope stability and integrity of the TDP structures around the construction sites. Soil erosion can also impact the water quality in Dhal Dara channel.

Excavation for construction of power evacuation facilities particularly on slopes and near water bodies (e.g., Haro River) can potentially cause soil erosion. Some of the eroded soil can enter the water bodies thus adversely affecting the water quality.

Disturbance of soils during construction including (and particularly) from movement of vehicles, may lead to destruction of the integrity of upper soil layers. Damaged soil is more readily eroded and washed into water courses during rainfall events and can also form dust during dry periods.Dust can have adverse effects on human health and ecological receptors near to construction sites. The potential impacts from the creation of dust are discussed in more detail later in this Section.

During construction a range of potentially hazardous substances would be used including oils, lubricants, fuels and cement. These materials will present a potential contamination risk during transportation to site as well as during storage, use and reuse or disposal. Accidental spills or leakages of hazardous substances may result in local contamination of soils. The magnitude of contamination impacts to soils would be minor to moderate negative. Based on the value of soils in the Project area (there are some cultivated lands along the transmission line route), impacts to soils are assessed as moderate.

Landslide and seismicity. During the construction phase of the project large volumes of bedrock are to be excavated for the powerhouse, tunnel and tailrace channel. The main impacts on landslides, geology and seismicity from these activities are as follows:

- Blasting of bedrock for construction of the powerhouse may cause shockwaves which have the potential to activate landslides. The impact is of moderate adverse significance
- Spoil arising from the construction activities can be placed according to good engineering practice and design at the toe areas of identified landslide features acting to improve stability and reduce the risk of future landslides. This impact is deemed to have a minor to moderate positive significance.
- Almost all project works will involve excavation of natural rocks, cutting of formations, moving and or dumping spoil using earth moving machinery. All these activities will disturb the existing ground conditions. The area of direct impact at the power generation facilities however, falls within an area of highly modified ground conditions in the vicinity of the Tarbela Dam and geotechnical design is an integral part of the power house construction. Excavation works for the power house are nonetheless considered to potentially have a high adverse impact.
- Excavation works for tower foundation construction along slopes and near water bodies can potentially cause some localized land sliding. The grid station construction however is not likely to cause any such effect since the area is fairly plain and levelled.
- The excavation of materials from the powerhouse foundations will provide a local source of aggregate which may be reused in construction activities. This impact is of minor positive significance
- No change (+/-) in the impact of seismology risk of the area is expected during the project construction phase as none of the project activities is expected to be sufficiently powerful to influence the tectonic risk. However, the high seismic risk of the region can disrupt the project construction activities at any time during construction. For example, causing liquefaction in the alluvial soils, ground failure and surface rupture. The high seismic risk in the area is known and has been taken into account in engineering design stages of the scheme as a whole and the powerhouse in particular. Based on the current seismic risk information available and the engineering design measures taken to allow for this risk, the impact is deemed as minor adverse significance.

Operational Phase

There may be occasions when landslides may take place due to earthquakes that fall outside of the engineering design parameters such as the 2005 Kashmir magnitude 7.6 earthquake. This has the potential to cause a major negative impact causing damage to the penstock and powerhouse.Therefore, the Project has incorporate appropriate design to further reduce the risk i.e. the penstock will be buried underground and the powerhouse has been designed with sufficient space between it and the top of the slopes to avoid impact.

It should also be noted that WAPDA has a Flood Management Manual (2011) which, *inter alia*, specifies responsibilities of key parties the operational limits that apply in the event of major flooding. For example, it specifies the tasks that need to be undertaken by operational and management staff in the event of a major flood and the maximum allowable reservoir water elevation for a given flood inflow. The Flood Management Manual constitutes an annex of the Tarbela Dam Emergency Response Plan that sets out procedures applicable in the case of:

- Floods
- Earthquakes
- Clogging of tunnels
- Formation of sinkholes
- Failure of rock cut slopes
- Excessive seepages
- Erosion at spillway plunge pools and Dhal Dara Weir

WAPDA also plans to reinforce flood impact mitigation through changes to operational policies of major water reservoirs, i.e. Tarbela, Mangla and also plans to upgrade its river flow monitoring system with telemetry which will reinforce the national flood early warning system.

The transmission line and grid station are not located in any areas of known landslide risk; therefore, negligible impact is predicted. The high seismic risk of the region i.e. Tarbela region, can pose a secondary risk to community safety from the potential for a tower collapse. Appropriate design measures will be taken to mitigate against such failures, the impact significance is considered as minor with medium sensitivity and minor magnitude.

The waste streams from residential colonies and workshops at TDP and grid station may potentially cause soil contamination. This impact has been assessed as moderate in view of the presence of communities and cultivation fields in the project AoI.

Summary of Impacts

The project's impacts associated with soil, geology, and seismicity are summarized in **Table 7.6** below.

Table 7.6: Impact assessment for soil and geology

Description of works	Impact	Sensitivity	Magnitude	Impact Significance	Residual Impact
• Site preparation (cut/fill and levelling) and vehicle	Vegetation loss, excavation, and compaction, resulting in erosion of soils sediment entering channel by accelerated water erosions and wind-blown dusts	Medium	Moderate	Moderate	No

movements • Earthworks/intrusive foundation construction works • Leaks and spills of contaminants • Waste water from construction and cleaning	Soil quality with secondary impacts on groundwater quality and human health	Medium	Moderate	Moderate	No
	Landslides Slope instability from vegetation clearance, excavation works and placement of spoil areas	High	Major	Major	No
• Vehicle movement • Worker camp operation	Degradation of soil quality	Medium	Negligible	Negligible	No
	Contamination of soil	Medium	Moderate	Moderate	No
	Soil erosion and/or loss of soil cover	Medium	Minor	Minor adverse	No
	Decrease in soil stability	Low	Negligible	Negligible	No
	Increased risk of landslides	Negligible	Negligible	Negligible	No
	Increased risk of seismic activity	Medium	Minor	Minor adverse	No
Operation and maintenance activities	Soil contamination (from workshops, residential areas)	Medium	Moderate	Moderate	No

7.2.3 Mitigation and Enhancement Measure

Soil Erosion and Contamination

Soil erosion and contamination impacts to soils for all aspects and phases of the Project are considered to be negligible due to the negligible sensitivity of the soils and the moderate or low magnitude of the impact. To ensure that the magnitude of impact stays within estimated levels it is particularly necessary during the construction phase to employ good construction management mitigation measures to avoid soil erosion and leaks and spills of hazardous materials (see **Table 7.7**).

Table 7.7: Mitigation measures required – Soil Erosion and Contamination

Process/Activity	Impact	Mitigation
Construction		
Site Preparation (cut/ fill and levelling) and vehicle movement	Vegetation loss and compaction, resulting in erosion of soils sediment entering channel by accelerated water erosions and wind-blown dusts	• Preparation of a Sediment and Erosion Control Plan in accordance with GIIP including World Bank Group EHS Guidelines. Dust control measures to be included in a specific Air Quality Management Plan. • Where possible vehicles to use defined access roads/tracks. • Where travelling off road, keep vehicle movements to a minimum. • Surface water run-off to be controlled by the construction of temporary drainage channels terminating in sediment traps/ soak away ponds. • Slope breakers to be installed where the potential for rill erosion is identified/observed. • Other measures to be employed as needed including straw bales, silt fences, stilling ponds, erosion protection matting, bio-engineering. • Top soil to be stripped and stockpiled where practical. • Temporary stockpiles to be protected from erosion.
Earthworks/	Mobilisation of	• Preparation of a Sediment and Erosion Control Plan in

Process/Activity	Impact	Mitigation
intrusive construction works	dust and secondary impacts on human health	accordance with GIIP including World Bank Group EHS Guidelines. Dust control measures to be included in a specific Air Quality Management Plan. • Use best practice construction methodology in line with local regulations and international guidelines. • Contractors to wear suitable PPE to protect against inhalation of dust. A risk assessment will be carried out to identify the level of PPE required in line with site specific risk factors. • If required, quarries and borrow pits following completion of works to be re-contoured and top soil reinstated and vegetation re-established through sewing of suitable grass seed if dormant seeds in top soil do not contain viable native seed stock. Measures to be specified in a Habitat Removal and Restoration Plan (HRRP). • Plant new trees and vegetation in the areas subjected to erosion in accordance with an HRRP • Other measures to be employed as needed including straw bales, silt fences, stilling ponds, erosion protection matting, bio-engineering.
Leaks and spills of contaminants	Soil quality with secondary impacts on groundwater quality and human health.	• Develop and implement an Emergency Response Plan and a separate Oil and Chemical Spill Response Plan in accordance with local Emergency Response regulations, GIIP and IFC and HSE guidance. Clean-up contaminated material in case of fuel leaks. • Undertake soil and groundwater quality baseline assessment for the Project area, including soil and groundwater contamination testing. Establish baseline values for the site to compare with future monitoring and to identify conditions the site should be returned to in future when the power station has closed and is to be decommissioned. • Use best practice construction methodology in line with local regulations and international guidelines to minimise the potential for leaks or spills to occur. • Hazardous materials will be suitably stored to prevent leaks and spills. Drip trays will be used to intercept leaks and spills from equipment and during refuelling. Adequate bunding will be provided for all fuel and chemical storage.
Waste water from construction, integrity testing and cleaning, construction camps	Soil quality with secondary impacts on groundwater quality and human health.	• Use best practice construction methodology in line with local regulations and international guidelines. • Similarly to what was applied in the T4HP, for sewage waste, a septic tank and soakage pits will be installed on site. Water will percolate into the ground so there will be no discharge. • Similarly to what was applied in the T4HP, effluent discharged from the screeners of the crushing plant (where aggregate/ sand is washed) generally contains fine particles of silt and clay. For the treatment of effluent to be discharged, sedimentation ponds will be provided to allow sediment to settle for periodic removal for disposal in designated site spoil areas. Water being discharged from these ponds will be regulated to ensure they are within turbidity limits. • Sewage from construction camps and other facilities to be treated before releasing to environment.

Process/Activity	Impact	Mitigation
Operation		
Storage and handling of hazardous materials	Soil quality with secondary impacts on groundwater quality and human health.	• Use best practice hazardous materials storage and handling in line with local regulations and international guidelines.
Waste water from operation	Soil quality with secondary impacts on groundwater quality and human health.	• Sewage waste from the T5HP powerhouse and residential areas will be processed in a dedicated sewage treatment facility (septic tank, leach field and chlorine dosing) before being discharged to the T5HP tailrace. • Sewage from grid station will be treated in a dedicated sewage treatment facility (e.g., septic tank).

Landslides

The main impacts of landslides for all aspects of the project are considered to be the potential to cause slope movement and instability. The final scheme layout has been determined with due consideration to the presence of landslides and a risk based assessment of their likely consequence to the Project. The major items considered in the rock slope design to avoid any potential landslide are shotcrete, rock bolts, anchors and dowels. The mitigation measures identified in **Table 7.8** are toaddress impacts after good seismic engineering design practice. These construction phase mitigation measures for the minimization of landslide hazards will also be identified for inclusion within the ESMP.

Table 7.8: Mitigation measures required for preventino of Landslides

Type of Measure	Impacts mitigated or enhanced	Detail
Embedded mitigation – mitigation which is built-in to the project during the design and procurement process	Slope instability from vegetation clearance, excavation works including blasting, construction of new roads, placement of spoil areas	• Preparation of a Landslip Control Plan in accordance with GIIP • Slope supports or mitigation measures will be employed to ensure that the slopes remain stable with design to appropriate standards. • Contractor will monitor engineering slopes and landslides near the powerhouse, including deformation, stress and strain, seismic response, blasting vibration. • Removal of the overburden deposits at the powerhouse site that are currently considered unstable. • As a rule, cutting and removal of the soil/rock mass should be performed from upper to lower portion to maintain the slope stability. • After the excavation of slope, timely sealing and protective measures shall be adopted for soft rock slope surface • Geological work (assessing conditions encountered) will continue throughout construction • Temporary works shall be designed to be safe, reliable, and adequate for all loads and uses. • Blasting will be avoided where possible. Where unavoidable blasting shall be in accordance with the control technique of Blasting Act in Pakistan. Contractor will prepare a Blast Management Plan. • Contractor responsible to undertake proper maintenance of all roads being used by the Contractor and Employer during the entire construction period including removal of slides, road surface repair and drainage system cleaning and

		upgrading. • An Emergency Response Plan needs to be prepared covering aspects such as landslides. • Location of transmission line towers will be selected in stable and plain areas as far as possible. If unavoidable, foundations will be appropriately designed to forestall any land sliding; appropriate measures such as stone pitching will be implemented.
Enhancement measures	Erosion control, slope stability	• Landscaping and afforestation programme around the project facilities where feasible.

7.2.4 Proposed Monitoring

Monitoring of mitigation/ enhancement measure will be conducted for the duration of the construction phase. These requirements, along with associated responsibilities and reporting requirements will be detailed in the ESMP. The Environmental Manager of the contractor will ensure the measures included in this report and the ESMP are implemented during the construction of the Project.

7.2.5 Residual Impacts

Residual impacts are those significant impacts that remain after the application of mitigation and/or enhancement measures. There are no adverse residual significant impacts predicted following the application of the mitigation measures listed in **Table 7.7**and **Table 7.8**.

7.2.6 Statement of Significance

This assessment of soils, geology and seismicity predicts that the proposed Project will not result in significant effects, assuming that the proposed mitigation measures are implemented.

7.3 Water Resources

This Section considers the potential impacts of construction and operation of power generation components of T5HP on water resources and water quality.

7.3.1 Assessment Criteria

The methodology adopted for this Section is consistent with the generic method described in Section 7.1.There are no national or international standards for the specific hydrological thresholds to be used for the ESA and hence the assessment of impacts relies to a large degree on professional judgment.

Three types of impact are assessed in this section:

- Water resources (including groundwater resources)
- Wastewater
- Flood risk.

The magnitudes of potential effects are assessed in terms of the scale and timing of proposed operations relative to the baseline water resources. The sensitivity of a specific receptor is based on the available water resources as described in the baseline status section.

7.3.2 Potential Impacts

The construction phase is expected to last for approximately 39 months and will consist of major construction works.

Construction activities and associated impact magnitude

Irrigation releases. The Project will require water to be abstracted from T5 and diverted to a new powerhouse. This will be achieved by modifying the existing tunnel to incorporate a bifurcation and connection to a new penstock arrangement. The reservoir size, inflow and sedimentation rate will not change because of the project. Joining the new tunnel with the existing tunnel will require complete closure of the latter. This is expected to last for 20 months but would be scheduled such that only one irrigation season is affected. Without mitigation the impact would be major, but since the irrigation water will be released through other tunnels the impact is considered to be moderate.

Surface water quality. The construction activities that could potentially impact on surface water quality are:

- Water turbidity as a result of coffer dam construction
- Run-off from excavation, crushed and ground rock material from drilling and blasting
- Run off from earthmoving and spoil handling, open excavations, concrete batching for new tower construction
- Run-off from dampening systems to control dust emissions; dumping of spoil material
- Sanitary effluents from construction workers camp
- Oil and chemical spills; washing of vehicles and other machinery

The associated impacts on water quality include:

- Harming of fish and aquatic life
- Contamination of water bodies (particularly Dhal Dara channel, Ghazi-Barotha headpond area, Haro river)
- Water contamination may increase if the surface runoff during rainy season (monsoon) carries toxic materials into the river
- Wastewater from construction activities and sewage discharges from construction camps may cause adverse impacts due to increased sedimentation and contamination
- Sewage effluent, mostly of an organic nature, will contain high biological oxygen demand (BOD), nutrients (phosphates and nitrates) and pathogens (faecal coliform).

Water quality impacts arising from construction are assessed to be minor and of short duration. See **Table 7.9** for impact magnitude associated with water resources. Ecological impacts associated with changes in water quality are assessed later in the Section.

Table 7.9: Construction activities and associated impact magnitude – Water Resources

Stage	Description of works	Key activities	Likelihood of impact on				Duration (months)	Impact magnitude
			Water quality		Release mgt			
			Surface	Ground-water	Irrigation	Flood		
Site preparation, including cofferdam construction, excavation for grid station and tower foundation	Excavation and moving soil and fill Site compounds and set-up Set-up of site utilities	Earthmoving Open excavation Open excavation of remaining rock barrier (outside of the cofferdam and under the cofferdam foundation) Underground excavation Shaft excavation Transport of materials Re-suspension of dust on unsurfaced roads	Medium	Low	Low	Low	7	Minor
Modification of T5	Construction of intake modification and new connection to penstock and manifold	Excavation works Transport and handling of soil/ materials Storage of soil/ materials Preparation of materials (cutting, grinding) Re-suspension of dust on unsurfaced roads. Concrete batching	High	Low	Medium	Medium	>3	Moderate
Powerhouse and switchyard construction Grid station construction	Ground preparation Cofferdam construction Power house construction New access road Construction of new open terminal 3-bay 500kV switchyard Set-up of utilities	Earthworks Excavation works Transport and handling of soil / materials Concrete batching Preparation of materials (cutting, grinding) Re-suspension of dust on unsurfaced roads.	Medium	Low	Low	Low	>3	Minor
Tail race	Construction of a 360m long reinforced concrete culvert Construction of a canal (40m base width x 6710m long) to discharge water from the culvert to Ghazi-Barotha head pond Construction of a concrete dividing wall between canal and Dhal Dara weir	Excavation works Earthworks Transport and handling of soil / materials Concrete batching Storage of soil/ materials	High	Low	Low	Low	>3	Moderate
All	Operation of construction camps	Collection and disposal of wastewater, including sewage effluent	Medium	Low	Low	Low	39	Moderate

Groundwater quality. Limited contamination may occur during piling for foundations, accidental spills or leakage during construction of work camp wastewater (domestic waste). Impacts on groundwater are assessed as negligible.

Receptor sensitivity

For the main Project site within TDP boundaries, the closest and only village/settlement with a public water supply well located within the water quality monitoring area is Kukar Chawa which is approximately 450m from the construction areas. The village is located on a hill located near the left bank. Any impacts on groundwater quality beneath the area of T5 would not be expected flow towards the village. A drinking water well is located within the village and there is a negligible risk to the water supply well from construction.

A number of settlements and cultivation fields exist along the transmission line route and near the grid station site (see **Table 5.31**). Any deterioration of water quality caused by the construction activities may adversely affect these receptors.

Downstream irrigation systems for agriculture are a receptor of the surface water and are dependent on the water quantity (through irrigation releases) and the water quality. The ecological receptors are considered later in the Section.

Population centers downstream are potential receptors of any change in flood risk.

Significance

In accordance with the significance criteria presented in **Section 7.1**, the risk of surface water quality effects during the construction phase is described as ‘moderate adverse’. To reduce this effect, generic good practice mitigations have been presented later in the Section. The risk of groundwater quality effects is negligible, as is the risk of surface water quantity impacts (i.e. irrigation releases and flood management). The impact significance is summarized in **Table 7.10**.

Table 7.10: Impact Evaluation for surface and ground water during construction

Description of works	Impact	Sensitivity	Magnitude	Impact significance	Residual impact?
• Coffer dam • excavation • Earthmoving and spoil handling • Open excavation • Concrete batching for new tower construction • Washing of vehicles and other machinery • Transport of materials • Material storage	Contamination from wastewater and sewage discharges from construction camps	Medium	Moderate	Moderate	No
	Contamination caused by improper storage, handling and use of hazardous materials	Medium	Moderate	Moderate	No
	Contamination of Dal Darra channel, Haro River, and small drainage channels caused by runoff	Medium	Moderate	Moderate	No
• Dust suppression • Temporary construction camp operation	Contamination caused by improper storage, handling and use of hazardous materials	Medium	Moderate	Moderate	No
	Wastewater and sewage discharges from construction camps	Medium	Moderate	Moderate	No

Operation Phase Impacts

Water contamination. The waste streams from residential colonies and workshops at TDP and grid station may potentially cause water contamination. This impact has been assessed as moderate in view of the presence of communities and cultivation fields in the project AoI.

Irrigation Releases. A detailed study was undertaken to understand the impact of irrigation releases due to the increase in intake level. Daily historical dam releases from 1975 to 2014 for the months of May, June and July are presented in the **Figure 7.1, Figure** 7.2**,** and**Figure 7.3**, respectively. In these figures, the outflow data are represented vs. reservoir level and the red curve represents all tunnels capacity (T1 to T5) assuming that PH4 and PH5 are operational.

It can be seen from these figures that:

- For May, all outflows are below the tunnels capacity.
- For June, only 3 daily outflows (circled in green) are above the tunnels capacity curve.
- For July, only 6 daily outflows (circled in green) exceed the tunnels capacity curve.

Thus it can be seen that the occurrence of tunnels capacity exceedance is very small. For these nine days exceeding tunnels capacity (in about 40 years), if PH4 and PH5 were built, we would shut down one of them and use the by-pass to complement the outflow, as irrigation has the priority. Hence it can be concluded that the impact on irrigation due to raised T5 intake level is negligible.

Figure 7.1:Histroical Daily Outflows from T5 in the Month of May

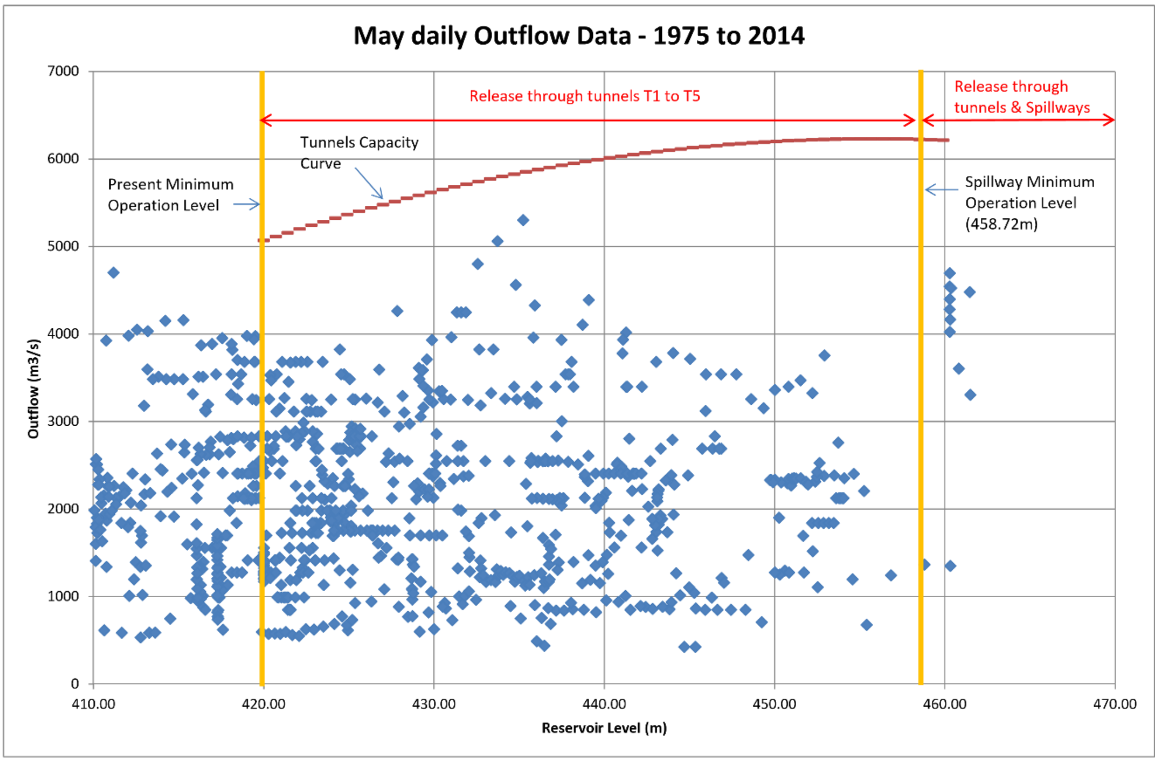


Figure 7.2: Histroical Daily Outflows from T5 in the Month of June

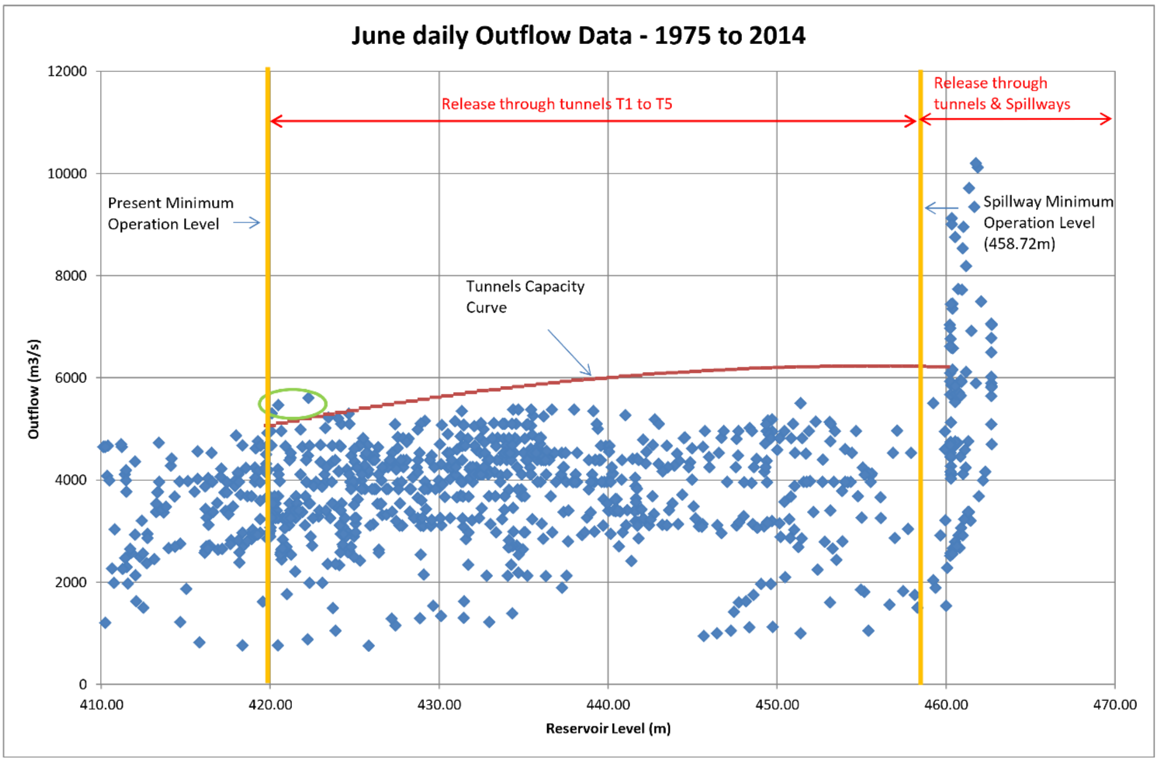
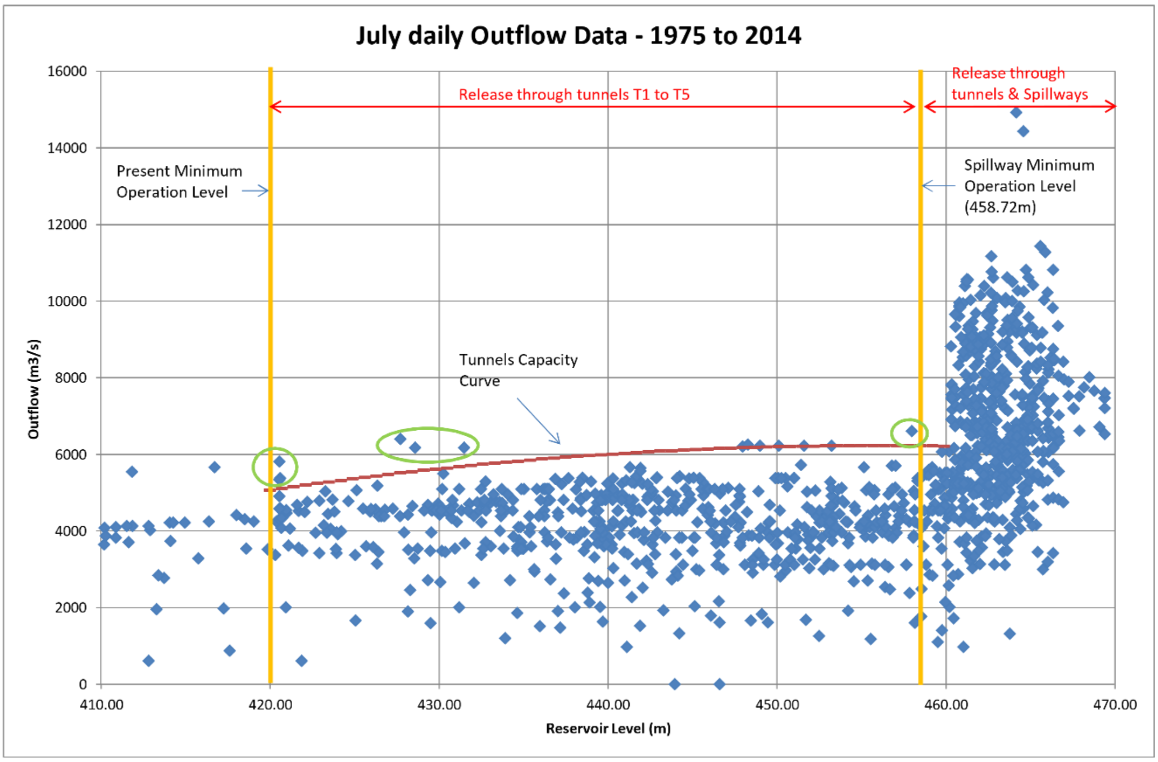


Figure 7.3: Histroical Daily Outflows from T5 in the Month of July



7.3.3 Mitigation and Enhancement Measures

Construction Phase

This section presents mitigation measures to manage potential water resources and water quality impacts during construction activities. The measures presented are based on the potential impacts identified in this Section.

To maintain the irrigation releases and manage flood risk during the construction phase:

- The required irrigation releases and flood management releases (if required) will be provided during the tunnel closure period via the other irrigation tunnels (expected to affect one release season). At other times the irrigation releases will continue with works in channel (primarily on the powerhouse) protected by a coffer dam.

To protect water quality during the construction phase:

- A Sediment and Erosion Control Plan will be developed as part of the ESMP in accordance with GIIP including World Bank Group EHS Guidelines.
- A Water Quality Management Plan will be developed as part of the ESMP in accordance with GIIP including World Bank Group EHS Guidelines.
- Work sites and access roads will be carefully selected so that the risk of surface runoff entering the river is minimised. Measures such as rip rap and slope protection will be adopted where appropriate.
- Sewage will be pre-treated prior to discharge by installation of septic tanks or a pilot activated treatment plant at sewage generating sources. A sewage collection system is also envisaged to avoid the spillage of sewage in open areas
- To mitigate water quality impacts in line with Pakistani and WHO standards, pre-treatment will be required to maintain net BOD levels below the established thresholds for effluent discharges to surface waters
- Oil and water separators and settling ponds will be installed where appropriate to minimise the risk of contaminated construction water entering the river or groundwater and degrading water quality
- Upon completion of the construction phase, disturbed areas will be contoured and re-vegetated to minimize the potential for soil erosion and water quality related impacts
- An Oil and Chemical Spill Response Plan will be required to be developed by the Contractor under the ESMP. This will provide the controls that should be implemented in the event of an accidental spill or leak incident
- Surface water and groundwater quality will be monitored during construction to identify any adverse impacts.

Operation Phase

The operation of the Project will not result in any changes to irrigation releases, flood management or water quality (such as changes in water temperature, dissolved oxygen and sediment concentration). This situation is unusual for a hydropower project and arises because power will only be generated from water that is required for irrigation, i.e. the water will be passed through the turbines rather than the existing irrigation outlets. As discussed earlier, there will be no change to the overall timing or total quantity of releases from the reservoir across the five irrigation / power generation tunnels. No mitigation measures are therefore required during the operation phase.

All waste streams from the operation and maintenance activities as well as from the residential facilities will be treated to minimize impacts on receiving water bodies.

7.3.4 Residual Risks

Significant residual impacts are those that remain moderate or major adverse after application of mitigation measures has been implemented. No significant adverse residual water resources or water quality impacts have been identified.

7.3.5 Proposed Monitoring

Baseline monitoring for the Project has been undertaken as a one-off monitoring at surface water locations in the vicinity of the Project sites and groundwater wells at Kukar Chawa and grid station site. The data has shown no exceedances of the NEQS in the public water supply and, with only one minor exception, the surface water quality data is consistent with Classes C and D of the national surface water criteria set by WWF in 2007 and approved by Pak-EPA.

Construction monitoring for T4HP will continue as described in the T4HP ESMP and this data should be reviewed by the Contractor prior to construction to confirm whether there have been any changes in baseline conditions that need to be taken into account.

In addition, it is recommended that monitoring at the sites sampled for the Project baseline continues throughout construction on a bi-annual basis, together with monitoring of wastewater discharges into the river. If monitoring demonstrates any exceedances of NEQS due to the construction of the Project, site practices and mitigation measures should be reviewed to reduce construction related impacts.

Weekly visual inspections should be undertaken by a suitably qualified/experienced member of the construction team throughout the construction phase to monitor the implementation and effectiveness of prescribed mitigation measures.

The ESMP sets out the responsible parties for ensuring implementation of mitigation measures during construction.

7.3.6 Statement of Significance

This assessment of water resources and water quality effects predicts that the proposed Project will not result in significant effects, assuming that the proposed mitigation measures are implemented.

7.4 Air Quality

This Section considers the potential impacts of construction and operation of power generation components of T5HP on air quality.

7.4.1 Assessment Methodology

Construction activities can result in temporary impacts from dust. ‘Dust’ is a generic term which usually refers to particulate matter in the size range 1-75 microns. The nature of the area and activities to be carried out suggests that emissions of construction dust would mainly be associated with the movement and handling of material and therefore predominantly composed of the larger fractions of this range which do not penetrate far into the respiratory system. The primary air quality issue associated with dust emissions from the construction phases is therefore loss of amenity and/or nuisance caused by, for example, soiling of buildings, vegetation and laundry and reduced visibility.

Nevertheless, methods proposed to reduce dust emissions will, by definition, reduce emissions of finer particulates too.

Dust deposition can be expressed in terms of mass per unit area per unit time, e.g. $mg/m^2/month$. No relevant Pakistan standards exist for dust deposition. A range of criteria from 133 to $350mg/m^2/month$ is found around the world as representative of thresholds for significant nuisance.

It is considered that a quantitative approach is inappropriate and unnecessary for assessing particulate emissions associated with the construction of the Project due to the nature of fugitive dust emissions. The potential for construction activities to raise dust, and the likely consequences of dust emissions have instead been assessed qualitatively.

Determining the significance of impacts identified is one of the main purposes of an environmentalassessment and enables the identification of necessary mitigation measures. An environmental impact can be either beneficial or adverse and is assessed by comparing the quality of the existing environment with the predicted quality of the environment once a project is in place.Impacts identified with the potential to change the air quality of the project study area have been assigned significance using the overarching framework presented in**Section 7.1**; this defines significance according to the magnitude of impact and sensitivity of receptor.Specific magnitude and sensitivity criteria used in the assessment of construction phase air quality impacts are presented below.

The first stage of the assessment identifies the construction activities which have the potential to cause dust emissions and the degree of that potential. Typical construction activities which result in dust pollution are presented in **Table 7.11** along with their dust raising potential.

Table 7.11: Relevant generic dust generating activities

Potential Dust Emitting Activities	Description	Dust Raising Potential
Soil handling	Potential to be high, depends on time of year and soil dryness	High
Loading Activities	Potential to be high, depends on time of year and soil dryness	High
Storage of materials onsite	Potential to be high, depends on time of year soil dryness	Medium
Transport of materials within site	Can be high depends on type of transport and nature of road surface	Medium
Drilling and digging activities (Including soil excavation)	Can be high depending on type of drilling and digging activities	High
Transport of material offsite	Generally low as transport occurs by surfaced roads	Low
Construction of powerhouse, switchyard, towers and grid station	Generally low although some activities with high dust raising such as material cutting can occur	Medium
Assembly of plant	Generally low as involves assembling already made pieces	Low

Table 7.12 uses the dust raising potential and duration of construction works to determine the magnitude of impacts from construction activities.

Table 7.12: Criteria for determining magnitude – construction phase

Dust raising potential	Duration	Impact magnitude
High	> 3 months	Major
High	< 3 months	Moderate
Medium	> 3 months	Moderate
Medium	< 3 months	Minor
Low	Any	Negligible

In the second stage of the assessment, all sensitive receptors with the potential to be significantly affected by construction dust emissions have been identified. The distances from source at which construction dust effects are felt are dependent on the extent and nature of mitigation measures, prevailing wind conditions, rainfall and the presence of natural screening by, for example, vegetation or existing physical screening such as boundary walls on a site. Research indicates that effects from construction activities that generate dust are generally limited to within 150-200m of the activity[30]. To ensure a conservative assessment, receptors located within 500m have been considered[31] and classified according to the sensitivity criteria in **Table 7.13**and**Table 7.14**. The air quality study area is thus defined as the area within 500m of construction activities.

Table 7.13: Receptor classification

Distance from source	Receptor classification			
	High	Medium	Low	Negligible
Within 500 metres of construction activity	Healthcare clinics	Residential receptors	-	Vegetation

Table 7.14: Identification of receptor sensitivity

Receptor classification	Distance from source			
	0–50m	50–100m	100–200m	200–500m
High	High	High	Medium	Low
Medium	Medium	Medium	Low	Low
Low	Medium	Low	Low	Low
Negligible	Negligible	Negligible	Negligible	Negligible

7.4.2 PotentialImpacts during Construction Phase

The construction phase is expected to last for approximately 39 months and will consist of major construction works. As noted earlier, construction phase activities could

[30]United Kingdom Highways Agency, Design Manual for Roads and Bridge (DMRB), May 2007.
[31]Institute of Air Quality Management (IAQM), Guidance on the assessment of dust from demolition and construction, February 2014.

increase dust emissions in the area; combustion-related pollutants may also be emitted from construction vehicles and on-site plant. The major sources of air pollution during construction phase are:

- Pollution due to fuel combustion from various construction equipment
- Fugitive emissions from crushers
- Impacts due to vehicular movement
- Generation of dust due to clearing of land and construction activity.

CombinedImpacts of T4 and T5 Construction

Impacts from construction dust generated from different construction sites will be limited to 500m from the site boundary. The separate T4HP is located on the opposite (west) bank of the Tarbela reservoir (over 500m from the Project) and is under construction. It is anticipated that construction of the Project will commence prior to completion of T4HP and therefore the two project's construction phases will run concurrently for some time. Although the T4HP and Project tunnels are located more than 500m from each other (meaning cumulative impacts associated with site-specific activities are unlikely), there is some potential for adverse cumulative impacts to occur through the use of shared access roads and associated facilities such as concrete batching and crushing plants. These impacts are not considered to be significant assuming appropriate mitigation measures (as described in **Section 7.4.4**) are implemented.

During construction of grid station and overhead transmission line, site preparation activities (excavation work, earth works, storage of exposed piles, truck dumping, hauling and vehicle movement) would be carried out which will remove the vegetation cover from the proposed development areas and expose the soil causing dust generation. Exhaust from construction machinery and vehicles will also deteriorate air quality in the immediate vicinity of the construction sites.

Construction activities of TL and Grid Station

During construction of grid station and overhead transmission line, site preparation activities (excavation work, earth works, storage of exposed piles, truck dumping, hauling and vehicle movement) would be carried out which will remove the vegetation cover from the proposed development areas and expose the soil. As the said activities would be limited to construction phase and will be performed according to ESMP included in this report, therefore there would be insignificant rise in fugitive dust emission and alteration of soil quality from removal of top soil.

The quantity of dust that may generate on a particular day of construction phase will depend on the magnitude and nature of activity and the atmospheric conditions prevailing on that day. Due to the uncertainty in values of these parameters, it is not possible to calculate the quantity from a 'bottom-up' approach, that is, from adding PM10 emissions from every activity on each construction site separately.

The assessment of air quality impacts is presented in the **Table 7.15**. No significant impacts have been identified. Generic best practice measures for ensuring air quality impacts do not arise from the power evacuation facilities are provided in this section and are included in the ESMP.

Table 7.15: Construction activities and associated impact magnitude

Stage	Description of works	Key activities	Dust raising potential	Duration	Impact magnitude
Site preparation	Excavation and moving soil and fill Site compounds and set-up Set-up of site utilities	Earthmoving Open excavation Open excavation of remaining rock barrier (outside of the cofferdam and under the cofferdam foundation) Underground excavation Shaft excavation Transport of materials Re-suspension of dust on unsurfaced roads	High	7 months	Major
Modification of T5	Construction of intake modification and new connection to penstock and manifold	Excavation works Transport and handling of soil/ materials Storage of soil/ materials Preparation of materials (cutting, grinding) Re-suspension of dust on unsurfaced roads. Concrete batching	High	>3 months	Major
Powerhouse and switchyard construction Grid station construction Construction of tower foundations	Ground preparation Cofferdam construction Power house construction New access road Construction of new open terminal 3-bay 500kV switchyard Set-up of utilities Grid station construction Tower foundation	Earthworks Excavation works Transport and handling of soil / materials Concrete batching Preparation of materials (cutting, grinding) Re-suspension of dust on unsurfaced roads.	High	>3 months	Major
Tail race	Construction of a 360m long reinforced concrete culvert Construction of a canal (40m base width x 6710m long) to discharge water from the culvert to Ghazi-Barotha head pond Construction of a concrete dividing wall between canal and Dhal Dara weir	Excavation works Earthworks Transport and handling of soil / materials Concrete batching Storage of soil/ materials	High	>3 months	Major

The activities associated with the construction phase of the Project are conservatively assumed to have ‘high’ dust raising potential throughout the whole construction period based on the nature of activities involved. Taking the dust raising potential and the duration of the works into account, the magnitude of dust effects is considered to be “major” in accordance with the magnitude criteria defined in **Table 7.12**.

Receptor sensitivity

As described in previous sections, consideration has been given to all potential receptors within the study area of the construction site boundary of the Project. The receptors identified and their classification (in accordance with the criteria defined in **Table 7.13** and **Table 7.14**) are presented above.

For the main Project site inside TDP boundaries, the closest and only village/settlement located within the air quality study area is Kukar Chawa which is approximately 450m from the construction areas at its closest point (the proposed switchyard site) and hence is classified as 'low' sensitivity. The labor camp is also conservatively considered to be a residential receptor; it is currently proposed to be located approximately 500m from the closest area of construction activity (a spoil area) and is therefore also classed as a 'low' sensitivity receptor. However, some of the communities along the transmission line route and near the gird station site may have low to medium sensitivity.

Significance

In accordance with the significance criteria presented in Section 7.1, the risk of dust effects during the construction phase is described as 'moderate adverse' as summarized in **Table 7.16**below. To reduce this effect generic good practice dust mitigations have been presented later in the Section.

Table 7.16: Assessment of air quality impacts (Construction phase)

Description of works	Impact	Duration	Sensitivity	Magnitude	Impact Significance	Residual Impact
Earth moving Open excavation Transport of materials Re-suspension of dust on unpaved roads	Dust generation	<3 months	Medium	Major	Moderate	No
Concrete batching for new tower construction	Plant emissions	<3 months	Medium	Major	Moderate	No
Assembly of already-made transmission line components	Vehicle emissions	<3 months	Medium	Major	Moderate	No
Storage of soil/materials	Vehicle emissions	<3 months	Medium	Minor	Moderate	No

7.4.3 Potential Impacts during Operation Phase

The project will not generate any additional air emissions during operation as vehicular access to the site for operations and maintenance purposes will be similar to those recorded during pre-Project activity.

7.4.4 Mitigation and Enhancement Measures

Constructionphase

This section presents mitigation measures to manage potential air quality impacts during construction activities. The measures presented are based on the potential impacts identified in this Section and in line with the World Bank Group EHS guidelines.

A number of lessons have been taken from the issues with dust experienced at the T4HP project site. In particular, dust emissions from on-site crushers, batching plant and vehicles appear to be the key problems. Preventative measures such as best practice site management, effective site planning/layout and imposing vehicle speed limits should be implemented to minimize dust emissions at source. A range of remedial or suppressive methods can then also be applied to control dust once released. Water suppression has been found to cause problems with mud on-site and therefore the use of non-toxic chemical dust suppressants, such as calcium magnesium acetate (CMA) could be explored instead.

The World Bank Group General EHS Guidelines and EHS Guidelines for Construction Materials Extraction provide general air emission abatement techniques to consider during construction and decommissioning of a project. Relevant measures from the Guidelines to be included within the ESMP are:

- Controlling dust emissions from drilling activities at the source by dust extractors, collectors, and filters, and adopting wet drilling and processing whenever possible
- Controlling dust emissions from processing equipment (e.g. crushers, grinders, screens, conveyors and bins) through dust collectors, wet processing, or water spraying. Dust control applications should consider the final use of extracted material, for example, e.g. wet-processing stages are preferred when wet materials or high water contents would not negatively affect their final use
- Implementing dust suppression techniques to minimize dust from vehicle movements and stockpiles. Techniques may include water spraying and surface treatment (e.g. hygroscopic media, such as calcium chloride, and soil natural–chemical binding agents) of roadways and exposed stockpiles using a sprinkler system or a ”water-mist cannon”
- Managing emissions from mobile sources (on-site vehicles) by requiring contractors to use modern, well-maintained vehicles that comply with applicable emission limits
- Avoiding open burning
- Planning land clearing, removal of topsoil and excess materials, location of haul roads, tips and stockpiles, and blasting with due consideration to meteorological factors (e.g. precipitation, temperature, wind direction, and speed) and location of sensitive receptors
- Designing, installing and applying a simple, linear layout for materials-handling operations to reduce the need for multiple transfer points, preferably locating processing plants within the extraction area
- Preferring use of mobile and fixed-belt transport and conveyors to hauling the material by trucks through internal roads (enclosed rubber-belt conveyors for dusty materials are recommended in conjunction with cleaning devices)
- Compacting and periodically grading and maintaining internal roads
- Vegetating exposed surfaces of stockpiled materials

At discrete locations blasting may be carried out. The EHS Guidelines for Construction Materials Extraction provides the following specific guidance with respect to blasting, which will be incorporated within the ESMP:

- Alternatives to blasting, such as hydraulic hammers or other mechanical methods
- If blasting is necessary, planning of the blasting (arrangement, diameter, and depth and direction of blast holes) will be implemented
- Correct burning of explosive, typically composed of a mixture of ammonium nitrate and fuel oil, will be ensured by minimising the presence of excess water and avoiding incorrect or incomplete mixing of explosive ingredients.

With regards to generators used on site, consideration should be given to the location and height of exhaust pipes to ensure proper dispersion of pollutants. Generators used should be of a modern design and well-maintained to minimize air pollutant emissions.

Managing the blending, packing, loading, unloading and use of bulk cement will be essential at the concrete batching plants. The following best available techniques will be incorporated to help manage and control dust emissions from these activities:

- Containment of dusty processes: containment and arrestment is the preferred option for control of emissions to air from processes handling cement
- Suppression of dust using water or proprietary suppressants. Where water is used for dust suppression, processes require an adequate supply of water. To demonstrate an adequate water supply on tanks that are not fed from the mains, a low level alarm will be fitted. It is noted that water-based suppression has caused issues with mud production on the T4HP site and therefore alternative chemical-based suppression options could be pursued in certain locations.
- Protection of external sources, such as stockpiles and external conveyors, from wind whipping is necessary. There are various methods that may be used to this end. Crushed rock, sand or coarse aggregate, can be delivered, stored and handled so as to minimise dust emissions, for example by dampening or covering

A list of mitigation measures set out in the World Bank Group General EHS Guidelines for dust are included within the ESMP. These include:

- Implementing dust suppression techniques, such as applying water or non-toxic chemicals to minimise dust from vehicle movements
- Using personal protective equipment (PPE), such as dust masks, where dust levels are excessive
- Equipping excavators, dumpers, dozers, wagon-drills, and other automated equipment with air conditioned, dustproof, and soundproof cabs.

After the implementation of the mitigation and enhancement set out in this Section the adverse predicted construction impacts are assessed as of minor significance.

7.4.5 ResidualImpacts

Significant residual impacts are those that remain moderate or major adverse after application of mitigation measures has been implemented. No significant adverse residual air quality impacts have been identified.

7.4.6 ProposedMonitoring

Baseline monitoring for the Project has been undertaken as a one-off survey at the Project site (labor camp and powerhouse locations) and at a view point (the closest accessible site to Kukar Chawa village). The data has shown an exceedance of the $PM_{2.5}$ NEQS at the view point site which may indicate potential exceedances at Kukar Chawa village where residential receptors are present. The $PM_{2.5}$ and PM_{10} levels at these sites should be corroborated through a monitoring survey immediately prior to construction as part of the construction monitoring program.

Construction monitoring for the T4HP project will continue as described in the T4HPESMP and this data should also be consulted to inform the Project.

In addition, it is recommended that monitoring at the three sites selected to inform the Project baseline (labor camp, powerhouse and Kukar Chawa village) continues throughout construction on a bi-annual basis. If monitoring demonstrates continued exceedances of NEQS due to the construction of the Project, site practices and mitigation measures should be reviewed to reduce construction related impacts.

Weekly visual inspections should be undertaken by a suitably qualified/experienced member of the construction team throughout the construction phase to monitor the implementation and effectiveness of prescribed mitigation measures.

The Environmental Manager of the contractor will be responsible for ensuring the measures included in this report and the ESMP are implemented during the construction of the Project.

7.4.7 Statement of Significance

This assessment of air quality effects predicts that the proposed Project will not result in significant effects, assuming that the proposed mitigation measures are implemented.

7.5 Noise and Vibration

This section considers the potential noise and vibration impacts associated with the power generation component of the T5HP. The assessment takes into account key sources of noise during construction and operation and sensitive noise receptors in the Project AoI. The key activities generating noise and vibration during the project construction and operation phases include:

- Excavation and blasting
- Operation of construction machinery, power generators for camps and construction sites, movement of vehicles.
- Operation of power plant.
- Operation (tripping) of circuit breakers at the grid station.

7.5.1 Impact Assessment Criteria

Noise and vibration impacts associated with the Project which can potentially result in effects to sensitive receptors have been assigned significance using the impact evaluation matrix presented in **Section 7.1**. Under the impact evaluation, impacts of moderate and major magnitude are considered significant effects.

The criteria for determining noise receptor sensitivity are provided in **Table 7.17**

Table 7.17: Criteria for determining receptor sensitivity

Category	Description/Examples
High	Residential, educational, institutional and healthcare and place of worship
Medium	Public assembly and entertainment
Low	Commercial and light industrial
Negligible	Heavy industrial

The criteria for determining the magnitude of impact for noise from construction are given in **Table 7.18**.

Table 7.18: Criteria for determining magnitude of impact – construction noise

Receptor sensitivity	Noise from Construction Alone LAeq,1h dB		Magnitude of Impact			
	Threshold		**Negligible**	**Minor**	**Moderate**	**Major**
	Daytime	Night-time				
High	65	55	Threshold not exceeded	Threshold exceeded by less than 3dB for any duration	Threshold exceeded by 3dB or more for less than one month	Threshold exceeded by 3dB or more for one month or more

With reference to the categories of receptors considered in the General EHS Guidelines and Pakistan noise standards, criteria for defining the magnitude of impact due to operational noise are given in**Table 7.19**.

Table 7.19: Criteria for determining magnitude of impact – operational noise

Receptor sensitivity	Operational noise LAeq,1h dB		Magnitude of Impact			
	Threshold		**Negligible**	**Minor**	**Moderate**	**Major**
	Daytime	Night-time	Ambient level increased by any amount	Ambient level increased by less than 3dB	Ambient level increased by 3dB or more	
High	55	45	Threshold not exceeded	Threshold exceeded by less than 3 dB		Threshold exceeded by 3 dB or more

7.5.2 Data Limitations and Assumptions

The main limitations of the assessment are identified as follows:

- Details on the construction programme, working methods and the inventory of plant to be used (type and quantity in each stage of work) are indicative at this stage. An inventory and reference noise emission values have been assumed and stated in order to provide a preliminary assessment of the potential impacts. This is mainly based on the T4HP project experience
- The hours of working during construction phase are not certain at this stage. For the purpose of this noise assessment we have considered a worst case scenario of night time construction works.
- Noise emissions of operational plant are not available at this stage.
- It is not possible to accurately predict noise from blasting. However, criteria for blasting overpressure and ground vibration can be referenced from guidance and standards applied for similar projects and recommended as a basis for monitoring criteria during the works.
- Details of road traffic associated with the project during the construction and operational phases are limited to a high level review of options at this stage.

7.5.3 Potential Impacts during Construction Phase

The construction phase is expected to be approximately three years (39 months) in duration.Construction activities (particularly for the power generation facilities) will take place 24 hours a day, seven days a week and are likely to consist of three shifts of eight.The critical path items for the Project are construction of the penstock, power house, tailrace and switchyard. A number of related facilities are also required to be developed to support the development of the main project components. These include upgrades to existing access roads and creation of new access roads, development of a temporary storage and works site and worker's accommodation area, construction of spoil disposal locations and batching plants on site. Full details are provided in **Chapter 3**.

Noise impacts during construction – general activities

The construction of the Project has the potential to generate significant noise from inherently noisy activities such as rock blasting, piling and breaking out of hard ground, together with the on-site operation of both fixed and mobile construction plant and equipment. Off-site movement of construction related traffic also has the potential for significant noise generation. These potential sources of construction noise are assessed separately below.

The precise type of equipment, quantity and utilization of the plant and the techniques employed at the Project site are uncertain at this stage. To inform the noise assessment an inventory of plant and reference noise levels for general works has been derived from the T4HP project. This has been used to define the spatial extent of noise impacts that may exceed the most stringent daytime noise criterion of 55 dB(A).

On-site Construction Activities

The main stages of work and activities that are expected to involve noise emitting work are summarized in **Chapter 3**. The noise emitted during each stage of work is dependent on the type, quantity and utilization of plant used. Noise from construction is inherently variable in nature and influenced by many factors. The noise levels for each stage of work as presented in **Table 7.20**. The noise associated with each stage of work (Activity L_{Aeq}) is the combined noise level from the group of plant items expected to be used. Activity L_{Aeq} is used to predict the noise impacts over the construction phase to identify construction stages where there is a risk of significant adverse noise effects.

Table 7.20: Main stages of the construction programme and reference noise levels

	Description of works	**Key activities**	**Activity LAeq,10m dB**
Site preparation	Excavation and moving soil and fill	Earthmoving	90
	Site compounds and set-up	Open excavation	90
	Set-up of site utilities	Open excavation of remaining rock barrier(outside of the cofferdam and under the cofferdam foundation)	90
		Shaft excavation	90
		Transport of materials	70
Modification of T5	Construction of intake modification and new connection to penstock and manifold	Excavation works	90
		Transport and handling of soil/ materials	70
		Storage of soil/ materials	88
		Preparation of materials (cutting, grinding)	86
		Concrete batching	95
Powerhouse and switchyard	Ground preparation	Earthworks	90
	Cofferdam construction	Excavation works	90

construction Grid station construction Tower foundation construction	Power house /grid station/tower foundation construction	Transport and handling of soil / materials	70
	New access road	Concrete batching	95
	Construction of new open terminal 3-bay 500kV switchyard	Preparation of materials (cutting, grinding)	86
Tail race	Construction of a 360m long reinforced concrete culvert	Excavation works	90
	Construction of a canal (40m base width x 6710m long) to discharge water from the culvert to Ghazi-Barotha head pond	Earthworks	90
	Construction of a concrete dividing wall between canal and Dhal Dara weir	Transport and handling of soil / materials	70
		Concrete batching	95
		Storage of soil/ materials	88

Predicted noise levels ata distance of 400 m to 800 m are presented **Table 7.21.**

With reference to the criteria for construction noise impacts given in **Table 7.18**, the assessment indicates that the magnitude of noise impacts due to construction activities carried out during the daytime is assessed as negligible at all receptors and during all stages of work as the daytime threshold of 65 dB(A) is not exceeded. If works are undertaken during the night-time, significant adverse impacts occur only where the noise impacts exceed 58 dB(A). This is only expected to occur where earthmoving works are carried out in close proximity to the labor camp under both the options considered.be too low and variable to make a meaningful quantitative assessment of the potential noise impacts. However, it is conceivable that the community response to noise from construction traffic could be adversely affected by noise from a small number of vehicles movements or even a single movement occurring in close proximity to sensitive receptors especially if it occurs at a sensitive time of day. It is concluded that whilst no significant adverse effects are expected due to construction traffic, basic measures to control noise from construction traffic and prevent disturbance of the community should be adopted as incorporated mitigation. These are given later in the Section.

Table 7.21: Summary of assessment of noise impacts during construction

Stage of work	Description of works	Key activities	Reference LAeq,10m dB	Predicted noise at 400 m, dB	Predicted noise at 800 m, dB
Site preparation	Excavation and moving soil and fill	Earthmoving	90	59	47
	Set-up of site utilities	Open excavation of remaining rock barrier(outside of the cofferdam and under the cofferdam foundation)	90	49	37
		Shaft excavation	90	50	49
		Transport of materials	70	31	28

Stage of work	Description of works	Key activities	Reference LAeq,10m dB	Predicted noise at 400 m, dB	Predicted noise at 800 m, dB
		Re-suspension of dust on unsurfaced roads	78	39	36
Modification of T5	Construction of intake modification and new connection to penstock and manifold	Excavation works	90	49	50
		Transport and handling of soil/ materials	70	29	30
		Storage of soil/ materials	88	47	48
		Preparation of materials (cutting, grinding)	86	45	46
		Re-suspension of dust on unsurfaced roads.	78	37	38
		Concrete batching	95	56	42
Power house, switchyard and grid station construction, tower foundation construction	Ground preparation	Earthworks	90	51	51
	Cofferdam construction	Excavation works	90	50	51
	Power house construction	Transport and handling of soil / materials	70	30	30
	New access road	Concrete batching	95	56	42
	Construction of new open terminal 3-bay 500kV switchyard	Preparation of materials (cutting, grinding)	86	45	43
	Set-up of utilities	Re-suspension of dust on unsurfaced roads.	78	38	38
Tail race	Construction of a 360m long reinforced concrete culvert	Excavation works	90	51	48
	Construction of a canal (40m base width x 6710m long) to discharge water from the culvert to Ghazi-Barotha head pond	Earthworks	90	51	48
	Construction of a concrete dividing wall between canal and Dhal Dara weir	Transport and handling of soil / materials	70	31	28
		Concrete batching	95	56	42
		Storage of soil/ materials	88	43	47

Blasting

Blasting may cause air overpressure which is an impulsive noise event with energy within and below the audible range (concussive component). The latter propagates more readily than the audible component and can result in impulsive vibration. The audible and inaudible impacts cannot be assessed quantitatively. However, given that they may cause concern in individuals, mitigation measures are required. A secondary issue is blast hole drilling which also generates noise. The noise effects from blasting are assessed as insignificant with a low risk of noise nuisance effects provided the measures to mitigate noise given are implemented.

Vibration can also cause a concern for individuals. Blasting is a significant source of vibration, and the effects can include rattling of windows or shaking of items on shelves.

In extreme cases vibration can cause damage to buildings. It is generally recognized that it is not realistic to undertake a detailed prediction and assessment of construction vibration as it is a complex subject comprising many factors and impacts cannot be assessed quantitatively. Given the distances to nearest residential receptors and that vibration from blasting will be taken into account as part of the construction risk assessment, significant impacts are not expected. This conclusion will be checked through the monitoring of community complaints. The criteria in Section 7.5.1 above shall be used as thresholds in the assessment of monitoring data collected as required for the management of complaints relating to vibration during blasting. Vibration during blasting will also be measured in terms of peak particle velocity (PPV) in millimeters/second, and using velocity transducers to confirm that vibration levels remain with predicted and safe limits. These measures are given later in the Section.

7.5.4 Potential Impacts during Operational Phase

Noise impacts during the operational phase of the Project are likely to be associated with noise generated on site from both fixed and mobile plant. Noise emission levels for these items are not available and therefore it is not possible to make a quantitative assessment of the potential impacts.

Operational noise impacts are expected to be limited to the turbines operating within the powerhouse and the equipment within the switchyard. The turbines will be enclosed or below ground level, which will limit the spread of noise. Kukar Chawa village and the labor camps also benefit from natural noise shielding; Kukar Chawa is separated from the powerhouse by the cliffs on the south bank of the Dhal Dara channel and the labor camps by the headland to the west of the service spillway. The noise from turbines and switchyard will generally be continuous and may be tonal in nature. It is considered unlikely that operational noise from the powerhouse and switchyard at the nearest community receptors will exceed the noise threshold of 45dB(A) in the NEQS and World Bank General EHS Guidelines. The noise effects due to the operation of the powerhouse and switchyard are therefore assessed qualitatively as insignificant.

Operational noise associated with the Power Evacuation Facilities could arise from vehicle movements and transmission line ‘humming’ from corona activity. Tripping of circuit breakers at the grid station can also cause noise however such events are not very frequent. The need for vehicle movements associated with operation and maintenance activities will be rare and associated impacts negligible.

Audible noise from corona activity can barely be heard in fair weather conditions on higher voltage lines. During wet weather conditions, water drops collect on the conductor and increase corona activity so that a crackling or humming sound may be heard near the line. This noise is caused by small electrical discharges from the water drops. Background noise is higher during periods of rainfall which acts to minimize effects.

7.5.5 Mitigation and Enhancement Measures

The assessment has indicated that no significant adverse effects are expected to arise due to noise during construction except if earthmoving works are undertaken at night in close proximity to the labor camp. It is recommended that the works are managed to avoid this.

Whilst the flows of construction-related traffic are low, it is recommended that basic measures for the control of noise from construction traffic are adopted including:

- Avoid unnecessary revving of engines, reducing speed of vehicles movements to avoid body slap from empty vehicles

- Timing of deliveries to avoid sensitive times of the day

Generalguidance on the mitigation of noise during construction is given in World Bank Group General EHS Guidelines to minimize the adverse effects due to construction. The assessment of construction phase noise impacts has identified that the phases of activity with the potential to generate the greatest noise impacts are the earthmoving works and concrete batching works. Specific mitigation measures that are relevant for this type of activity include:

- Unnecessary revving of engines will be avoided and equipment will be switched off when not in use
- Internal haul routes will be kept well maintained
- Use of effective exhaust silence systems or acoustic engine covers as appropriate
- Plant will always be used in accordance with manufacturers' instructions. Care will be taken to site equipment away from noise-sensitive areas. Where possible, loading and unloading will also be carried out away from such areas
- Regular and effective maintenance by trained personnel will be undertaken to keep plant and equipment working to manufacturers specifications
- Procedures for handling noise and vibration complaints
- Advance notification of at least 24hrs to all sensitive receptors during critical phases of construction and during blasting events
- Blasting will be avoided where possible, although it is recognised a number of key activities will require blasting to take place. Where unavoidable, blasting shall be in accordance with control techniques according to the Blasting Act in Pakistan. Contractor will prepare a Blast Management Plan.
- Vibration during blasting should be measured in terms of PPV in millimetres/second and using velocity transducers. Measurements should be made on hard ground as close as possible to affected receptors. The peak value should be recorded during each blasting event for comparison with the criteria given above. Where levels indicate potential risks of the onset of building / infrastructure damage then measures to reduce vibration should be implemented.
- Prior to the commencement of construction operations, a detailed pre-construction building condition survey of buildings identified at risk shall be conducted; buildings surveyed are also to include buildings up to 200m from the blast site within the AoI for precautionary reasons, even if they are out of the zone of possible impact.

7.5.6 Residual Impacts

No residual impacts are anticipated provided that the mitigation described above is implemented.

7.5.7 Proposed Monitoring

Pre-construction noise monitoring should be undertaken at the key receptor locations i.e. the village of Kukar Chawa, grid station site, key location along transmission line route, and the labor camps, then:

- At monthly intervals throughout construction, but not at pre-arranged times
- As and when required, during critical phases of construction, i.e. when possible exceedance of the project noise criteria is anticipated

- In response to reasonable noise complaints being received
- At locations representative of sensitive receptors in the vicinity
- Monitoring of noise and vibration effects of blasting activities shall be set out in the Contractors blast management plan and will include measurement of PPV.

7.5.8 Statement of Significance

No significant adverse effects due to noise vibration are anticipated provided that the mitigation described above is implemented.

7.6 Traffic and Transport

The traffic and transport assessment focuses on impacts associated with the construction and operation phases of the Project. It considers the receptors external to the project site which could potentially be sensitive to the traffic and transport associated with the construction and operation phase of the Project.

The assessment presented in this section focuses on several aspects including:

- Roads networks external to the site which could experience wear and tear
- Delays and congestion to other road users as a result of abnormal loads transport of materials or from exceedance of road network capacity
- Road safety implications for other road users (i.e. as a result of increased volume of traffic).

During the construction phase there will be a number of transport activities, including transport of abnormal loads, however, during the operation phase of the Project, transportation activities would be limited to routine maintenance, disposal of wastes and movement of operation personnel. Predicted traffic and transport activities are provided in **Table 7.22**.

Table 7.22: Predicted traffic and transport activities

Phase	Activity
Construction	• Import of abnormal loads • Disposal of solid waste • Delivery of materials and equipment • Movement of construction workforce between workers accommodation and construction site
Operation	• Maintenance activities • Disposal of solid waste • Movements of operations staff

7.6.1 Assessment Methodology

The assessment has been undertaken using primary data collected during a site visit in June 2015 and by secondary data identified through a desktop study. The methodology for the assessment can be summarized as follows:

- Establishment of baseline – an examination of existing traffic and transport routes which lead to the proposed Project area, using knowledge and data gained by the Mott MacDonald project team during a site visit in June 2015 and previous data collected for the T4 Hydropower Project.

- Assessment of impacts based on predicted volumes of vehicle movements generated during the construction and the operation phases. Possible effects arising as a result of the additional traffic have been identified and their significance assessed. Significance criteria have been adopted for the prediction of impacts.

- Development of mitigation measures to avoid or reduce any significant impacts and to identify good practice measures to minimise the overall impact from traffic and transport associated with the Project.

7.6.2 Construction Phase Impact Assessment Criteria

As outlined in Chapter 6, the criteria for determining significance of an impactare a function of magnitude of the impact and sensitivity of the receptor. This section provides details on the significance criteria for impacts associated with traffic and transport.

Magnitude

The criteria for determining magnitude of the impact are shown in **Table 7.23**.

Table 7.23: Criteria for determining magnitude

Categorisation	Description (adverse impacts)
Major	Increase in traffic volume of 60 % or greater Large scale damage to existing road network that renders sections of the road network unusable Death or injury to another road user or a near miss
Moderate	Increased traffic volume between 41 and 60 % Damage to the existing road network of a scale that cause lengthy disruptions to other users Road safety incident that results in damage to property (e.g. vehicle) of another road user (or a near miss) that occurs at a frequency of more than 3 times per year
Minor	Increased traffic volume between 21 and 40 % Small scale damage to the existing road network that could include pot holes or noticeable wear and tear Road safety incident that results in damage to property (e.g. vehicle) of another road user (or a near miss) on at a frequency of less than 3 times per year
Negligible	Increased traffic volume of less than 20 % Imperceptible level wear and tear to the existing road network Imperceptible change in road safety conditions

Sensitivity Criteria

The assessment has identified sensitive receptors that could be impacted by the traffic and transport impacts of the Project. Sensitive receptors are as follows:

- Other roads users of the road network (commercial and private users including pedestrians)
- The residents in communities along transport routes, particularly those close to the project site

The sensitivity criteria have been defined in **Table 7.24** and are consistent with the generic criteria outlined **Section7.1**.

Table 7.24: Criteria for determining sensitivity

Category	Description (adverse impacts)
High	Vulnerable receptor with little or no capacity to absorb proposed changes or minimal opportunities for mitigation
Medium	Vulnerable receptor with little capacity to absorb proposed changes or limited opportunities for mitigation
Low	Receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation
Negligible	Receptor with good capacity to absorb proposed changes or and good

	opportunities for mitigation

The criteria for determining the sensitivity of receptors in relation to traffic and transport impacts have been applied to the aforementioned receptors.

7.6.3 Project-related Traffic during Construction Phase

During the construction phase a variety of materials will be transported to the project site, which will result in an increase in vehicle movements. These materials will include steel, concrete, building materials, pipes, large plant and construction equipment.

The current estimate for volume of construction materials including concrete and building materials is approximately 545,815 m^3. The volume of steel and other metals required for construction is estimated to be 156,729 metric tons.

Concrete, building materials, steel and other metals will be sourced from within Pakistan. However, any materials required for the power house will be sourced internationally. The precise locations from which abnormal loads and construction materials will be transported are yet to be determined.

During the construction phase it is expected that there will be between six and 14 heavy vehicle movements per day, depending on the construction activity that is being undertaken at the time. These figures are based on the movements of heavy vehicles during peak periods of T4 construction according to information provided by the T4HP contractor.

The project will employ between 1,000 and 2,500 construction personnel depending on the stage of construction. Peak construction is scheduled to occur during 2017 and it is expected that there will be between 2,000 and 2,500 construction personnel during this peak time.

It is expected that construction personnel will be sourced from nearby villages, as is the practice for T4HP, and around 500 construction personnel will be housed locally at a workers accommodation camp located within the Project site (refer to **Chapter 3**).

Buses will also transport construction personnel from nearby villages to the construction sites from existing meetings points in the townships of Ghazi, Topi and Swabi. These existing meeting points were established for T4HP. Information provided by the T4HP Contractor has been used to estimate the required bus movements to transport construction personnel from meeting points to the construction site. This estimation is provided in **Table 7.25.**

Construction personnel that reside at construction camps will either walk the 1.5km to the construction site or will be transported by buses. These bus movements are not expected to increase vehicle movements on public roads as the transport will be within the Project site only.

Construction of transmission line will require 2-3 heavy vehicle movements per day. Construction of grid station will also require similar level of vehicle movement.

Table 7.25:Estimated number of buses to transport construction personnel to the Project site

	Number of buses	**Seating capacity**
	Shift 1 (0700 – 1800 hours)	
	6	52
	2	58

	2	28
Total	**10**	**484**
	Shift 2 (1900 – 0600 hours)	
	4	52
	2	58
	2	28
Total	**8**	380

Source: Sino-hydro (T4HPP Contractor)

Regular vehicle movements for services and supplies, including fuel delivery, domestic deliveries and waste disposal will be required. Solid wastes will be disposed of by truck and disposal is likely to take place at the following intervals:

- Domestic wastes – bimonthly
- Packaged wastes – bimonthly
- Waste oils – bimonthly
- Batteries – monthly
- Medical wastes – to be determined by the WAPDA hospital waste contractor
- End of life tyres – monthly.

It is expected that the volume of traffic associated with service and supply movements will be low.

Estimated increase in traffic volumes

The increase in the volume of traffic is expected to be low, with an estimated number of 32 additional vehicle movements in the TDP area per day during the peak construction period. It is estimated that the increase in vehicles movements outside peak construction times would be less than this number. It is expected that the 32 vehicles movements would comprise 18 bus movements and 14 truck movements. For the construction of power evacuation facilities, there will be quite insignificant increase in traffic volume.

7.6.4 Project-related Traffic during Operations

During operation traffic movements will be limited to routine maintenance vehicles, the transport of operations staff around the project site, domestic deliveries and waste disposal vehicles. It is expected that this volume of traffic will be less than that generated during the construction phase.

7.6.5 Potential Impacts during Construction Phase

Capacity

Additional vehicle movements can lead to congestion on roads, resulting to disruption and delays to other road users.

During peak construction it is expected that there will be 32 vehicle movements per day, including 14 truck movements and 18 bus movements, which will result in a percentage increase of less than 1% on the busiest road (Road A, **Table 5.25**) and approximately 3% on the least busy road (Road F, **Table 5.25**) compared to current total traffic volumes.

When comparing this increase in traffic volume to baseline data for larger vehicles only (see buses, trucks and tractors in **Table 5.25**) this would result in a percentage increase of approximately 2 % on the busiest road for heavier vehicles (Road A) and approximately 32 % on the road that is currently the least busiest road for heavier vehicles (Road E). For the construction of power evacuation facilities, there will be quite insignificant increase in traffic volume, as stated earlier.

The sensitivity of road users in the study area is considered to be low as they would have some capability to adjust to the small increase in traffic volumes. The magnitude of the impact is considered to be minor even for the worst case scenario (32 % increase of heavier vehicles on the least busy road). This would result in an impact of adverse minor prior to mitigation.

Wear and Tear

Trucks and buses have the potential to effect road conditions through vehicle movements that result in wear and tear, and subsequently cause damage which could impact on other users of the road. Other users of the roads are considered to be of low sensitivity to wear and tear as they would have the ability to absorb some limited changes in road conditions.

The magnitude of the impact is considered to be minor due to the small scale wear and tear that is expected to result from the Project. This will result in an adverse minor impact to existing roads.

Abnormal Loads

The transport of abnormal loads has the potential to impact on other road users by causing disruption to traffic flows and subsequent delays.

The exact number of abnormal load movements during construction is not currently known, although it is predicted that the number will be low based on experience from T4HP. The sensitivity of other roads users is considered to be low as most other road users would have some capacity to absorb minor disruptions to traffic flows. The magnitude of the impact is considered to be negligible owing to the low number of abnormal load movements that are expected.

This results in an impact of adverse negligible prior to mitigation.

Road Safety

Additional vehicle movements, particularly heavy vehicle movements, can have safety risks for other road users, if not managed appropriately.

There are other road users, including rickshaw drivers and pedestrians using the shoulder of the road who are considered to be of high sensitivity to road safety risks, due to their vulnerability and lack of ability to absorb changes in road safety conditions. However, due to the low number of expected vehicle movements the magnitude of the impact is considered to be minor. This would result in an impact of adverse moderate prior to mitigation.

7.6.6 Potential Impacts during Operational Phase

Capacity

During operation vehicle movements will largely be limited to transport of workers around the site, routine maintenance vehicles and disposal of waste. Although WAPDA does not keep a record of operational vehicle movements, operational movements attributable to the operation and maintenance of TDP prior to the development of T4HP and T5HP are captured in the T4HP traffic baseline presented in **Table 5.25**. The number of vehicle movements will be lower than the number of vehicle movements in the construction phase.

The sensitivity of the other road users in the study area is considered to be low as they would have some capability to adjust to the small increase in traffic volumes. The magnitude of the potential impact is considered to be minor due to the low number of vehicle movements expected. This would result in an impact of adverse negligible.

Wear and Tear

As outlined earlier, the number of vehicle movements during the operation phase will be lower than the construction phase and will be limited to transporting workers around the site, routine maintenance and disposal of waste.

Other users of the roads are considered to be of low sensitivity to wear and tear on the roads as they would have the ability to absorb some limited changes in road conditions. The magnitude of potential impact is considered to be negligible owing to the low volumes of vehicle movements expected during operation. This will result in an impact of adverse negligible.

Road Safety

Operational vehicles have the potential to impact on the safety of other road users. Some of the existing roads users (rickshaw drivers and pedestrians that use the shoulder of the roads) are considered to be of high sensitivity to road safety impacts. The magnitude of potential impacts is considered to be minor owing to the small number of vehicle movements during operation. This would result in an impact rating of adverse minor.

7.6.7 Mitigation and Enhancement

A range of measures are proposed to mitigate the adverse impacts of traffic movements associated with the Project on the road network and sensitive receptors. There are not considered to be any significant impacts that will result from the vehicle movements associated with the Project. However, good practice mitigation measures are recommended to reduce the non-significant impacts that have been identified. These mitigation measures are outlined in **Table 7.26**.

Table 7.26: Mitigation and enhancement measures

Impact theme	Mitigation and enhancement measures
Increase in traffic due to additional vehicle movements	• Develop a Traffic Management Plan (TMP) for construction and operation that includes information on optimising schedule of vehicle movements to minimise disruptions to other road users
Wear and tear on local roads as a result of an increase in traffic and abnormal roads	• Measures to avoid and reduce wear and tear will be considered as part of the Construction TMP (CTMP). • Undertake a road conditions assessment prior to and following the peak construction period, to assess any damage to road infrastructure that can be attributed to Project construction. Repair damage as appropriate or enter into a voluntary agreement with the relevant roads authority to reimburse the cost of any repairs required to the public road network as a result of the Project.
Road Safety of vulnerable road users	• Measures to reduce the risk to vulnerable road users and occupants of residential properties in the vicinity of roads which will be affected by construction traffic will be identified as part of the detailed CTMP. • The CTMP will draw on international best practice in developing and ensuring the implementation of suitable safety strategies. Consultation will take place with the appropriate highways authority to ensure identified measures take into account local circumstance. • Other measures for improved safety could include the following:

Impact theme	Mitigation and enhancement measures
	– Ensure contractors put in place appropriate driver training programmes. – Erect appropriate signage of site access routes, construction areas and where vehicles may be turning. – Locate spoil dump sites close to Project site to minimise journey distance and limit movements to site access roads. – Locate concrete mixing plant at Project site limiting traffic movements associated with concrete delivery to site access roads – Construct worker accommodation on site to reduce light vehicle movements relating to travel to/ from the site – Provision of bus/minibus services for personnel living in nearby settlements – Movements of construction workers planned to avoid the busiest roads in Ghazi and Topi and times of day when traffic is at its greatest. – Schedule deliveries and road movements to avoid peak periods – Speed restrictions for project traffic travelling through communities (to be agreed with National Highway Authority) – Use temporary signage where necessary – Implement a community liaison scheme to facilitate formal communication between contractor and community • Run a safety campaign to improve the people's knowledge of the traffic hazard on their roads, public information and other activities to address the issues, including a pedestrian awareness programme.

7.6.8 Residual Impacts

The potential traffic and transport impacts have been reassessed following the adoption of mitigation and no residual impacts have been identified. Refer to **Table 7.27**.

Table 7.27: Residual impact assessment

Activity	Potential Impacts	Sensitivity	Magnitude	Impact Significance	Residual Impacts
Construction					
Capacity	Additional volume of traffic on the road network resulting in disruption to existing users	Low	Minor	Negligible	Negligible
Wear and tear	Wear and tear as a result of type of traffic and volumes	Low	Minor	Negligible	Negligible
Road safety	Reduced safety of local residents and surrounding villages, particularly vulnerable groups such as pedestrians.	High	Minor	Adverse moderate	Negligible
Operation					
Capacity	Additional volume of traffic on the road network resulting in disruption to existing users	Low	Minor	Negligible	Negligible
Wear and Tear	Wear and tear as a result of type of traffic and volumes	Low	Negligible	Negligible	Negligible

Road safety	Reduced safety of local residents and surrounding villages, particularly vulnerable groups such as pedestrians.	High	Minor	Adverse moderate	Negligible

7.6.9 Proposed Monitoring

Procedures for monitoring the effectiveness of the mitigation measures proposed in this section are provided in the ESMP and will be expanded upon in the Project specific TMP. Monitoring measures should in particular be designed to identify failure or ineffectiveness of measures in terms of road safety.

7.6.10 Statement of Significance

The assessment of potential traffic and transport impacts has found that the Project should not result in significant effects, assuming that the proposed mitigation measures are implemented.

7.7 Wastes and Material Handling

This Section outlines information about materials and waste expected to arise during the construction and operation phases of the Project and provides recommendations for its management. Waste management is important to achieving minimization of raw material consumption and ensuring that treatment or disposal of wastes generated by the Project is conducted in an environmentally sound manner, particularly for hazardous wastes.

7.7.1 Impact Assessment Criteria

Potential impacts have been assigned significance using the overarching framework presented in **Section 7.1**. Specific magnitude and sensitivity criteria related to the assessment of waste are presented below in **Table 7.28**and**Table 7.29**. The overall impact significance matrix in **Section 7.1**has been used to identify significance taking into account the interaction between magnitude and sensitivity.

Table 7.28: Criteria for determining magnitude

Category	Description
Major	Mismanagement of waste arising and / or materials results in a significant incident which potentially causes a fundamental change to the specific environmental conditions assessed resulting in long term or permanent change, typically widespread in nature (regional national and international), would require significant intervention to return to baseline; exceed national standards and limits.
Moderate	Mismanagement of waste arising and / or materials results in an incident that causes a detectable change to the specific environmental conditions assessed resulting in non-fundamental temporary or permanent change.
Minor	Mismanagement of waste arising and / or materials results in an incident that causes a detectable but minor change to the specific environmental conditions assessed.
Negligible	Mismanagement of waste arising and / or materials results in an incident that causes no perceptible change to the specific environmental conditions assessed.

Table 7.29: Criteria for determining sensitivity

Category	Description
High	Waste and / or materials handling related incident impacts on a vulnerable receptor (human or ecological) with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.

Medium	Waste and / or materials handling related incident impacts on a vulnerable receptor (human or ecological) with limited capacity to absorb proposed changes or limited opportunities for mitigation.
Low	Waste and / or materials handling related incident impacts on a vulnerable receptor (human or ecological) with some capacity to absorb proposed changes or moderate opportunities for mitigation.
Negligible	Waste and / or materials handling related incident impacts on a vulnerable receptor (human or ecological) with good capacity to absorb proposed changes or and good opportunities for mitigation.

There are a range of impacts which can occur from the mismanagement of waste during construction and operation of a hydropower project. Assessment of materials and waste handling primarily involves identification of waste streams and adoption of best practice management approaches centered on waste avoidance rather than mitigation of impacts. Nevertheless, the sensitivity and magnitude approach has been adopted in order to demonstrate the different expected outcomes and impacts associated with waste arising in the non-management and management strategy scenarios.

7.7.2 Materials and Waste Generation

This section describes the raw materials usage and waste streams envisaged to arise from the construction and operation of the Project. Temporary and permanent construction related infrastructure from which waste could be generated is described in **Chapter 3**.

Considering the proposed facilities and construction works, the following waste streams are expected to be generated as part of the construction phase of each scheme:

- Excavated spoil arising from the raised intake, tunnelling/ penstock and powerhouse, tailrace channel, roads and other building foundations, foundations of transmission line towers, and construction of grid station.
- Concrete and cement wash from batching plant required for the construction of infrastructure
- Iron and steel scrap associated with demolition of existing intake and penstock
- Bricks and tiles from constructing buildings
- Waste oil and lubricants from turbine installation and vehicle maintenance / repair
- Domestic waste
- Packaging including pallet, timber, plastics, glass, paper, cardboard and tyres.

7.7.3 Material Use

The principal materials that are expected to be required or consumed as part of the construction specific components of the Project are summarized in**Table 7.30**. Quantities provided are estimates based on the tender design bill of quantities.

Table 7.30: Estimated construction phase materials

Description	Unit	Quantity
Raised Intake		
Blinding concrete, Class E	m^3	75
Mass concrete under intake tunnel lining, Class C	m^3	2,000
Concrete lining in T5, type T1 & T2, Class AA	m^3	2,000
Concrete lining in intake shaft, type S1 to S4, Class AA	m^3	8,300
Concrete in intake structure piers, Class HS01	m^3	2,300

Concrete in foundation/ ring struts/roof, second stage Class HS02	m^3	13,300
Reinforcing steel bars, No 2 through No. 11, Grade 60	t	3,200
90 mm thick steel fibre reinforced shotcrete (SFRS)	m^2	7,754
100 mm thick steel wire mesh shotcrete	m^2	27,181
Grouting consolidation holes	t	259
Cut & Cover Penstocks		
100 mm thick steel wire mesh shotcrete	m^3	95884
Reinforcement steel	t	7191
Steel liner In penstock	t	6173
Plum (Cyclopean) Concrete	m^3	31419
100 mm thick steel wire mesh shotcrete	m^3	12551
Grouting consolidation holes	t	547
Power House		
Concrete in the crane beams, Class A	m^3	882
First stage concrete in powerhouse, Class A	m^3	303,722
Second stage concrete in powerhouse, Class A	m^3	42,073
Precast concrete, Class A	m^3	2175
Reinforcement Steel	t	26001
50 mm thick steel wire mesh shotcrete	m^2	12,382
100 mm thick steel wire mesh shotcrete	m^2	10,024
Grouting consolidation and curtain holes	t	1,010
Culvert		
Concrete	m^3	83876
Plum (Cyclopean) Concrete	m^3	41,339
Reinforcement Steel	t	6597
100 mm thick steel wire mesh shotcrete	m^2	8830
Grouting consolidation holes	t	609
Channel		
Blinding concrete, Class E	m^3	9,150
Divide Wall Mass Concrete, Class A	m^3	23,062
Divide Wall Mass Concrete, Class C	m^3	15,952
Canal lining concrete , Class A	m^3	17,562
Reinforcement Steel	t	615
100 mm thick steel wire mesh shotcrete	m^2	26,303
Grouting consolidation and curtain holes	t	1,503

There will also be a number of other materials required or consumed during the construction of the Project, including: lubricants, oils, fuel (diesel), paint, plastics, packaging materials (paper, cardboard, timber) and food. Exact quantities of materials required are not yet known. A detailed materials plan and associated procedures will be developed and managed by the Contractors and suitable materials storage facilities will be provided.

7.7.4 Solid Waste

Spoil

The waste stream of greatest volume will be spoil arising from intake, penstock, powerhouse and tailrace excavation works. **Table 7.31** presents the spoil volumes anticipated to be generated as a result the construction phase.

Table 7.31: Estimated spoil arising from the construction phase

Description	Unit	Quantity
Intake to T5 (Civil Works)		
Open excavation in rock	m^3	1,227,750
Open excavation in loose rock / soil	m^3	50,000
Underground excavation in rock	m^3	32,000
Geological overbreak, load and transport to stockpile	m^3	50,000
Demolishing tunnel lining in T5	m^3	2,000
Cut & Cover Penstocks		
Excavation	m^3	160,995
Demolition of Structures	m^3	14,962
Power House		
Open Excavation in rock	m^3	961,741
Open Excavation in Common material	m^3	233,098
Culvert		
Open Excavation in rock	m^3	356,800
Open Excavation in Common material	m^3	89,200
Channel	m^3	
Open Excavation in rock	m^3	782,425
Open Excavation in Common material	m^3	195,606
Demolition at outlet	m^3	21,946
Total	m^3	**4,178,523**

Hazardous and non-hazardous wastes

The hazardous and non-hazardous wastes that are likely to be produced on site during the construction and operation phases of the Project are listed in**Table 7.32**. The quantities of hazardous waste materials are not anticipated to be high. As part of the waste management plan an estimate of waste materials will be developed taking into account materials requirements.

Table 7.32: Predicted hazardous and non-hazardous waste streams

Hazardous	Non-hazardous
Oils and lubricants and contaminated cloths	Excavation spoil
Oily debris from shop sumps/spill clean-ups	Concrete
Batteries	Concrete washings
Fluorescent tubes	Iron and steel scrap
Paints and chemicals	Non-ferrous scrap
Contaminated material	Packaging
Medical waste	Plastics
Asbestos (from potential demolition of existing contractor's camp site)	Paper and cardboard
	Timber and woody debris
	Bricks and tiles
	Pallets
	Glass
	Tyres
	General domestic waste
	Organic household waste
	Sewage sludge

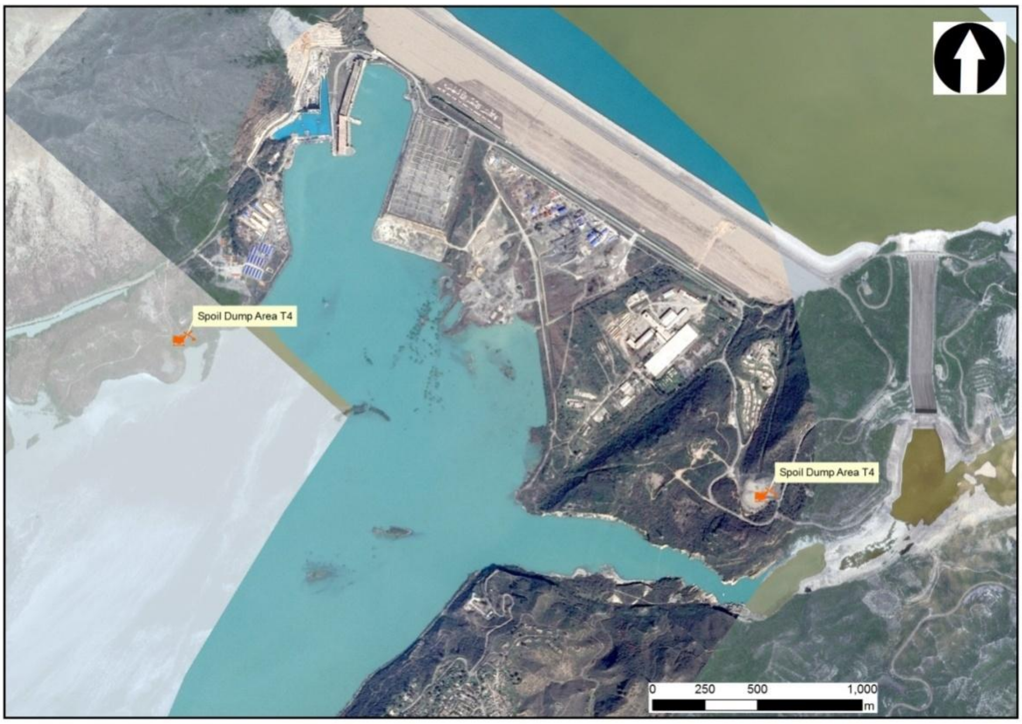
Hazardous	Non-hazardous
	Process waste water
	Sewage and sanitary chemicals

There are no identified approved landfill sites in close proximity to the Project. Appropriate disposal sites or methods will therefore need to be identified for the disposal of construction and municipal waste as well as medical waste. There is an existing contractor's accommodation site that was constructed using asbestos. At this stage is not clear whether this accommodation will be demolished or if it will be refurbished, however some degree of asbestos handling is expected. All asbestos handling should be carried out by appropriately qualified specialist contractors and in accordance with Good International Industry Practice, such as that set out by the UK Health and Safety Executive (HSE) on its website and including in the following documents:

- Asbestos: The Survey Guide (2012)
- Managing asbestos in buildings: a brief guide (2012).

It is envisaged that wastes will be stored prior to disposal in the designated waste areas currently being used for T4HP construction as detailed in **Table 7.33**. Waste management practices will be reviewed and updated in accordance with mitigation and enhancement measures set out later in the Section. These requirements also form part of the ESMP.

Figure 7.4:T4HP waste disposal areas*



* Note waste storage / disposal takes place at the T4HP spoil sites

Table 7.33: Storage and disposal of wastes on T4HP construction

Waste	Storage / disposal
Domestic waste	Disposed at sites in the spoil disposal areas (refer to **Figure 7.4**) and covered with spoil. There are potential issues with this practice if not carried out correctly and it will require review and updating for T5HP in accordance with GIIP.

Recyclable inert waste (steel, wood, plastic bottles etc.)	Segregated and stored at dedicated locations at the west bank spoil disposal area as indicated in **Figure 7.4**. Uplift is by local recycling contractors. The materials have a resale value and are sold to the contractors. Segregation and recycling is in accordance with GIIP and this practice will continue for the Project.
Recyclable hazardous waste (batteries, waste oil etc.)	Stored at dedicated locations at the west bank spoil disposal area as indicated in **Figure 7.4**. Uplift is by local recycling contractors. The materials have a resale value and are sold to the contractors. Storage practices will be reviewed against GIIP to ensure that measures are appropriate as discussed later in the Section. Segregation and recycling is in accordance with GIIP and this practice will continue for the Project.
Non-recyclable hazardous wastes (oily rags, contaminated soils etc.)	Stored and sent to landfill. Disposal of non-recyclable hazardous wastes is not in accordance with GIIP and practice will be reviewed and amended to the extent possible through application of mitigation and enhancement measures set out later in the Section.
Medical waste	Collected in waste bags with uplift for disposal in the hospital incinerator at Rawalpindi. Storage practices will be reviewed against GIIP to ensure that measures are appropriate as discussed later. The disposal route for medical waste is in accordance with GIIP and is expected to continue for the Project.

It is envisaged that all non-hazardous waste will be disposed in the designated areas currently being used for T4 (refer to the ESMP).

7.7.5 Waste Water

Surface water and potentially groundwater are at risk of contamination from the construction activities, including the improper management and disposal of construction waste water (including concrete washwater), sewage and other fluids generated by the Project.

The following waste water streams may be generated during the construction and operation of the Project:

- Waste water from the asphalt aggregate/concrete production system
- Contaminated/oily water
- Non oily water
- Sanitary waste water/sewage from the workers accommodation camps, offices and portable toilets
- Domestic facilities such as kitchens and canteens.

7.7.6 Potential Impacts

This section presents the identification and assessment of the following potential adverse impacts of the Project in the construction and operational phases. Potential impacts associated with the handling and use of raw materials includes the following:

- Use of potentially finite and / or scarce resources
- Handling and storage of hazardous materials
- Fire and explosion due to reactive, flammable and explosive materials
- Spills and leakages of hazardous materials which lead to an environmental incident
- Contamination of receiving environments (particularly surface watercourses, groundwater and the ground) due to leakage and spillage of wastes associated with poor waste handling and storage arrangements
- Fugitive emissions, such as dust and odour, associated with the handling and storage of some waste streams

- Land take from disposal of spoil and excavation material
- Visual amenity impacts associated with poor storage of waste
- Increased 'waste miles' from the transportation of waste materials for disposal off site.

Wastes will be generated during both the construction and operational phases of the Project for which appropriate waste management, minimization and disposal practices will need to be established. The likely waste types from both the construction and operational phases of the Project include solid, liquid, hazardous, non-hazardous and inert wastes.

The following sections will discuss the potential environmental impact, and proposed handling/storage and disposal methods for each of the waste streams that may arise during the two stages of the Project. Measures to mitigate the likely adverse impacts and enhance the beneficial impacts and benefits of the Project are also discussed.

7.7.7 Potential Impacts during Construction Phase

This section characterizes the waste streams expected to arise from construction activities associated with the development of the Project. The potential environmental impact, proposed handling and/or storage and disposal methods for each of the waste streams is presented in**Table 7.34**.

Table 7.34: Potential environmental impact, proposed handling / storage and disposal methods

Waste	Source	Potential unmitigated environmental Impact	Disposal method
Non-hazardous			
Excavation spoil	Associated with site preparation works and the excavation of the dam, diversion tunnels, spillway, headrace tunnels, tailrace and the powerhouse.	Contamination of receiving environments Fugitive emissions Disposal of spoil and excavation material which occupies large amounts of land	Excess material will be disposed of in spoil disposal sites.
Concrete	Associated with the construction of temporary and permanent Project infrastructure	Fugitive emissions Additional pressure on the use of existing landfill, where waste re-use or recovery is not feasible Increased waste miles from transporting waste materials from the Project site	In the absence of a national waste classification system, waste will be segregated according to European Waste Catalogue (EWC) code and suitably stored in a waste management area Further investigation into alternative disposal methods required by the contractor: Potential uses include road developments and as aggregate Soils contaminated by cement can also be used as landfill cover Where possible, waste will be collected by a competent carrier for crushing and re-use. Carriers will be identified as part of the waste management plan
Concrete	Associated with the	Contamination of	As specified in the ESMP, to be

Waste	Source	Potential unmitigated environmental Impact	Disposal method
Washings	construction of temporary and permanent Project infrastructure.	receiving environments	reused on site wherever possible Further investigation into disposal method required the Contractor Wash water to be stored and allowed to evaporate (settlement pond) Slurry flocculation Treatment by the aggregate/construction water system. Concrete handling equipment at washing facilities located in approved bunded areas on site
Non-hazardous construction waste: Iron and steel scrap Non-ferrous scrap Packaging Plastics Paper and Cardboard Timber Woody debris Bricks and tiles Pallets Glass Tyres.	Associated with the construction of temporary and permanent Project infrastructure	The use of landfill, where waste re-use or recovery is not feasible Visual amenity impacts associated with poor storage of waste Increased impact from transporting waste materials from the Project site	Waste will be segregated according to EWC code and suitably stored in a waste management area Further investigation into disposal methods required by the Contractor Collected by local vendors for recycling
General domestic waste	Kitchen and worker facilities	The use of landfill, where waste re-use or recovery is not feasible Visual amenity impacts associated with poor storage of waste Windblown litter and potential odour and health risks by attracting pests Increased waste miles from transporting waste materials from the Project site.	Waste will be segregated according to EWC code and suitably stored in a waste management area. Further investigation into disposal methods required by the Contractor
Organic household waste	From worker accommodation camps	Potential odour and health risks by attracting pests Lost opportunity for composting	Where possible, organic household waste will be composted
Hazardous			
Oils, lubricants and contaminated cloths	Associated with the construction of temporary and permanent Project	Hazardous. Contamination of receiving environments The use of landfill,	Collected in bunded, segregated drums within a waste management area Segregated according to EWC

Waste	Source	Potential unmitigated environmental Impact	Disposal method
	infrastructure	where waste re-use or recovery is not feasible	code and suitably stored in a waste management area Further investigation into disposal methods required the Contractor Recovery and re-use options to be fully explored
Batteries Fluorescent tubes Paints and chemicals	Associated with the construction of temporary and permanent Project infrastructure	Hazardous. Contamination of receiving environments The use of landfill, where waste re-use or recovery is not feasible	Waste will be segregated according to EWC code and suitably stored in a waste management area Further investigation into disposal methods required by the Contractor Recycling options to be fully explored
Medical waste	First aid and on-site medical facility	Hazardous. Contamination of receiving environments Health and safety: risk of infection and exposure to diseases	Colour coded medical waste Containers will be puncture-proof (usually made of metal or high-density plastic) and fitted with covers Bags and containers for infectious waste will be marked with the international infectious substance symbol Stored in a waste management area Transported to a medical facility with a licence for waste incineration
Contaminated material Oily debris from shop sumps and spill clean-ups	Spills and leaks on site	Improper handling, storage, and collection of hazardous waste. Discharge of untreated wastewater at construction site Accidental spillage and leakage of chemicals including fuel, oil and lubricants from on-site fuel storage tanks and equipment maintenance During the transport of materials to the designated treatment/disposal facilities may pose a risk of contamination to the land, groundwater and surface water	Collected and stored on an impermeable sheet and appropriately covered. Collected by the Contractor Appropriately handled and disposed of in accordance with the relevant international and local requirements
Sewage and sanitary chemicals Sewage sludge	From portable worksite toilets and workers accommodation	Hazardous. Contamination of receiving environments Discharge of untreated wastewater at workers	Treated by onsite sewage treatment plant Sludge to be transported and disposed of within site landfill

Waste	Source	Potential unmitigated environmental Impact	Disposal method
		accommodation and construction site	

During construction of T4HP it has been possible to sell much of the waste generated and it is considered likely that similar arrangements will be made for the Project. General wastes sold in this manner on T4HP include packaging, pallets, timber, plastics, glass, paper and cardboard, tires, batteries, oils and lubricants, bricks and tiles, iron and steel scrap.

Spoil material which is unsuitable to be reused or recycled or which is suitable but exceeds need, will be disposed of at a dedicated spoil disposal area (as illustrated and described in in **Chapter 3**). The spoil disposal area will be managed by the Contractor in accordance with the management plans and framework waste management plan outlined in the ESMP.

7.7.8 Potential Impacts during Operations Phase

Materials use

During the operational phase it is envisaged that the following materials will be used:

- Cement and concrete during maintenance and outage activities
- Chemical, paints, oils and fuels
- Wood and timber
- Ferrous and non-ferrous metals
- Electrical equipment, paper, cardboard, plastics and glass.

Exact quantities will be dependent upon the operation regime of the powerhouse and the frequency of maintenance activities.

Waste generation

Once the Project is operational waste is expected to arise primarily from office and maintenance activities. The quantity of waste produced during the operational phase will be minimal compared to the construction phase. It should be possible to sell much of the operational waste generated to local contractors for recycling based on experience during construction of T4HP. A list of likely operational wastes is presented in **Table 7.35** alongside a review of current operational waste management practice at Tarbela Dam.

Table 7.35: Potential environmental impact, proposed handling / storage and disposal methods

Waste	Source	Potential unmitigated environmental Impact	Existing Practice at TDP	Assessment of current TDP practice
Non - Hazardous				
General domestic waste	• Kitchen and workers facilities	• Potential contamination of receiving environment • Visual amenity	• Recyclable materials are segregated via an informal system. WAPDA cleaners	• Informal system of recycling is positive and review of whether the system could be enhanced through adoption of a more formal system and processes should be included in the application of mitigation and

Waste	Source	Potential unmitigated environmental Impact	Existing Practice at TDP	Assessment of current TDP practice
		impacts • Use of finite landfill resource	(sweepers) find and segregate waste encountered during their duties and supplement their income through selling the waste on to local contractors. • Non-recyclable waste is collected and disposed of in the nearby Ghazi and Topi open landfill areas.	enhancement measures set out later in the Section. • The landfill sites in Ghazi and Topi are not examples of best practice. Landfill practice will be reviewed and amended to the extent possible through application of mitigation and enhancement measures set out later in the Section.
Electrical Equipment, Paper Cardboard/ Plastics/ Glass etc.	• Maintenance and replacement of electrical equipment • From packaging and deliveries etc. • Workers facilities	• Potential contamination of receiving environment • May contain heavy metals depending on the item	• Recyclable materials are segregated via an informal system. WAPDA cleaners (sweepers) find and segregate waste encountered during their duties and supplement their income through selling the waste on to local contractors.	• Informal system of recycling is positive and review of whether the system could be enhanced through adoption of a more formal system and processes should be included in the application of mitigation and enhancement measures set out later in the Section.
Concrete	• Associated with outages and maintenance	• Visual amenity impacts • Use of finite landfill resource	• Concrete waste is collected and disposed of in the nearby Ghazi and Topi open landfill areas.	• The landfill sites in Ghazi and Topi are not examples of best practice. Landfill practice will be reviewed and amended to the extent possible through application of mitigation and enhancement measures set out later in the Section. • Options to avoid, reduce or recycle concrete wastes will be identified through mitigation later in the Section.
Pallets	• Associated with	• Visual amenity	• Recyclable materials	• Informal system of recycling is positive and review of whether

Waste	Source	Potential unmitigated environmental Impact	Existing Practice at TDP	Assessment of current TDP practice
	deliveries	impacts	including pallets are segregated via an informal system. WAPDA cleaners (sweepers) find and segregate waste encountered during their duties and supplement their income through selling the waste on to local contractors.	the system could be enhanced through adoption of a more formal system and processes should be included in the application of mitigation and enhancement measures set out later in the Section.
Hazardous				
Fluorescent tubes	• Associated with routine and ongoing maintenance in facilities and workshops	• Fluorescent tubes contain mercury • Use of finite landfill resource	• Waste is collected and disposed of in the nearby Ghazi and Topi open landfill areas.	• Disposal of non-recyclable hazardous wastes is not in accordance with GIIP and practice will be reviewed and amended to the extent possible through application of mitigation and enhancement measures set out later in the Section.
Contaminated packaging	• Primarily associated with any chemical deliveries	• Unknown contaminants and potential contamination of receiving environments • Use of finite landfill resource	• Waste is collected and disposed of in the nearby Ghazi and Topi open landfill areas.	• Disposal of non-recyclable hazardous wastes is not in accordance with GIIP and practice will be reviewed and amended to the extent possible through application of mitigation and enhancement measures set out later in the Section.
• Waste oil • Paints and chemicals • Batteries	• Associated with routine and ongoing maintenance in the facility and outages	• Potential contamination of receiving environment	• Recyclable hazardous wastes are segregated and sold on to local contractors by WAPDA.	• Recycling is positive and review of whether the system could be enhanced should be included in the application of mitigation and enhancement measures set out later in the Section.
• Non-recyclable contaminate wastes including oily rags	• Associated with routine and ongoing maintenance in the facility and outages	• Unknown contaminants and potential contamination of receiving environments	• Waste is collected and disposed of in the nearby Ghazi and Topi open landfill areas.	• Disposal of non-recyclable hazardous wastes is not in accordance with GIIP and practice will be reviewed and amended to the extent possible through application of mitigation and enhancement measures set out later in the Section.

Waste	Source	Potential unmitigated environmental Impact	Existing Practice at TDP	Assessment of current TDP practice
		• Use of finite landfill resource		
• Sewage and sanitary chemicals • Sewage sludge	• From offices	• Hazardous. Contamination of receiving environments • Discharge of untreated wastewater	• Sewage disposed in local open drains. • Sewage sludge collected and disposed of in the nearby Ghazi and Topi open landfill areas. • Septic tanks are also used.	• Treatment of sanitary wastes is not in accordance with GIIP. Hygienic treatment options to be identified in accordance with operational waste management requirements specified later in the Section.
Waste electronics and electrical equipment (WEEE)	• Maintenance and replacement of electrical equipment	• Potential contamination of receiving environment • May contain heavy metals depending on the item	• Recyclable hazardous wastes are segregated and sold on to local contractors by WAPDA.	• Recycling is positive and review of whether the system could be enhanced should be included in the application of mitigation and enhancement measures set out later in the Section.
Insulated switchgear	• Maintenance and replacement of gas insulated switchgear (GIS)	• Potential release of GHG (SF6 gas)	• N/A	• If it is necessary to use GIS, ensure management procedures for installing, maintaining and operating the GIS are in line with GIIP to prevent unplanned discharges to atmosphere (as required later in the Section.
Medical waste	• First aid and on-site medical facility	• Hazardous. Contamination of receiving environments • Health and safety: risk of infection and exposure to diseases	• Collected in waste bags with uplift for disposal in the hospital incinerator at Rawalpindi.	• Storage practices will be reviewed against GIIP to ensure that measures are appropriate as discussed later in the Section. The disposal route for medical waste is in accordance with GIIP and is expected to continue for the Project.

7.7.9 Summary of Potential Impacts

A summary of the potential impacts prior to mitigation is provided in **Table 7.36**below.

Table 7.36: Summary of significance assessment of potential unmitigated impacts

Potential Impact	Adverse/ beneficial	Magnitude	Sensitivity	Impact Evaluation	Significance
Construction phase					
Use of potentially finite and / or scarce resources	Adverse	Moderate	Low	Minor	Not significant
Ineffective spoil / excavated material handling, storage and	Adverse	Major	Medium	Major	Significant

Potential Impact	Adverse/ beneficial	Magnitude	Sensitivity	Impact Evaluation	Significance
disposal causing contamination of environment or sedimentation of water resources					
Contamination of environments (particularly surface watercourses, groundwater and the ground) due to leakage and spillage of wastes associated with poor waste handling and storage arrangements	Adverse	Major	Medium	Major	Significant
Fugitive emissions, such as dust, associated with the handling and storage of some waste streams	Adverse	Moderate	Medium	Moderate	Significant
Visual amenity impacts associated with poor storage of waste	Adverse	Moderate	Low	Minor	Not significant
The use of landfill, which is a finite resource	Adverse	Moderate	Medium	Major	Significant
Increased waste miles from transporting waste materials from the Project site	Adverse	Moderate	Low	Minor	Not significant
Operational phase					
Use of potentially finite and / or scarce resources	Adverse	Moderate	Low	Minor	Not significant
Contamination of environments (particularly surface watercourses, groundwater and the ground) due to leakage and spillage of wastes associated with poor waste handling and storage arrangements	Adverse	Major	Medium	Major	Significant
Visual amenity impacts associated with poor storage of waste	Adverse	Moderate	Low	Minor	Not significant
The use of landfill, which is a finite resource	Adverse	Moderate	Medium	Major	Significant

7.7.10 Mitigation and Enhancement Measures

This section sets out mitigation and enhancement measures that will be implemented to reduce adverse potential impacts as assessed in earlier in this Section. As part of the process of identifying appropriate mitigation measures reference has been made to the World Bank Group’s EHS Guidelines for Construction Materials Extraction and General EHS Guidelines.

The EHS Guidelines for Construction Materials Extraction state that rock waste and removed topsoil overburden are the main inert wastes typically produced by materials extraction. Hazardous wastes may be generated from impurities and trace components included in the exploited (waste) rocks (eg asbestos or heavy metals or minerals that could result in acidic runoff). The recommended prevention and control methods to reduce material extraction wastes include the following:

- Operational design and planning should include procedures for the reduction of waste production (eg blending high-quality rock with poor rock)
- Topsoil, overburden, and low-quality materials should be properly removed, stockpiled near the site, and preserved for rehabilitation
- Hazardous and non-hazardous waste management plans should be developed and adopted during the design and planning phase. Impacts associated with specific chemical and / or physical properties of extracted materials should be considered during the design phase, and impacts from waste rock impurities should be adequately controlled and mitigated by covering waste disposals with non-contaminated soil.

The General EHS Guidelines require that all waste material arising (regardless of the stage of the Project) should be segregated into non-hazardous and hazardous wastes for consideration for re-use, recycling, or disposal. Waste management planning should establish a clear strategy for wastes that will be generated including options for waste elimination, reduction or recycling or treatment and disposal, before any wastes are generated. A Project specific waste management plan documenting the waste strategy, storage (including facilities and locations) and handling procedures should be developed and should include a clear waste tracking mechanism to track waste consignments from the originating location to the final waste treatment and disposal location.

In accordance with the EHS Guidelines the general waste management measures for the construction and operational phases of the Project will comprise:

- A detailed construction phase materials storage, handling and use plan and a waste management plan as part of the construction phase ESMP. A framework for a combined materials and waste management plan has been provided in the ESMP.
- Operational phase materials storage, handling and use procedures and a waste management procedure which will form part of an overarching Environmental and Social Management System (ESMS).

Specific mitigation and enhancement measures that will be captured in these plans are set out in the subsections below.

7.7.11 Materials Storage, Handling and Use

Good practice waste management begins with the efficient storage, handling and use of raw materials. To achieve this aim for the Project during construction and operation, the following material use and handling measures will be considered and embedded in the construction ESMP and operational phase procedures as appropriate:

- Re-using materials on site wherever possible. The most significant opportunity in the construction phase is with respect to excavated spoil
- Instituting good housekeeping and operating practices, including inventory control to reduce the amount of waste resulting from materials that are out-of-date, off-specification, contaminated, damaged, or excess to plant needs
- Instituting procurement measures that recognise opportunities such as ordering the correct amount of materials to be delivered when needed, reducing the amount of packaging used by suppliers and establishing a take back system with suppliers
- Substituting raw materials or inputs with less hazardous or toxic materials wherever economically and technically feasible.

Material handling and storage areas will be established during the construction phase and will be specifically designed giving due consideration to the following requirements:

- Located away from sensitive receptors
- Not at risk from theft or vandalism
- Prevention of being spoiled by the elements
- Easily accessible in a safe manner
- Well ventilated
- Unlikely to be damaged
- Located next to any required personal protective equipment (PPE) (as necessary for irritants and hazardous materials)
- Bunded and located next to spill kits (as necessary for hazardous liquids).

The construction and operational waste procedures developed as part of the ESMP will include reference to the control measures in order to minimize the likelihood of incidents associated with materials storage, handling and use. This will include the following:

- Identification of the necessary PPE requirements
- Identification of the necessary bunding and spill kit requirements
- Details of the correct procedure for handling and storing any hazardous materials
- A map showing the material storage locations
- Training requirements (as necessary) with respect to materials handling procedures
- The correct procedure for reporting any environmental incidents related to spills / leakages and how to deal with any spills / leakages
- The specific regulatory reporting requirements as they relate to materials storage.

1.1.1 Temporary waste storage handling

Temporary waste storage facilities are expected to be provided for the construction and operational phases. It is envisaged that these will be scaled down once the Project moves into the operational phase. These are intended as a secure, short-term storage for all waste streams generated on site prior to being collected by relevant waste collectors for treatment and/or final disposal. They will be designed to include the following:

- Separate storage areas for hazardous and non-hazardous wastes
- Separate skips for each waste stream to allow segregation in order to maximise re-use and recycling opportunities
- All skips to have a suitable cover
- Liquid wastes/oil/chemicals to be stored in tanks or drums located in bunded areas which can hold 110% of the total storage volume32
- Spill kits to be available at all times
- Store hazardous waste in closed containers away from direct sunlight, wind and rain in designated storage areas
- Provide adequate ventilation where volatile wastes are stored
- Handling and storage shall be carried out by trained staff

[32]Secondary containment for drum storage will be provided by a drip tray which will be able to contain either 25% of the total volume of the containers or 110% of the largest container, whichever is the greater.

- Provide readily available information on chemical compatibility to workers including labelling each container, demarcation of the area (eg on a facility map / site plan)
- Conduct periodic inspections of waste storage areas and document the findings
- Prepare and implement spill response and emergency response plans to address accidental releases and leakage
- Avoid underground storage tanks and underground piping of hazardous waste
- A description of the control measures at each spoil disposal site (such as spot checking of spoil loads) to ensure that only material excavated from each of the Project's components is deposited there.

7.7.12 Waste Management

This section presents the waste management measures designed to manage the waste generated on the Project during the construction and operational phases.

Construction phase waste management strategy

The primary consideration for the waste management plan will be the handling and disposal of excavation spoil (through a dedicated spoil management sub-plan). The waste management plan will also identify likely waste arising and appropriate handling, reuse and recycle opportunities and, as a last resort, disposal methods. The waste management plan will be prepared in accordance Pakistani waste regulations, the European Waste Catalogue and the World Bank Group's EHS Guidelines for Construction Materials Extraction and General EHS guidelines.

The following waste management hierarchy is to be adopted by all Contractors as good practice:

- Waste prevention
- Recycling and reuse
- Treatment and disposal in accordance with the relevant statutory requirements, guidelines, and GIIP.

Key considerations for inclusion in the construction phase waste management plan are expected to be as follows:

Waste prevention

Processes should be designed and operated in accordance with the following strategy to prevent or minimize waste and hazards associated with the wastes generated:

- Substituting raw materials or inputs with less hazardous or toxic materials, or with those where processing generates lower waste volumes
- Applying manufacturing processes that convert materials efficiently and provide higher product output yields. This may include modification of the production process, operating conditions and / or process controls
- Instituting good housekeeping and operating practices, including inventory control to reduce the amount of waste resulting from materials that are out-of-date, off specification, contaminated, damaged, or excess to plant needs
- Instituting procurement measures that recognize opportunities to return usable materials such as containers and which prevent the over ordering of materials

- Minimizing hazardous waste generation by implementing stringent waste segregation to prevent the co-mingling of non-hazardous and hazardous wastes.

Reuse and recycling

On-site sorting, temporary storage and collection by recycling contractors shall be performed to recover inert, reusable and recyclable materials before disposal off-site. Specific areas should be identified by the Contractor for on-site sorting and temporary storage of the sorted materials in properly labelled skips. The frequency of skip emptying or removal should be sufficient to prevent overflow of wastes.

The Contractor should identify appropriate disposal methods in liaison with the provincial environmental authorities. As an enhancement measure WAPDA should identify and take action to strengthen regional and/or local waste management capacity for example with regard to recycling (e.g. use of community-based recycling organizations within the Project AoI).

Treatment and disposal

Solid wastes shall be collected by licensed collectors, treated, and/or disposed of safely and appropriately at a facility designated by the local environmental authorities. Hazardous wastes shall be collected by licensed collectors, treated, and/or disposed of safely and appropriately at a facility designated by the local environmental authorities. Contaminated soils, if any, should be appropriately handled and disposed of in accordance with the relevant international and local requirements.

Spoil disposal site

The principal waste stream which will be generated during the construction phase is excavation material / spoil. It will be possible to use much of this material as aggregate for construction and concrete batching. Spoil which cannot be re-used will be deposited at the spoil disposal site as described in Chapter 3 of this report. The identified site will be engineered to avoid the potential for sedimentation. The area is flat and approximately 200m from any water bodies and will include a buffer zone with vegetation, further reducing the risk of sedimentation.

Contaminated soils management

Should any contaminated soils be identified during construction, good international industry practice (GIIP) should be employed to minimize potential exposure. Confirmation from the local environmental authorities should be sought to confirm the acceptability of reuse of contaminated soils on site. Prior to reusing potentially contaminated soils as backfill, appropriate risk mitigation measures shall be implemented to avoid environmental contamination and impacts on health.

7.7.13 Operational waste management strategy

A detailed operational waste management procedure will be produced to embed best practice waste management in the operational philosophy of the Project. The waste management procedure will highlight the relevant policy and legislation of Pakistan and include a Site Waste Management Plan (SWMP) which will contain:

- A waste management philosophy based on the waste hierarchy of prevention, reduction, reuse, recovery, recycling, removal and disposal of wastes
- A map showing each temporary waste storage location for the Project

- A description of each waste generated by the operation of the facility, the appropriate handling methodology, the correct approach for temporary storage and the correct route for removal/disposal off site
- Staff training requirements with respect to waste handling procedures
- Waste generation data collection for each waste stream by volume, according to the EWC. This should include the proportion of each waste stream going for reuse, recycling or disposal. Any unusual waste volumes should be investigated
- Any waste monitoring as deemed to be necessary
- An audit schedule which details the frequency of waste management audits and those responsible for undertaking them
- A section related to continuous improvement and corrective actions where audit findings can be recorded and incorporated into the waste management procedure. This will also highlight any new and feasible reuse or recycling opportunities which may arise over time
- A mechanism by which to routinely track waste consignments from the originating location to the final waste treatment and disposal location
- The correct procedure for reporting any environmental incidents related to waste
- The specific regulatory reporting requirements as they relate to waste.

In addition, a valid copy of all waste carriers' licenses will be kept on site. All transfer notes related to waste uplifts will be completed in full and contain an accurate description of the waste and be signed by the producer and carrier before waste leaves the site.

The following mitigation is set out to address specific deficiencies identified in current waste management practice at Tarbela Dam.

- To minimise the effects of using the landfill areas at Topi and Ghazi, as part of the development of its operational waste management plan WAPDA should consider the potential to develop an international standard landfill site within its property/ TDP site and dispose all non-recyclable waste there according to international best practice.
- WAPDA should review existing practices for the treatment and disposal of sanitary and sewerage effluents and identify and implement a solution in accordance with GIIP. This may require the development of new or rehabilitation of existing waste water treatment plants on site in accordance with GIIP.
- If it is necessary to use Gas Insulated Switchgear, ensure management procedures are in place for installing, maintaining and operating the GIS and that the procedures are in line with GIIP.
- Medical wastes will be stored and transported as follows:
  - Colour coded medical waste containers will be used. These will be puncture-proof (usually made of metal or high-density plastic) and fitted with covers
  - Bags and containers for infectious waste will be marked with the international infectious substance symbol
  - Wastes will be stored in a waste management area
  - Wastes will be transported to a medical facility with a licence for waste incineration

7.7.14 Summary of Mitigation

A summary of the mitigation and enhancements measures identified earlier in the Section is provided below.

Table 7.37: Mitigation and enhancement measures for materials use and waste arisings

Type of Measure	Impacts Mitigated or Enhanced	Detail
Embedded mitigation – mitigation which is built-in to the Project during the design and procurement process	Use of potentially finite and / or scarce resources Ineffective spoil / excavated material handling, storage and disposal causing contamination of environment or sedimentation of water resources	Utilise the principles of the waste management hierarchy Reuse of spoil for backfilling involved in penstock and LLO. Spoil will also be reused as fill material to level the proposed switchyard location
Mitigation of significant effects	Contamination of environments (particularly surface water in plunge pools, groundwater and the ground) due to leakage and spillage of wastes associated with poor waste handling and storage arrangements Fugitive emissions, such as dust, associated with the handling and storage of some waste streams The use of landfill, which is a finite resource	Detail material storage, handling and use procedures. Implement waste management plans for construction and operation, according to national and international legislation and GIIP Reuse and recycle materials wherever possible Follow dust management procedures identified in **Section 8.3**.
Mitigation of non-significant effects	Visual amenity impacts associated with poor storage of waste Increased waste miles from transporting waste materials from the Project site	Detail material storage, handling and use procedures in ESMP Implement waste management plans for construction and operation, according to national and international legislation and GIIP Reuse and recycle materials wherever possible Follow dust management procedures
Enhancement measures	The use of finite landfill resource Increased 'waste miles' from transporting waste materials from the Project site	Identify opportunities for the Project to help and strengthen regional and/or local community capacity in waste management, especially with regard to recycling (eg use of community-based recycling organisations within the site proximity, if any)

7.7.15 Residual Impacts

Residual effects are those that remain significant after mitigation has been implemented. The mitigation measures identified above will ensure that the vast majority of waste generated as a result of the Project will be managed according to environmental best practice and the risk to the environment is significantly reduced.

On consideration of the expected impacts and proposed mitigation and management measures the only residual impact expected to remain is the use of finite landfill resource where waste re-use or recovery is not feasible. The creation and use of landfill as a disposal option for some waste streams is expected to persist throughout the life of the

Project with notable peaks expected during the construction (and decommissioning) phases.

7.7.16 Proposed Monitoring

Monitoring of waste mitigation measures will be conducted for the duration of the construction phase. The Project team will set out a materials usage and waste management monitoring program to address all activities that have been identified to have potentially significant impacts on the environment during construction and operation.

Procedures for monitoring the effectiveness of mitigation proposed in the ESMP will be incorporated within the detailed SWMP and the SWMP procedure during construction and operation respectively. Monitoring will be sufficient to provide representative data for the parameter being monitored, and will be conducted by trained individuals following monitoring and record-keeping procedures. Monitoring data will be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken.

7.7.17 Statement of Significance

Volumes of waste generated during the construction phase of the Project are expected to be high and will require careful management to ensure adverse impacts are not realized. However, good site waste management practices are well understood and provided the mitigation set out in this Section is implemented it has been assessed that the only significant impact remaining will be in relation to the use of landfill facilities which are a finite resource.

7.8 Ecology

7.8.1 Ecological Impact Assessment Criteria

The magnitude of the potential impacts upon each ecological feature for the construction and operation of the Project have been defined in accordance with the criteria set out in **Table 7.38**. In accordance with World Bank operational policies, the conservation value (sensitivity) or weighting attributed to each ecological feature which occurs within the AoI of the Project has been assessed using the definitions in **Table 7.39**.

In order to categorize the sensitivity on the basis of biodiversity-specific criteria typically adopted for the assessment of ecological impacts, the sensitivity ranking presented in Table 7.39slightly differs from the evaluation matrix presented in Section 7.1 by including the conservation value category “Very High”. A “High” or “Very High” sensitivity (conservation value) is equivalent to the general category “High” for receptor sensitivity in the impact evaluation matrix in Section 7.1 for the purposes of determining significance.

Significance has been determined by the interaction between the magnitude of impacts and the sensitivity of receptors affected, as depicted in the impact evaluation matrix in Section 7.1.

Table 7.38: Criteria for determining impact magnitude

Category	Definition
Major	Fundamental change to the specific environmental conditions assessed resulting in long term or permanent change, typically widespread in nature (regional national and international), would require significant intervention to return to

	baseline; exceeds national standards and limits.
Moderate	Detectable change to the specific environmental conditions assessed resulting in non-fundamental temporary or permanent change.
Minor	Detectable but minor change to the specific environmental conditions assessed.
Negligible	No perceptible change to the specific environmental conditions assessed.

Table 7.39: Criteria for determining receptor sensitivity (conservation value)

Conservation Value (Sensitivity)	Detail	Species Criteria	Habitat or Site Criteria	Conservation Value (Sensitivity)
Very high	Very high importance and rarity. International scale with limited potential for substitution.	IUCN Critically endangered and endangered species.	Internationally designated sites (or equal status). Critical habitats of significant international ecological importance.	Very high importance and rarity. International scale with limited potential for substitution.
High	High importance and rarity, national scale, or regional scale with limited potential for substitution, species of international status but not within designated areas.	IUCN Vulnerable species. Nationally protected species of significant population size and importance.	Nationally designated sites (or equal status). Areas of critical habitats of national ecological importance, and natural habitats of significant ecological importance and/or high biodiversity with limited potential for substitution.	High importance and rarity, national scale, or regional scale with limited potential for substitution, species of international status but not within designated areas.
Medium	High or medium importance and rarity, local or regional scale, and limited potential for substitution, species of national status but not within designated areas.	IUCN Near Threatened species. Nationally protected species or rare species, but not a significant population size and not of national importance.	Regionally important natural habitats. Natural habitats. Modified habitats with high biodiversity or under significant threat of loss within the region.	High or medium importance and rarity, local or regional scale, and limited potential for substitution, species of national status but not within designated areas.
Low	Very low or low importance and rarity, and local scale.	IUCN Least Concern. Species of local national importance.	Undesignated sites and habitats of natural habitats of some local biodiversity and cultural heritage interest. Modified habitats with limited ecological value.	Very low or low importance and rarity, and local scale.
Negligible	Other sites with			Other sites with

Conservation Value (Sensitivity)	Detail	Species Criteria	Habitat or Site Criteria	Conservation Value (Sensitivity)
	little or no local biodiversity and cultural interest. Modified habitats with limited biodiversity value.			little or no local biodiversity and cultural interest. Modified habitats with limited biodiversity value.

7.8.2 Potential Impacts during Construction Phase

Protected areas

There are no protected areas for nature conservation designated at national or international levels within 40 km of the Project, and therefore no further impact on designated sites is considered in this assessment.

Terrestrial habitats and flora

Across the AoI, the impacts on the terrestrial habitats and flora are largely associated with the temporary and permanent habitat loss/degradation resulting from the construction of permanent and temporary Project infrastructure (refer to **Chapter 3**). Introduction or spread of non-native invasive species is also a risk during construction activities.

The landcover mapping and field surveys identified the presence of seven habitat types in the AoI of the Project covering an area of 10,400 0ha in total for both dam and power evacuation facilities..

The most valuable natural terrestrial habitat is the open and closed broadleaved scrub land, covering 37% of the AoI. Even though this habitat is currently in a degraded status, its conservation value is considered to be medium because of the scarcity of forests in Pakistan. Only small areas of this habitat will be affected by the Project, ie about 15 ha; therefore the magnitude of the impact is considered to be adverse minor. The resulting effect is therefore adverse minor and not significant.

The magnitude of the impact on the remaining habitat categories of low conservation value is minor and therefore the effect is negligible and not significant.

No globally or nationally threatened species or endemic plant species were recorded in the Project AoI. It is to be noted that whole non-agricultural landcover underneath proposed transmission lines is already subjected to considerable disturbance and human pressure. Thus, laying out the transmission line will merely place a provisional superfluous burden on a system that is already stressedas the plant species are considered to be of low conservation value, the effect is considered to be adverse minor or negligible and not significant.

Vegetation: The impact of the Project on flora is expected to be minimal. The main activities that are anticipated to damage the vegetation include clearance of land at proposed switch yard, transmission line towers, grid station and temporary facilities such as access roads. It must be mentioned that the whole non-agricultural landcover underneath proposed transmission lines is already subjected to considerable disturbance and human pressure. Thus, laying out the transmission line will merely place a provisional superfluous burden on a system that is already stressed.

Since the nature of the impact is linear for transmission line, both in terms of access to the tower sites and the lines themselves, it can be expected that the vegetation will regenerate quite rapidly after the project activities and any accidental hazard such as fire, that might have resulted in damage to the plants or their propagules over a wider area.

In situations where Eucalyptus plantation will be crossed by the transmission Line, it will be necessary to fall the trees along transmission corridor. Being exotic/introduced species, it is already a hurdle in growth of many native species, thus the felling may be beneficial and ecological damage done will be least.

The most probable effect may be a change in plant succession. The area is already under infestation of invasive Lantana camara with an apparent North- South gradient. It is suggested that the workflow be maintained from south (Grid station) towards North (power house), so that the project activities might not help encroach this weedy species further.

When trees will be removed in the transmission line corridor, it may facilitate wind erosion due to removal of windbreaks planted on field edges thus a plantation might be carried out alongside the route of transmission line.

A group of interrelated impacts viz., soil mixing, erosion, rutting, and compaction are commonly associated with transmission construction and can greatly affect future agricultural yield. Thus the soil excavated from the poles foundations should be avoided to mixed up with agricultural soil and be properly disposed off.

The transmission lines may also hinder future consolidation of farm fields or for residential development thus compensation to affected will have to be made.

Terrestrial and riparian fauna

Mammals. Mammals are likely to be affected by construction through habitat loss/degradation, disturbance (presence of people, artificial lighting and noise), injury or death owing to construction works (including trapping in deep excavations) and increased traffic, and temporary habitat fragmentation. Construction activities will be undertaken for the coffer dams, temporary roads, batching plants switchyard area and other associated facilities in the dam area and also along the transmission line corridor and grid station site. Construction impacts will be confined to these project components and up to 500m around them. The habitats affected by the construction of the infrastructure mentioned above are common at the national and local level and the areas affected directly are relatively small.

Threats to Fauna of special concern bearing IUCN status in the Project Area. The prevailing threats to the fauna of the area are overgrazing in species habitats, hunting and poaching, disturbance due to anthropogenic activities, droughts, deforestation, unsustainable agricultural practices, increase in fuel wood consumption, water diversion for agriculture and industrial use etc.

Manis crassicaudata Indian pangolin, is a Endangered (EN) species and also included in the CITES Appendix II. The thick tailed Pangolin is exclusively a terrestrial species and found in the project area from Tarbela to Islamabad. The pangolin has been recorded from various forest types, including rainforest and plains to middle hill levels. The animal can be found in grasslands and secondary forests, and is well adapted to desert regions as it is believed to have a tolerance to dry areas, but prefers more barren, hilly regions.

Indian pangolin is protected by national legislation but still it is heavily exploited for its flesh, scales, and skin. Illegal demand has increased over the past 20 years. Populations are declining due to hunting and poaching for both subsistence and international trade. As they only have a single offspring per year, this high demand is starting to seriously endanger populations. Various parts of the pangolin are valued as sources of food and medicine. The scales are used as an aphrodisiac, or made into rings or charms. The skins are used to manufacture leather goods, including boots and shoes. The majority of hunting is carried out by nomads and trained local hunters. The Pangolins are the most heavily trafficked CITES-protected mammal.

Pangolin burrows fall into one of two categories: feeding and living burrows. Feeding burrows are smaller than living burrows (though their sizes vary depending on the abundance of prey) and are created more frequently during the spring, when there is a greater availability of prey. Living burrows are wider, deeper, and more circular, and are occupied for a longer time than feeding burrows, as they are mainly used to sleep and rest during the day. After a few months, the pangolin abandons the burrow and digs a new one close to a food source. However, it is not uncommon for the pangolin to shift back to an old burrow.

Birds. Bird species are likely to be affected by loss/degradation of breeding/feeding habitat and disturbance (presence of people, artificial lighting and noise). These impacts will be associated with the construction of temporary and permanent infrastructure as described in **Chapter 3**. Construction impacts will be confined to these project components and up to 500m around them. The habitats affected by the construction of the infrastructure mentioned above are common at the national and local level and the areas affected directly are relatively small.

The Project is in the region of a major bird migratory flyway and internationally important numbers of one species of waterbird, i.e. mallard, are known to occur at Tarbela Reservoir. This species is therefore of very high conservation value. Construction activities associated with the Project, notably in relation to the construction of the penstock, tailrace and the coffer dams, will involve a temporary loss/disturbance of aquatic/riparian river habitat in the Dhal Dara channel only. Given the temporary nature of the works and short section of the Dhal Dara channel to be affected, and that the area of the reservoir to be affected directly by construction associated with the raised intake is negligible given the size of the waterbody, the impact magnitude is considered to be negligible. The overall impact is therefore considered negligible and non- significant.

The remaining bird species known to be in the Project AoI are common and widespread and of low conservation value. The construction impacts described above are likely to be of minor magnitude and therefore the resulting effect is negligible and not significant.

Herpetofauna. Reptiles and amphibians in the Project AoI are likely to be affected by construction through habitat loss/degradation, disturbance (presence of people, artificial lighting and noise), injury or death owing to construction works (including trapping in deep excavations) and increased traffic, and temporary habitat fragmentation. Temporary changes in hydrology and reduction in water quality during construction are also likely to pose a risk to amphibians.

Construction impacts on herpetofauna will be confined to the Project ADIincluding 500m buffer.The habitats affected by the construction of the infrastructure mentioned above are common at the national and local level and the areas affected directly are relatively small.

No globally threatened or endemic herpetofauna species were recorded in the AoI during the 2015 or 2011 surveys, and no globally threatened herpetofauna species are known from the area around Tarbela Reservoir according to current published literature or interview with local people.

The herpetofauna species in the Project AoI are considered to be of low conservation value. The construction impacts described above are considered to be of minor magnitude and the resulting effects are negligible and not significant.

Python molurus, Python is a large non venomous python species found in many tropic and sub-tropic areas and also included in the CITES Appendix I. It is commonly known as Indian python, black-tailed python and Indian rock python as well. The species is limited to Southern Asia. It occurs in a wide range of habitats, including grasslands, swamps, marshes, rocky foothills, woodlands, open jungle and river valleys. They depend on a permanent source of water. Sometimes they can be found in abandoned mammal burrows, hollow trees, dense water reeds and mangrove thickets. Lethargic and slow moving even in its native habitat, they exhibit timidity and rarely try to attack even when attacked. Locomotion is usually rectilinear, with the body moving in a straight line. They are excellent swimmers and are quite at home in water. They can be wholly submerged in water for many minutes if necessary, but usually prefer to remain near the bank.

The main threat for this species is the overexploitation as for centuries, humans have killed pythons out of fear. Snakes of all kinds are also hunted for food, skins, and blood believed to have medicinal values. Live snakes are killed to order in Thai markets so customers can drink the fresh blood, thought to impart vitality. Python and other snake skins are made into fashionable accessories such as purses, shoes, and belts. Even before the snake skin boots were fashionable, pythons were considered a trophy species and hunted heavily by Europeans. More recently, they have become sought after for the pet trade and for zoos. In addition, the habitat loss is the main threat to this species as python’s jungle habitat is disappearing as trees are cut down for lumber, firewood and to make room for spreading human settlement and agriculture.

Varanus bengalensis monitor lizard is listed in the Appendix I of CITES therefore a protected species. It is found in the Indian Subcontinent, as well as parts of Southeast Asia and West Asia. This large lizard is mainly terrestrial, and grows to about 175 cm from the tip of the snout to the end of the tail. The species is distributed mainly in the lower elevations, and is found both in dry semi arid desert habitats to moist forest. They are often found in agricultural areas, and are mainly found below 1500 m altitude.

They shelter in burrows or crevices in rocks and buildings and tree hollows. Monitor lizard show true sleep at night and are diurnal, becoming active around 6 AM and bask in the morning sun. During winter, in the colder parts of their distribution range, they may take shelter and go through a period of reduced metabolic activity. They are not territorial, and may change their range seasonally in response to food availability. They are usually shy and avoid humans. They have keen eyesight and can detect human movement nearly 250 m away. The natural threat for these animals is predation from pythons, mammalian predators and birds. A number of ectoparasites and endoparasites are also recorded. Major threats for this species include the habitat destruction and the international trade in reptile skins and in monitors as pets and human consumption.

Aquatic habitats and species

The construction works will result in impacts on the plunge pools, Dhal Dara channel and Ghazi-Barotha head pond and species populations. The subsections below assess the impacts in relation to the following construction activities:

- Construction of the powerhouse and associated Project components (intake, headrace and diversion tunnels, tailrace, spillway)

The construction works will involve the following potential impacts:

- Temporary disturbances to downstream water flow volume and variability during the construction of the intake (raising of the current intake structure), powerhouse and tail race, as well as coffer dams
- Temporary disturbance of plunge pools and Dhal Dara channel bed substrate due to construction work resulting in a reduction in water quality due to a temporary increase in suspended sediments
- Reductions in water quality, resulting from potential release of contaminants into the plunge pools as well as localised water quality issues due to discharges from construction facilities
- Dewatering of the Dhal Dara channel.

During the project construction, deterioration in water quality from an increase in suspended sediments and subsequent deposition on the plunge pools and Dhal Dara channel bed substrate is expected. There is potential for excavation works in the river banks to release sediment into the plunge pools also. This will result in smothering of downstream habitats with the potential deposition of finer sediments. However, this impact is considered temporary and the affected habitats are not considered particularly sensitive to an increase in sediments. The plunge pools and channel are already subject to sedimentation and there is no spawning habitat in the channel. To allow construction of the powerhouse, cofferdams will be constructed across the Dhal Dara channel which will result in the dewatering of the channel. This will result in a temporary loss of aquatic habitat.

Habitat. The aquatic habitats present in the AoI are unnatural and highly modified with limited biodiversity value. The sensitivity of aquatic habitat is therefore considered low. Given the temporary nature of the works, the poor quality of the aquatic habitats presents in the AoI, and the fact that there is no further sensitivity to sedimentation predicted, the impact magnitude is considered negligible. Therefore, the overall impact of the construction of the Project components on aquatic habitats is adverse negligible and non-significant.

Common fish species. During the fish surveys carried out in April 2015 a total of 26 fish species were recorded. The fish community is not considered diverse and is mostly constituted by species adapted to lentic habitats. With the exception of the species *Tor putitora*, the overall sensitivity of the fish community present in the AoI is considered to be low. *Cyprinus carpio* is present in this section of the river and is assessed as Vulnerable by the IUCN; however, this species is widespread and introduced (probably invasive) in this region and therefore no longer considered a sensitive receptor in this assessment. The sensitivity of *Cyprinus carpio* is therefore also considered low.

Given the temporary nature of the works, the poor quality of the aquatic habitats presents in the AoI, and the fact that there is no further sensitivity to sedimentation predicted, the impact magnitude is considered negligible. Therefore, the overall impact of the construction of the Project components on common fish species is considered adverse negligible and non-significant.

Sensitive fish species. The species *Tor putitora* typically inhabits montane and sub montane regions in Pakistan, in rapid streams and rivers with rocky bottoms. It is not considered that there is a viable population of this species present in the AoI, given the waterbodies present are unnatural and/or heavily modified, the lack of suitable habitat present for this species, and the presence of in-river structures which inhibits this species migration.

Only two *Tor putitora* specimens were recorded in the 2015 surveys. During previous surveys undertaken in 2011for the purposes of the T4HP ESA, this species was not recorded. The results suggest that the presence of this species in the AoI is rare, and the individuals identified in the 2015 surveys are likely to represent isolated individuals of this species only. Impacts on the individuals present in the AoI will not affect the wider population significantly.

The conservation status of the species *Tor putitora* is endangered and consequently the sensitivity of this species is assessed as very high. Given the rare occurrence of this species in the AoI, the poor quality of the aquatic habitats present in the AoI, and the fact that there is no further sensitivity to sedimentation predicted, the impact magnitude is considered negligible. Therefore, the overall impact of the construction of the Project components on *Tor putitora* is considered adverse negligible and non-significant.

The Tarbela Dam is currently a barrier to upstream fish migration and the proposed changes to the T5 outlet will not change this. Impacts on fish migration are therefore not considered in this assessment.

7.8.3 Potential Impacts during Operational Phase

Terrestrial habitats and flora

Vehicle movements along the new access roads and routes along transmission line corridor during operation may lead to increased dust deposition and run off within the adjacent habitat. Permanent habitat fragmentation may also occur but this will be of very small scale and the habitats concerned are of low conservation value. These impacts are likely to be of minor magnitude and the resulting effect is therefore negligible and not significant.

Avian Risk Assessment

The birds that often perch on towers or on high tension lines: Small birds such as ring-dove (Streptopelia decaocto) and also passerines such as European Starlings (Sturnus vulgaris) often use the transmission line poles and wires for perching during winter or for some resident species also in other seasons.

The species of the study area are sometimes seen perching on High Towers of high tension transmission lines are:

- Black shouldered Kite Elanus caeruleus
- Pariah Kite Milvus migrans
- Long-legged Buzzard Buteo rufinis

It was observed that most bird species usually do not perch on high level transmission lines. However, there is no proper data collection for this in Pakistan. On the contrary the low level transmission lines are often used by some bird species for perching.

Birds with large wingspans in the Project area: Birds with large wingspan such as storks, cranes and birds of prey there is risk of bird collision with transmission lines. Wing spans of large birds that visit or pass through Tarbela or might cross proposed transmission line are given in **Table 7.40**.

Table 7.40:Wingspan of large birds in the project area

No.	Name	Wingspan
1.	Great Euration cormorant *Phalacrocorax carbo*	12.1 to 16.0 m
2.	Black stork *Cconia nigra*	1.8 m
3.	White-necked *Ciconia episcopus*	1.80 m
4.	White stork *Ciconia ciconia*	up to 2 m.
5.	Black-necked stork *Ephippiorhynchus asiaticus*	2.3–2.7 m
6.	Graylag goose *Anser anser*	7.6 to 8.9 m
7.	Bar-headed goose *Anser indicus*	1.68 m
8.	Lammergeyer Gypaetus barbatus	2.3 - 2.8 m
9.	Eurasian griffon Gyps fulvus	2.3–2.8 m
10.	Himalayan griffon vulture *Gyps himalyansis*	2.6 m
11.	Shor-toed eagle *Circaetus gallicus*	1.70-1.85 m
12.	Marsh harrier *Circus aeruginosus*	1.15 to 1.30 m
13.	Goshawk *Accipiter gentilis*	1.03–1.17 m
14.	peregrine falcon *Falco peregrinus*	0.78-1.22 m
15.	Eurasian Sparrow-hawk *Accepter nisus*	up to 0.80 m
16.	Tawny eagle *Aquila rapex*	1.59-1.83 m
17.	Steppe eagle *Aquila rapex nepalensis*	1.65 m
18.	Golden eagle *Aquila chrysaetos*	1.5 to 2.4 m
19.	Imperial eagle *Aquila haliaca*	2.14 m
20.	Bonnelli’s eagle *Hieraaetus fasciatus*	1.5 – 1.8 m
21.	Booted eagle *Hieraaetus pennatus*	1.2 m
22.	Common crane *Grus grus*	1.8–2.4 m
23.	Demoiselle crane *Anthropoids virgo*	1.55–1.8 m
24.	Rook Corvus frugilegus	9. m
25.	Raven Corvus corax	up to 1.3 m

Information from communities living close to the transmission line on avian mortality: During the field trips several people at four different sites near the transmission were interviewed, including livestock herds’ boys, an ex-soldier, a school teacher, 10-15 school boys and 5-6 field women. They were asked questions about bird mortality due to collision with the existing transmission lines. No one had ever seen any bird colliding with high power transmission lines. However, the school boys said they had once seen in a morning a dead house crow near the TL area. Herds boys had seen an egret in the mouth of a dog in August during rain. One herd boy had seen sparrow-like bird fallen right under TLs. Ex-soldier had never seen any bird colliding with wires of the existing TLs. He said no bird sits on these wires or Towers. However, low level power lines are mostly perched with several types of birds. He said he has seen bird sitting on poles of low power transmission lines. School Master said once he had picked a fresh dead dove from ground under the western TL. He said that it had no wound or blood on its body. He said with confidence that it must have died of collision with high tension wires.

They were also asked if they had seen birds perching on wires or on towers. The herds' boys said occasionally they see a bird bigger than a kite on TL towers. Upon asking about any sighting of the birds passing between the wires of transmission lines, every one replied in negative.

The biological survey team, while gathering information also asked the local community about bird collision with any of the four transmission lines. According to his information only 4 people could mention bird mortality of House crows. A couple of people mentioned about the mortality of doves, pigeons, sparrows etc. They mentioned that they observe these casualties mostly in rainy season. Nothing is known about large sized birds.

Discussion on the avian risk: In Pakistan there is total lack of observational and data-collection or reporting system or systematic studies on collisions of birds with Power Lines or their electrocution. In other countries alarming number collisions are estimated, particularly of the big size raptors such as golden eagles and buzzards, more particularly the juveniles.

The bird specialist visited the study sites in three trips. There are four high tension lines and the tower already existing close to the proposed TL5. Apart from author's own understanding and visual survey the communities of the area were asked about the bird mortality due to collision with high tension lines in the area. There was no observation for that. However, there were assumptions of collision with wires on the basis of some occasional dead bird found on the ground.

There are observations in the West of the power poles of particular favorite structures for the raptors to perch in the agricultural plains where range of their vision allows them to scan wider areas for their prey. From such high structures the speed of attack gives them success in their hunt. But the design of the high tension Power Towers in Pakistan, in the author's observation provides least suitability for the birds to perch. However, soaring bird over agricultural areas, where if prey is in abundance, might swoop at fast speed. The high power lines can cause collision accident for the attacking birds.

In some countries thick flocks of small birds flying fast, particularly in misty mornings, have been observed to collide with the wires across their way, causing mortality of several birds. Similarly, mortality of ducks and swans has been reported due to collision with power lines during their migration in huge flocks. Large birds, which are less maneuverable, such as heron and cranes are more vulnerable to collisions with power lines.

Conclusion: It cannot be concluded that there is bird collision risk with high power transmission lines, nor this risk can be denied in the absence of any authentic reporting. Wire spacing is critical for large-winged birds. Present Power Lines have long spacing of over 3 m between them. It appears these are safe for birds. However, there is need for such observations information on scientific lines. There is also need of observations on the major flight lines crossing the TLs. At such places high visibility subjects such colour balls or bird deterrent devices needs to be installed.

Terrestrial fauna.

There will be no further temporary or permanent habitat loss during the operational phase of the Project. However, impacts on terrestrial species occurring within the Aol of the Project may include an increase in disturbance, noise, dust and an increased risk of road kills/injury due to increased vehicle movement on the new/refurbished roads.The small increase in vehicle collision risk is likely to be of negligible magnitude for terrestrial fauna species (mammals, birds, herpetofauna),the resulting effect will be adverse negligible and non-significant.

Aquatic habitats and species

Changes in water quality have the potential to affect fish communities if species water quality requirements (for example water temperature and oxygen concentrations) or thresholds (sediment concentration) are breached. However, during the operation of the project no significant changes to water quality or changes in the flows regime are expected. Changes in changes in water temperature, dissolved oxygen and sediment concentration are not anticipated and consequently the impacts on aquatic habitats and fish species are considered negligible.

However, during the operation of the project there is the possibility for fish to be entrained in the powerhouse turbines and killed. Given the fact that the fish population present in the AoI is not diverse and of low conservation value, the overall impact is considered adverse minor and non-significant.

The conservation status of the species *Tor putitora* is endangered and consequently the sensitivity of this species is assessed as very high. However, the population numbers are very low and the presence of this species in the study area is considered rare. Consequently, the overall impact is considered negligible and non-significant.

Impacts from pilot project on floating solar power panels

Feasibility studies will be carried out to develop and implement a pilot project on power generation from floating solar panels in Tarbela reservoir. The potential impacts expected from installation of floating solar panels reduced light penetration into the water, by the obstruction of panels, which may in turn affect the organisms that depend on light for their existence (photosynthesis) and fish; reflection from the panels may induce thermal changes in to the water; changes in the reservoir water quality due to its contact with the photovoltaic panels; and decreased evaporation. Detailed mitigation plans will be developed and monitoring will be carried out during implementation of the pilot project

7.8.4 Summary of Impacts

A summary of the potential impacts is shown in **Table 7.41**.

Table 7.41: Summary of significance assessment of potential impacts

Potential Impact	**Receptor**	**Adverse/ beneficial**	**Magnitude**	**Sensitivity**	**Impact Evaluation**	**Significance**
Construction phase						
Terrestrial habitats and flora: • Loss and degradation of terrestrial and riparian habitat • Introduction or spread of non-native invasive species	Sensitive terrestrial habitat (dry sub-tropical broad-leaved scrub forest)	Adverse	Minor	Medium	Minor	Not Significant
	Other habitats	Adverse	Moderate	Low	Minor	Not Significant
	Flora	Adverse	Moderate	Low	Minor	Not Significant
Terrestrial fauna: • Habitat loss/degradation • Disturbance (presence of	Common mammal species	Adverse	Minor	Low	Negligible	Not Significant
	Common birds	Adverse	Minor	Low	Negligible	Not Significant

Potential Impact	Receptor	Adverse/ beneficial	Magnitude	Sensitivity	Impact Evaluation	Significance
people, artificial lighting and noise) • Injury or death owing to construction works (including trapping in deep excavations) and increased traffic • Temporary habitat fragmentation	Internationally important birds (mallard)	Adverse	Negligible	Very High	Negligible	Not Significant
	Common herpetofauna	Adverse	Minor	Low	Negligible	Not Significant
Aquatic habitats and species: Construction activities leading to: • Temporary disturbance to flow • Temporary disturbance to substrate • Changes in water quality	Habitats: Tarbela Reservoir, Dhal Dara channel, plunge pools and Ghazi-Barotha head pond	Adverse	Negligible	Low	Negligible	Not Significant
	Threatened fish (*Tor putitora*)	Adverse	Negligible	Very High	Negligible	Not Significant
	Common fish species	Adverse	Negligible	Low	Negligible	Not Significant
Operational phase						
Terrestrial habitats and flora: • Dust deposition and run off from increased vehicle movements • Permanent habitat fragmentation (low scale)	Sensitive terrestrial habitat (dry sub-tropical broad-leaved scrub forest)	Adverse	Minor	Medium	Minor	Not Significant
	Other habitats	Adverse	Minor	Low	Negligible	Not Significant
	Flora	Adverse	Minor	Low	Negligible	Not Significant
Birds : • Risk of collision and electrocution by transmission line	Water birds	Adverse	Negligible	Low	Negligible	Not Significant
	Migratory birds	Adverse	Minor	Medium	Minor	Not Significant
Terrestrial and riparian fauna: • Permanent habitat fragmentation (low scale) • Increased disturbance, noise, dust • Increased risk of road kills	Common mammal species	Adverse	Negligible	Low	Negligible	Not Significant
	Common birds	Adverse	Negligible	Low	Negligible	Not Significant
	Internationally important birds (mallard)	Adverse	Negligible	Very high	Negligible	Not Significant
	Common herpetofauna	Adverse	Negligible	Low	Negligible	Not Significant
Aquatic habitats and species: • Changes in water quality (sediments, chemical due to pollution events) • Changes in water levels • Entrainment	Habitats: Tarbela Reservoir, Dhal Dara channel, plunge pools and Ghazi-Barotha head pond	Adverse	Negligible	Low	Negligible	Not Significant
	Threatened fish (*Tor putitora*)	Adverse	Negligible	Very High	Negligible	Not Significant
	Common fish species	Adverse	Negligible	Low	Negligible	Not Significant

7.8.5 Mitigation, Enhancement and Monitoring Measures

The actions in this section have been identified to implement good practice measures during the construction process, in order to ensure the impacts of the proposals on biodiversity remain non-significant, and to ensure enhancement and monitoring measures are imposed. This will allow for the careful management of risk and the best possible outcomes for the Project and local communities, without compromising the health, function and integrity of the ecological systems.

These practical measures should minimize any additional pressures on habitats and animals from construction and land clearance activities. In addition, further survey and assessment works are proposed during the pre-construction, during construction and post-construction (operational) phases to determine the significance of the biodiversity and to refine the good practice measures proposed.

Ecological Management Plan

As part of the CEAP, the contractor will prepare an ecological management plan covering the following measures before starting of vegetation clearance:

- Survey of the area by qualified biologist(s) ahead of ROW clearing, as well as strict prohibition for the workforce on killing or capturing any of the species.
- Vegetation clearing be ensured to be limited to minimum required for work.
- Felling of trees of >30cm girth is to be minimized during project implementation.
- Utilization of existing accessible tracks as much as possible.
- Establish a perimeter of protection around sensitive ecosystems and unique habitats.
- Plan work activities to minimize presence and duration of work in ecologically sensitive areas thus less interference on wildlife.
- Limit vegetation clearing to footprint required for construction purposes to minimize disturbances along proposed transmission line ROW.
- Allow re-growth, within height restrictions, of native ground cover beneath lines (along ROW, lay-down areas and access roads).
- Maintain construction equipments to optimal function conditions.
- Monitor presence of wildlife species during construction activities.
- The design of the transmission line shall be in line with standards observed by International bodies.
- Periodically carry out ROW maintenance activities to manage growths of weeds and other creeping plants on the tower bases in a manner that minimizes adverse impacts on vegetation.
- Machinery, vehicles and instruments that emit high levels of noise should be used on a phased basis to reduce the overall impact.
- Limit heavy duty construction works to the day hours only where practicable.
- Competency training and certification of drivers before mobilization.
- Setting and enforcing speed limits.
- Coordinate work activities to avoid heavy traffic periods.
- Use warning signs and traffic wardens/directors.
- Develop project specific waste management plan and ensure proper implementation.
- Provide adequate containers for waste collection.

- Ensure that all personnel deployed on project activities are qualified and certified for their relevant works
- Ensure that approved safe work procedures are provided and complied with at all times.

Good Practice Measures for Terrestrial Habitats and Flora

All construction and operational working areas will be kept to a minimum to reduce habitat loss and degradation. All off-road access will be prohibited or allowed along pre-defined routes that limit the extent of off-road activity. Plans will be implemented to minimize all construction traffic activities. Measures, such as water sprays, will be implemented for the reduction of dust during the working periods.

A Habitat Removal and Restoration Plan (HRRP) will be produced by the Contractor and reviewed by a qualified ecologist before start of construction. The HRRP will set out the minimum requirements in relation to the clearance and restoration of natural habitats, and the removal, storage and reinstatement of soil. The HRRP can be an independent document or can be included in the CEAP.

The HRRP is likely to include the following practices:

- Where practical, soil removed from construction sites will be stored and used in the restoration
- Habitats affected temporarily during construction will be restored/reinstated on a 'like-for-like or better principle', using the species recorded during the baseline surveys (native species only)
- Specifications for a tree inventory of all trees to be removed or affected by the works. The inventory will be undertaken pre construction and pre-vegetation clearance and will include an assessment of the tree species to be affected, their size and condition
- The habitat/land-use maps prepared for this ESA will be used to inform the habitat restoration
- All species used in the habitat restoration will be native. No introduction of non-native plant species will be allowed.

Where restoration of natural habitat is not possible on site (e.g. under the footprint of the permanent structures), similar habitat will be created off-site. The client will investigate options for compensation land in the same district. The following two approaches could be considered:

- One option is for the client to commission a forest restoration or similar plan to replace the habitats permanently lost by the Project in an offsite location. A local ecologist should be employed to determine a suitable offsite area and restoration works should be undertaken under a defined restoration plan. The restoration plan should include instruction on the preparation of the area identified, to sourcing of soil and trees of local provenance and a defined management and monitoring plan to ensure the habitats created are established successfully for the long-term viability of the habitat.
- A second option is for the client to provide financial and logistical support to existing afforestation programmes by the Forest Department. The afforestation supported by the client will be commensurate with the habitat areas to be permanently lost under the different components of the project.

To ensure the habitats restored on-site or created off site are established successfully, they will be maintained and monitored for at least five years (discussed later in the Section).

Good Practice Measures for Terrestrial and Riparian Animal Species

Noise reduction. All construction activities have the potential to generate noise and vibration, which may disturb birds, mammals and other wildlife. The following measures will be implemented across the Project AoI to reduce noise levels and disturbance to wildlife:

- Avoidance of unnecessary revving of engines and switch off equipment when not in use
- Vehicles and equipment will be properly maintained to meet the manufacturers' noise rating levels. Any silencers or bearings which become defective would be replaced as soon as possible
- Using reverse warning systems incorporating broadband noise where practicable
- Using enclosures for noisy plant such as pumps or generators
- Minimizing drop height of materials
- Limiting the use of particularly noisy plant or vehicles where practicable
- Plant and vehicles will be operated with noise control hoods closed.

Reduction and control of artificial lighting. Artificial lighting used on construction sites and camps at night will be shaded and directed downwards to avoid light spillage and disturbance to nocturnal birds, bats and other wildlife.

Ban on hunting and poaching. A ban on hunting and poaching by construction and operation staff will be implemented to reduce pressure on threatened and protected species in the Project areas and surroundings. All construction and operation staff will be required to follow company rules and code of conduct. Signage will be installed illustrating the hunting ban on any species throughout the Project areas. This measure will be implemented by both the Contractor and the client, who will employ suitable environmental staff to audit this.

Checks for breeding birds. To minimize the potential impact to all breeding bird species, vegetation clearance will be undertaken outside of the main bird breeding period if possible. Where this is not possible, the areas to be cleared will be checked for breeding birds prior to the clearance and if nesting birds are found, appropriate mitigation measures will be implemented. This may involve avoiding construction within 50m of the active nest until the chicks have fledged.

Mitigation measures for birds in relation to the power lines connecting the powerhouse to the switchyard will include the installation of bird diverters at 7m to 10m spacing[33]due to location within 500m of a water body andpartial perpendicular orientation to the line of bird flight.

Other good practice measures. All pits, trenches and excavations will be covered overnight or fenced to avoid animals falling in. Pits and trenches will be checked prior to refilling.

[33]Avian Power Line Interaction Committee (APLIC), (2012). Reducing Avian Collisions with Power Lines: The State of the Art in 2012. Edison Electric Institute and APLIC. Washington, D.C.

Vegetation clearance will be carried out in a methodical manner so that any fauna present in these areas can disperse. Where clearance of dense scrub is required, it will be preceded by a hand search for mammal and/or reptile species which may be present in the sward. The dense vegetation will only be cleared once it has been established that any individuals present have fled. The incidental creation of pockets of habitat or islands will be avoided. Before and during vegetation clearance or tree felling, any animals found will be removed and released to safe refugium.

Notices will be put up along the site roads to highlight the risk of collision with mammals and other animals.

Good Practice Measures for Aquatic Habitats and Species

The following good practice measures associated with the aquatic habitats will be implemented:

Avoiding increased sedimentation. Management controls will reduce, capture, and treat soil erosion to avoid increased sediment load during construction and operation. For example:

- Exposed work areas near watercourses or in the riparian zones will be reinstated with suitable vegetation as soon as possible. Where possible, reinstatement will be undertaken using the same species present in the area before construction
- During construction, riparian vegetation adjacent to the water courses will be retained where possible to act as buffer zones to assist in trapping sediments before reaching the water course.

Avoiding pollutants in waterbodies. There will be no direct discharges of any pollutants to the river, and the river should not be used to clean machinery or for any other purpose where pollutants may be released. Fuel storage, asphalt manufacturing, explosives and other potentially polluting activities must occur away from rivers and have adequate pollution control measures.

Fish catch and release. During construction, fish catch and release must be carried out prior and during the dewatering period of the Dhal Dara channel and in all cases where coffer dams are created. Catch and release methods must be reviewed and approved by the Engineer before being implemented on site. The Contractor will need to ensure that expected fish numbers are calculated and sufficient resources are available.

During operation some fish maybe killed while moving through the turbines. In line with previous studies carried out for T4HP ESA no fish screens have been included in the design. However, it is proposed that monitoring of the fish populations in the plunge pools should be undertaken to identify any potential population decrease in the plunge pools and Dhal Dara channel. This will be undertaken pre and during construction and for the first three years of operation tofacilitate understanding of trends and confirmation of whetheradditional measures are required.

Measures to Prevent Introduction and Spread of Non-native and Invasive Species

Fifty terrestrial non-native and invasive plant species have been recorded in the AoI. The contractor will monitor these species during construction and will identify and report new invasive species establishing in the Project AoI during construction. Other species known to be invasive in Pakistan and globally[34] will also be monitored if they are recorded on the construction sites. A local botanist will be employed to undertake the monitoring or will be contacted to confirm the identification of invasive species.

In the absence of industry specific guidance, construction and operational activities on this Project will comply with international guidelines on the prevention and management of alien invasive species (AIS)[35]. Preventative, control and monitoring measures will need to be implemented with regard to the following aspects of the Project:

Packaging and movement of materials:

- Minimize traffic and the distance it has travelled
- Source goods/materials locally where possible
- Contain any AIS and report their presence.

Vehicles and plant:

- 'As-new' wash-down is essential before entering non-infested areas and after working in infested areas
- Train and raise awareness regarding AIS
- Pressure wash vehicle tires in a contained area
- Contain and destroy residue
- Record and report the presence of any AIS.

Soil and vegetation:

- Minimize disturbance to, or movement of, soil and vegetation
- Prevent soil damage and erosion
- Ensure imported soil/other materials are safe and free of AIS (source from a reputable supplier, request information on the soil's origin and certification of AIS-free status if possible)
- Prevent AIS establishment on exposed stored soil (do not store bare soil near known sources of AIS, consider using matting to cover exposed soil)
- Ensure infested material is disposed of safely
- Retain as much natural vegetation as possible.

Habitat reclamation:

- Use native plants for reinstatement and landscaping
    - Assess any non-native species (to be used in landscaping) for AIS potential
    - Consider that some AIS may be soil-based
    - Avoid altering soil and water body properties.

Linear elements (transmission lines, roads, waterway):

- Plan the timing of activities to avoid impacts on AIS
- Minimize spread width
- Minimize vehicle-related impacts

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[34] Refer to Lowe, S., Browne, M., Boudjelas, S., De Poorter, M. (2000). 100 of the World's Worst Invasive Alien Species. A Selection from the Global Invasive Species Database. Published by the Invasive Species Specialist Group (ISSG), a specialist group of the Species Survival Commission (SSC) of the World Conservation Union (IUCN). Updated 2004

[35] IPIECA & OGP (2010). Alien invasive species and the oil and gas industry. Guidance for prevention and management. OGP Report Number 436

- Contain existing AIS
- Minimize entry and exit points.

It has to be mentioned that not all the above measures will need to be implemented; a risk screening will need to be undertaken by the contractor for each construction site and this will inform the implementation of the most appropriate prevention and control measures. The EMP will provide further details.

Apart from the measures relevant to invasive plant species (to be implemented by the Contractor), the client will implement measures to prevent or minimize the introduction/spread of invasive fish species, including the non-native carp species. Awareness raising and education programs for the local communities will be implemented (discussed later in the Section).

Awareness Raising and Education

WAPDA will sponsor awareness raising programs for the local communities to explain why and how invasive species of plants and animals (especially invasive fish) affect native biodiversity. The conservation importance of native species and their threats will be explained along with the services provided by the local ecosystems and biodiversity. Measures to reduce overgrazing and soil erosion will also be explained to the local communities. These programs will be implemented by a local NGO to be employed by the client.

Monitoring

Ecological surveys to inform this assessment were undertaken in spring and autumn of 2015. For certain biodiversity features, additional baseline data is needed before construction. In addition, monitoring of certain biodiversity features will be undertaken during construction and for a number of years' post-construction. The pre-construction surveys and subsequent monitoring are summarized in **Table 7.42** below, with some more information provided in the following two sections.

Table 7.42: Summary of pre-construction, construction and operational biodiversity surveys and monitoring

Survey / Monitoring Type	Pre-construction	During Construction	Post-construction (Operation)
Terrestrial systems			
Habitats and flora	Undertake pre-construction surveys using transects and quadrats in the footprint of the Project components which were not surveyed in 2015.	Not required	Timescale: first five years after construction Areas: restored natural habitats and offset habitats; monitoring habitat condition and the health of replanted trees.
Birds, mammals and herpetofauna	Undertake pre-construction surveys using transects and survey points in the footprint of the Project components which were not surveyed in 2015.	Not required	Not required
Tree inventory	Timescale: pre-vegetation clearance Areas: all areas to be cleared	Not required	Not required
Invasive plant species	Not required	Timescale: every 3	Not required

		months during construction Areas: all construction sites, new access roads, and stockpiles	
Aquatic systems			
Fish (together with water quality monitoring)	Timescale: pre-monsoon, during and after monsoon Areas: repeat same four sites surveyed in 2015.	Timescale: pre-monsoon, during and after monsoon Areas: repeat same four sites surveyed in 2015, however it may not be possible to survey the Dhal Dara channel as it will be dry for part of the construction period.	Timescale: pre-monsoon, during and after monsoon first three years of operation Areas: same 2015 locations at the Dhal Dara channel and downstream of the weir in the Dhal Dara channel.

Monitoring of terrestrial systems

Pre-construction baseline surveys are recommended for habitats, flora, birds, mammals and herpetofauna, to address the limitations to the data collected in 2015. The layout of the Project (**Chapter 3**) has altered since these biodiversity surveys were undertaken and therefore the terrestrial biodiversity surveys are not representative of the current Project layout and component locations. The pre-construction surveys should follow the same methodologies used for the original baseline surveys, but covering the areas under the footprint of the current Project components to confirm there is no potential for habitats or species of high conservation value to be impacted by the Project.

Any restored natural or offset habitats should be monitored to measure the success of habitat reinstatement and creation, including the habitat condition and the health and mortality of planted trees. The monitoring will start six months after the completion of habitat restoration or creation at each site and will continue every six months for five years. The biannual monitoring reports will include recommendations for any remediation measures needed, for example replacement of dead tree saplings, watering of tree saplings in the dry season, weed control, and pest protection.

During construction, checks will be undertaken for the accidental introduction or spread of alien, invasive species, especially plant species which may be brought into the areas from construction activities (on vehicles, in any imported materials). Checks by a qualified botanist will be undertaken around all major working areas and site compounds every three months. Measures to remove/eradicate any species introduced, if found, will be put in place. The monitoring will include the invasive species already known in the AoI and any other species that are known to be invasive in Pakistan.

Monitoring of aquatic systems

Aquatic monitoring surveys will be undertaken at the four sites surveyed for fish in the study area in 2015 pre, during and post construction, in order to further monitor the fish populations, present in the waterbodies of the AoI. These will be carried out seasonally by local specialists' pre, during and post monsoon for the duration of construction and during the first three years of operation. They will include notes on the habitat suitability and presence of key sensitive species as well as an assessment of water quality and sediment loads.

7.8.6 Residual Impacts

Residual impacts are those significant impacts that remain after the application of mitigation and/or enhancement measures. None of the potential impacts described in **Table 7.41**are considered to be significant and therefore it is not considered they will remain after the implementation of the good practice measures described earlier. Therefore, there are not considered to be any remaining residual impacts on biodiversity as a result of the proposed scheme.

7.8.7 Statement of Significance

The natural land and under the proposed project footprints has been undergoing transformation in to cultivation or degraded to barren land, and only at some locations the scrub land of relatively semi-natural are located. The trend of the degradation is expected to continue (even without project scenario) due to agricultural and residential development. The vegetation species are also mostly dominated by invasive species of*Lantana camara.* This ecological impact assessment predicts that the proposed Project will not result in any significant effects.

8 Assessment of Social Impacts

This chapter considers the potential socio-economic and community impacts associated with construction and operation of the power generation component of the Project. This social impact assessment (SIA) involves the processes of analyzing managing and monitoring the intended and unintended socioeconomic consequences, both positive and negative, of the Project interventions, and any socioeconomic change processes invoked by those interventions. The chapter includes a description of the methodology and assessment criteria, the socio-economic baseline, assessment of socio-economic impacts, mitigation and enhancement measures and residual significance. It concludes with proposed monitoring and reporting and a statement of significance and compliance.

8.1 Assessment Methodology

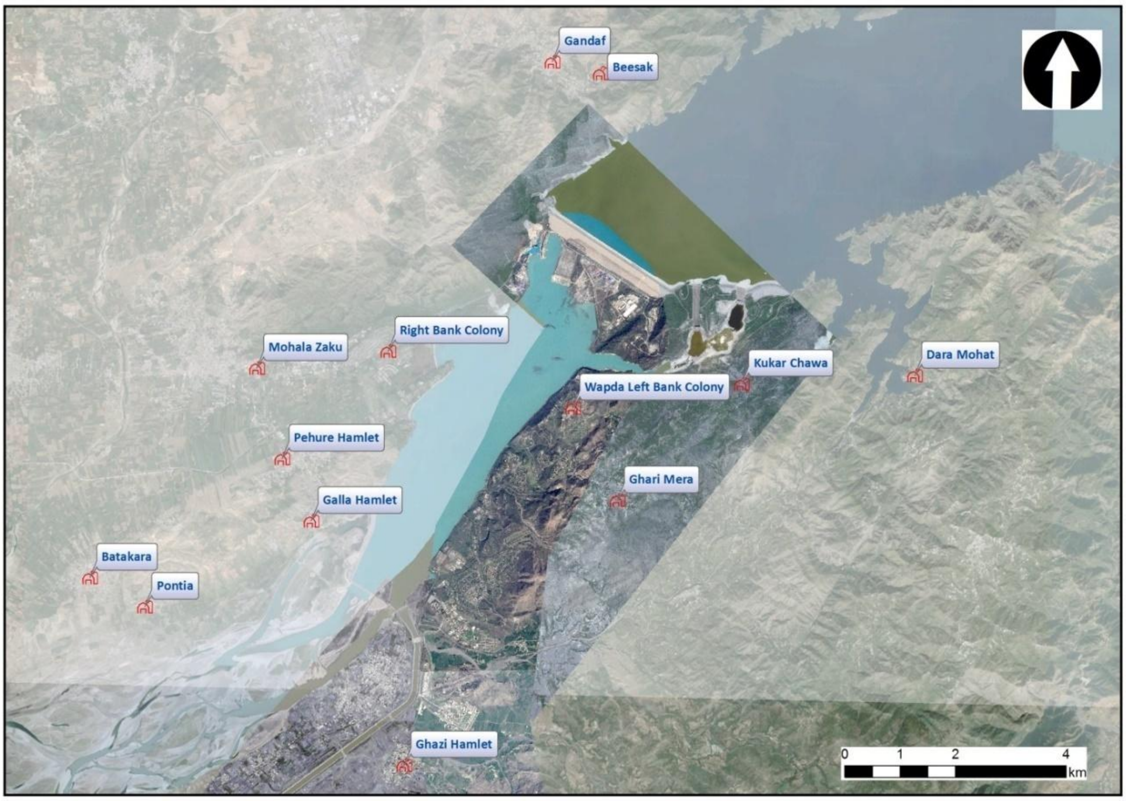
8.1.1 SIA Area of Influence and Study Area

The SIA uses the same ADI and AoI as presented in **Section 1.4**. The area of direct influence is where construction activities will take place and Project components are located. The AoI includes the ADI and additional areas where impacts may affect receptors. The AoI is the same as was used for T4; 5km on upstream,10km on downstream of the dam and 2km on each side (right and left bank) of the elongated area. The villages and WAPDA employee residential colonies within the AoI is presented in **Table 8.1** and shown in**Figure 8.1.**

Table 8.1: Villages and WAPDA residential colonies in the AoI

Villages	District	Approximate Distance from site (km)
Kukar Chawa	Haripur	0.55
Ghari Mera	Haripur	3.11
Ghazi Hamlet	Haripur	9.01
Dara Mohat	Haripur	3.80
WAPDA Left Bank Colony	Haripur	3.39
Gala Hamlet	Swabi	7.86
Mohala Zaku	Swabi	7.15
Pontian	Swabi	11.04
Batakra	Swabi	11.85
Gandaf	Swabi	5.79
Beesak	Swabi	10.03
Pehure Hamlet	Swabi	8.03
WAPDA Right Bank Colony	Swabi	6.12
Omar Khana	Haripur	Within TL AoI
Qibla Bandi	Haripur	Within TL AoI
Burhan	Attock	Within TL AoI
Pind Sahab	Attock	Within TL AoI
Bahatar Mera	Attock	Within TL AoI
Kaimalpur Mayan	Attock	Grid station site

Figure 8.1:Villages in the AoI (at/near TDP)



Settlements along/around the power evacuation facilities are given in **Table 8.2**

Table 8.2: List of villages along TL and grid station

S.No	Name of Village	District	Angle Tower Number
Grid Station			-
1	Kamalpur Miyan	Attock	-
Transmission Line			-
2	Bahtar Mera	Attock	34 & 35
3	Katariyan	Attock	31, 32 & 33
4	Dhok Khaliq Dad	Attock	29 & 30
5	Islamgarh	Attock	28
6	Burhan	Attock	26 & 27
7	Noorabad	Attock	25
8	Dhok Mughal	Attock	24
09	Dhok Ghar	Attock	22 & 23
10	Narcey	Attock	21
11	Qibla Bandi	Attock	18, 19 & 20
12	Qutab Bhandi	Attock	16 & 17
13	Pakki Ban	Haripur	14 & 15
14	Harbara	Haripur	13
15	Dhamrai	Haripur	12
16	Bera	Haripur	11
17	Piplian	Haripur	10
18	Ghara	Haripur	9
19	Barwasa	Haripur	8
20	Umer Khana	Haripur	5, 6 & 7
21	Gahri Mehra	Haripur	3&4
22	Minar Kot	Haripur	1&2

8.1.2 Determining Social Impact Significance

As discussed in **Section 7.1**, significance attribution takes into account magnitude and sensitivity criteria. Impacts identified with the potential to change the socio-economic context have been assigned significance using the overarching framework presented in **Section 7.1**. The SIA specific criteria for sensitivity and magnitude are presented below.

Social receptors considered in the assessment are individuals, households, social groups, business entities, and communities. The sensitivity of receptors is related to their socio-economic vulnerability to impoverishment risks, considering their capacity to cope with impacts that affect their access to or control over additional or alternative socio-economic resources of a similar nature. Very sensitive or vulnerable socio-economic receptors generally have less means to absorb adverse changes or to replicate beneficial changes to their resource base than non-sensitive or non-vulnerable receptors. Project activities that increase impoverishment risks including landlessness, joblessness, homelessness, marginalization, increased morbidity and mortality, food insecurity, loss of access to common property resources, and lack of voice contribute to increased vulnerability. **Table 8.3** presents the criteria used to categorize the sensitivity of receptors.

Table 8.3: Criteria for determining sensitivity

Category	**Description**
High	An already vulnerable social receptor with very little capacity and means to absorb proposed changes or with very little access to alternative similar sites.
Medium	An already vulnerable social receptor with some capacity and means to absorb proposed changes or with little access to alternative similar sites.
Low	A non-vulnerable social receptor with limited capacity and means to absorb proposed changes and with some access to alternative similar sites.
Negligible	A non-vulnerable social receptor with plentiful capacity and means to absorb proposed changes and with good access to alternative similar sites.

The magnitude of an impact and its effects is the extent to which the impact results in a receptor gaining or losing access to or control over resources resulting in a beneficial or adverse effect on their wellbeing. Well-being refers to the financial, physical and emotional conditions of a receptor.

The assessment of magnitude has been undertaken in two steps. Firstly, the key social impacts associated with the project are identified along with the nature of the impact as to whether it is beneficial or adverse, direct or indirect, transboundary or cumulative, or a combination of any of the above. Secondly, the magnitude of impacts is categorized as either major, moderate, minor or negligible based on consideration of the parameters listed below:

- Duration of the impact
- Spatial extent of the impact
- Number of people affected and severity of impact
- Likelihood

Table 8.4 summarizes the categories of magnitude criteria.

Table 8.4: Criteria for Determining Magnitude of Impact

Category	**Determination**
Major adverse / beneficial	A highly likely impact that would have implications beyond the

	Project life affecting the wellbeing of many people across a broad cross-section of the population and affecting various elements of the local communities', or workers', resiliencein a negative/harmful way.
Moderate adverse / beneficial	A likely impact that continues over a number of years throughout the Project life and affects the wellbeing of specific groups of people and affecting specific elements of the local communities', or workers', resilience.Also an impact that continues over a short period of time but affects some groups of people intensely in multiple ways.
Minor adverse / beneficial	A potential impact that occurs periodically or over the short term throughout the life of the Project affecting the wellbeing of a small number of people and with little effect on the local communities', or workers', resilience.
Negligible	A potential impact that is very short lived so that the socio-economic baseline remains largely consistent and there is no detectable effect on the wellbeing of people or the local communities', or workers', resilience.

8.2 Potential Impacts

This Section presents the expected social impacts as a result of the Project and assesses their beneficial and adverse. Impacts have been considered and assessed for the construction and operation phases of the Project. Because the Project is part of a large dam producing needed electricity, and decommissioning is far into the future and currently is not planned, decommissioning impacts such as staff retrenchment cannot currently be anticipated with any certainty and therefore are referred to infrequently. Mitigation and benefit enhancement measures are proposed in **Section 8.3**.

8.2.1 Land Acquisition/ Resettlement

Land Acquisition and Resettlement at the Dam Site

The powerhouse and auxiliary infrastructure will be built on uninhabited WAPDA owned land. Construction of temporary and permanent infrastructure, including the new switchyard, batching plant and labor camp, and the upgrading of access roads will all be in WAPDA owned uninhabited land. This land is also not used for any livelihood related activities by local communities. Hence no land acquisition or resettlement is required for the power generation components of the T5HP.

Land Acquisition and Resettlement for Transmission Line

The proposed 52 km T5 transmission line requires about 160 towers, in which only 32 angle tower locations are tentatively identified by NTDC at this stage. The final alignment of the transmission line including sitting of tower locations will be done under design-build contract. Hence exact land acquisition and resettlement impacts are not known at this stage. However socioeconomic surveys were carried out to understand the livelihood sources and landholdings near the tentative angle tower locations. Nearly 80 percent of the people who own the tower locations are farmers (for 50% farming is primary source of income and for remaining 30% it is secondary source of income).

Each tower requires about 200 square meters of area. The impacts associated with the towers include temporary loss of land under the foundation of the towers, disturbance to crops at the time of construction, and clearing of tall trees under the alignment. Detailed impact assessment will be prepared during the design stage. A land acquisition and resettlement frame work (LARF) has been prepared and presented under a separate cover. This framework will guide the preparation of future RAP in case permanent land acquisition is involved and in this case, there should be no commencement of construction activity at such locations until complete implementation of RAP. The NTDC standard entitlement matrix for the losses is given in **Table 8.5**.

Table 8.5: NTDC Standard Entitlement Matrix

Asset	Impact/Specification	Affected People	Compensation Entitlements
Arable Land	Access is not restricted and existing or current land use will remain unchanged	Farmer/Titleholder	• No compensation for land provided that the land is rehabilitated/restored to its former quality following completion of works; • Compensation, in cash, for all damaged crops and trees as per item below
		Leaseholder *(registered or not)*	• No compensation for land provided that the land is rehabilitated/restored to its former quality following completion of works; • Compensation, in cash, for all damaged crops and trees as per item below
		Sharecroppers *(registered or not)*	• Compensation, in cash or kind, for all damaged crops and trees as per item below
		Agricultural workers	• Compensation, in cash or kind, for all damaged crops and trees as per item below
		Squatters	• Compensation, in cash, for all damaged crops and trees as per item below
Arable Land where access is restricted and/or land use will be	All adverse effects on land use independent of severity of impact	Farmer/Titleholder	• Land for land compensation with plots of equal value and productivity to the plots lost; or; • Cash compensation for affected land at replacement cost based on market value [a] free of taxes, registration, and transfer costs
		Leaseholder *(registered or not)*	• Renewal of lease in other plots of equal value/productivity of plots lost, or Cash equivalent to market value of gross yield of affected land for the

Asset	Impact/Specification	Affected People	Compensation Entitlements
affected			remaining lease years (up to a maximum of 3 years).
		Sharecroppers *(registered or not)*	• Cash compensation equal to the market value of the lost harvest share once (temporary impact) or twice (permanent impact)
		Agricultural workers losing their contract	• Cash indemnity corresponding to their salary (including portions in kind) for the remaining part of the agricultural year.
		Squatters	• 1 rehabilitation allowance equal to market value of 1 gross harvest (in addition to crop compensation) for land use loss.
	Additional provisions for severe impacts (More than 10% of land loss)	Farmer/Titleholder Leaseholder	• 1 severe impact allowance equal to market value of gross harvest of the affected land for 1 year (inclusive of winter and summer crop and additional to standard crop compensation)
		Sharecroppers *(registered or not)*	• 1 severe impact allowance equal to market value of share of harvest lost (additional to standard crop • compensation)
		Squatters	• 1 severe impact allowance equal to market value of gross harvest of the affected land for 1 year (inclusive of winter and summer crop and additional to standard crop compensation)
Houses and Structure s		All relevant APs (including squatters)	• Cash compensation at replacement rates for affected structure and other fixed assets free of salvageable materials, depreciation and transaction costs. In case of partial impacts full cash assistance to restore remaining structure.

Asset	Impact/Specification	Affected People	Compensation Entitlements
Crops	Crops affected	All APs (including squatters	• Crop compensation in cash at full market rate for one harvest (either winter or summer) by default for impacts caused by tower bases, stringing and access.
			• All other crop losses will be compensated at market rates based on actual losses.
Trees	Trees affected	All APs (including squatters)	• Cash compensation shall reflect income replacement
Community assets			• Rehabilitation/substitution of the affected structures/utilities (i.e. mosques, footbridges, roads, schools, health centers, etc.)
Vulnerable AP livelihood		AP below poverty line	• Employment priority in project-related jobs.

Land Acquisition and Resettlement for Grid Station

About 226 acres of agricultural land will be acquired for construction of Islamabad West Grid station. The land acquisition will have impact on the livelihoods of the land owners; 50% of them depend on farming on these lands as the primary source of income. The site is located about 30 km from west of Islamabad. Since it is located close to Islamabad, there is lot of private housing development in these areas. Local communities are also eager to sell their lands for the housing developments. Same is the case with the owners of the grid station site, and they are willing to sell their lands for the market rates. NTDC is also planning to buy this land through negotiations with individual owners. A Resettlement Action Plan will be prepared for this site.

8.2.2 Construction Phase Impacts

Employment generation

The workforce requirement during construction of the transmission line would vary at various stages. Some of the workfore, particulary highly skilled labour and some of the semi-skilled labour, will be brought by the contractor. It is estimated that most of the unskilled labour will be hired from local communities. It is estimated that an overall labor force of 2,500 to 3,000 will be required during the peak construction phase of the power generation component of Project.

Construction activities near the dam site will take place 24 hours a day, seven days a week and are likely to consist of three shifts of eight hours. While the works for power power evacuation component are less labour intenstive and it is estimated that about 60 workers may be required on regular basis during the construction. These opportunities may attract people to the area around the Project but the induced in-migration will be minor or negligible because of the site access restrictions. Consultation results indicate that local communities will be looking to the Project to provide employment preferences for those already living near the Project. Using local community members will increase the local skill base and provide a boost to the local economy. Jobs that will be available using the skills they can provide include bricklayer, cement finisher, bus driver, worker camp and catering staff, scaffolder, concrete form setter, general construction laborer, cook, crane operator, driller, electrician, mechanic, ironworker, painter, pipefitter, plumber, security staff, sheet metal worker and truck driver.

Employment generation during the construction phase is considered to be a beneficial impact of moderate significance based on construction workers considered to be receptors of medium sensitivity and the magnitude being moderate.

Local economic development

During the Project construction phase, contracting parties will need to purchase materials, equipment and services for the Project, thereby creating business opportunities for suppliers. Opportunities will provide economic benefits to suppliers, especially to those who receive longer term contracts. For example, workers' accommodation supply companies may have contracts throughout the construction phase. This may also be the case for worker transportation, catering, security providers, or providers of construction materials and plant. For T4HP, contracts were let for two canteens and three grocery shops which could be maintained for the Project. There are other local businesses, such as a restaurant and a hotel near to the Project site which also benefit from increased business during the construction phase.

Overall, the procurement of goods and services by the Project will have a beneficial impact to suppliers, which are considered to be of low sensitivity as they are likely to have access to similar opportunities. The magnitude of this impact is considered to be minor based on the T4HP experience as it will be largely restricted to the construction phase and probably carry on existing contracts from T4HP. Therefore, local economic development is predicted to be a beneficial impact of negligible significance.

Construction disturbances to neighbors

The Project site will create some localized disturbances related to construction activities that produce noise, movement or vibration, traffic, hindrance of movement, and dust. The nuisance and disturbance related to construction activities will be most felt by thecommunities along the transmission line corridor and around the Tarbela.

Because of the distance from the work site to certain villages, such as Kukur Chawa and Kamalpur Miayan, it is anticipated that movement and vibration, dust and noise from construction will affect community member's daily activities. Adequate dust and noise control measures will be implemented during construction to minimize impacts on the local communities (these measures are described in Sections 7.4 Air Quality and 7.5 Noise and Vibration).

Noise from blasting with explosives and drilling will be resonated between the valley slopes and the dam and spread over the Ghazi-Barotha reservoir during excavation and construction works with predominant northerly winds and will reach the residential areas, including right bank and left bank WAPDA colonies, which are both situated at a distance within 2- 3 km from the construction site, while the nearest village Kukar Chawa is located at a distance of 500 m from left bank. Noise pollution would be restricted to day time periods and levels would be properly monitored. Workers in drilling areas will wear suitable ear protection. Noise monitoring at the residential colonies will be required, and if the noise levels at these locations are beyond the acceptable limits

(NEQS and WB Guidelines), appropriate mitigation measures such as noise barriers will need to be employed.

Traffic constraints have the highest potential to create the most nuisances for community members. The construction activities can potentially impact the residents of the WAPDA Left Bank Colony and residential areas along the transmission lines particularly the movement and safety of school children. In addition, due to increased use of trucks and other vehicles on the local roads, elderly people, women and children will be more exposed to dangerous situations, which may lead to traffic accidents. Measures identified in the Traffic Management Plan will aim at ensuring access to the local communities, preventing of unsafe situation, especially near schools, housing areas, construction areas, camps and offices.

Construction nuisance is considered an adverse impact of minor significance at the dam site. Mitigation for the nuisance effects are considered within the relevant sections addressing transportation, air quality, and noise. Efforts will need to be made to ensure that all surrounding villages areaddressed in the ongoing T4HP community development activities to offset the construction nuisance. It is likely that decommissioning could have similar effects as construction disturbance.A Grievance Redress Mechanism will also ensure that any measures can be implemented on noise nuisance as far as possible.

8.2.3 Operational Phase Impacts

Employment generation

Operation phase employment will be managed by WAPDA central level human resources. The number of operational staff will be small. There are vacant houses at Tarbela left bank colony that could be used for new staff. Employment generation during the operation phase is considered to be a beneficial impact of negligible significance based on operational workers considered to be receptors of low sensitivity and the magnitude being minor.

Provision of electricity

During operation, electricity would be generated and transmitted to the national grid. The Project will provide an additional installed capacity of 1410MW during the monsoon period of the year. The electricity generation will make a contribution to increased national energy security and increased national income from energy The current shortfall in Pakistan is about 7000 MW resulting in to long hours of loadshedding. Power shortages result in long hours of load shedding, impacting households, industrial and commercial activities. Lack of power affects people’s quality of life, schools, colleges, clinics and hospitals; shops and businesses, reducing sales and revenues; and industry, reducing productivity.

The Project will facilitate access to electricity for households and companies in Pakistan. These benefits are analyzed in Chapter **4**, which presents the justification for the Project. Energy shortfalls are recognized as a major limit to the country’s economic progress. Electricity linkages to millennium development goals, which are relevant for Pakistan are presented in **Table 8.6**.

Table 8.6: Electricity linkages to human development

Millennium development goal	Electricity linkage to achieving goal
Eradicating extreme poverty and hunger:	Electricity is an energy input to generate jobs, industrial activities, transportation, commerce, micro enterprises and agriculture outputs.

Achieving universal primary education:	Electricity needed for homes and schools attracts teachers and allows after dusk study by providing illumination. Electricity can save girl students from fuel wood collection duties which can affect school attendance.
Promoting gender equality and empower women	Electricity can be a time saver for productive activities.
Reducing child mortality	Disease caused by lack of clean boiled water and respiratory disease from indoor air pollution from traditional fuels and stoves can be positively affected by electricity provision.
Improving maternal health	Electricity can help with illumination for night time deliveries and drudgery of fuel collection.
Combatting HIV/AIDS, malaria and other diseases	Electricity for radio and television can spread important public health messages to combat disease. In health care facilities, electricity is needed for illumination, refrigeration and sterilization.
Ensuring environmental sustainability	Cleaner electricity sources like hydropower contribute to environmental sustainability.

The transmission of electricity via the overhead transmission line would not create interference with radio reception, satellite reception or aircraft safety.

The benefits from the production and transmission of more electricity for local, national and regional development are considered to be a beneficial impact of major magnitude (facilitating electricity access to a wide range and a number of consumers). The sensitivity of the general population is moderate (they have alternative fuel sources but electricity users face blackout periods on a regular basis) and therefore this is considered a major beneficial impact and is evaluated as significant.

8.2.4 Summary of Impacts

A summary of the potential impacts is shown in **Table 8.7**.

Table 8.7: Summary of significance assessment of potential impacts

Potential Impact	Adverse/ beneficial	Magnitude	Sensitivity	Impact Evaluation	Significance
Pre-Construction Phase					
Land acquisition	Adverse	Major	High	Major	Significant
Disruption in social economic setup	Adverse	Major	High	Major	Significant
Construction phase					
Employment Generation	Beneficial	Moderate	Medium	Moderate	Significant
Local Economic Development	Beneficial	Minor	Low	Negligible	Not Significant
Construction Disturbances to Neighbors	Adverse	Minor	Medium	Minor	Not Significant
Operational phase					
Employment generation	Beneficial	Minor	Low	Negligible	Not Significant
Provision of electricity	Beneficial	Major	Medium	Major	Significant

8.2.5 Workers Health and Safety

Occupational Health and Safety Risks at the Dam Site

Site preparation, construction activities and the use of temporary workers' accommodation pose potential risks to the health, safety, security and therefore wellbeing of construction workers if not managed appropriately. Health and safety issues associated with the use of temporary accommodation sites include those relating to sanitation, disease, fire, cultural alienation, sleeping space, quality and quantity of food, personal safety and security, temperature control and recreation, amongst others. Issues related to food quality and quantity are of particular concern following consultations with T4HP laborers carried out in December 2014 and February 2015 which also suggested that accommodation conditions are poor and that quality and quantity of food in workers' accommodation is not up to the mark due to un-trained kitchen staff.

Discussions with the environmental and social staff of T4HP and WAPDA environmental and social staff also identified labor right risks to workers from delayed payment of wages, harsh working conditions, overtime, lack of job security and people working without employment contracts.

Some of the Occupational Health and Safetyrisks which are likely to arise during the construction phase of the Project, and are typical to many construction sites, include: exposure to physical hazards from use of heavy equipment including cranes; trip and fall hazards; exposure to dust, noise and vibrations; falling objects; exposure to hazardous materials; and exposure to electrical hazards from the use of tools and machinery. Other risks common to power infrastructure projects, and specifically relevant to this Project, include working around large water bodies; working at height, live power equipment and lines; and exposure to electro-magnetic fields.

There are risks associated with working on or near water such as the river or reservoir for the workers constructing the dam and spillway infrastructure. Another likely OHS risk to Project workers includes exposure to extreme heat during summerespecially if critical needs such as access to safe drinking water and places for rest are not available.

OHS risks during the operation phase include risk of working near water, shocks from live equipment and exposure to electromagnetic fields from switchyards and overhead lines. OHS risks during decommissioning will be similar to those identified for construction.

Workers on the Project, particularly sub-contracted construction workers, are vulnerable to risks to their wellbeing, health and safety on a daily basis. The Pakistan's regulatory standards provide some protection through the Factories Act 1934, amended in 1997. Appropriate health and safety management planning and execution in line with good international industry practice will be undertaken by the Project team to reduce the risks as far as possible.

Electromagnetic fields (EMF)

For EMF exposure, this assessment draws on the guidelines set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). ICNIRP is a non-governmental organization, formally recognized by the WHO, which evaluates scientific results from all over the world to produce guidelines recommending limits on exposure.

Electromagnetic fields are invisible lines of force emitted by and surrounding electrical devices such as power lines and electrical equipment. Electric fields are produced by voltage and they increase in strength as the voltage increases. Electric field strength is measured in volts per meter (V/m). Magnetic fields result from the flow of electric current and they increase in strength as the current increases. EMF are measured in units of tesla (T). Electric fields are shielded by materials that conduct electricity, and other materials, such as trees and building materials, whilst magnetic fields pass through most materials and are difficult to shield.

The voltage of electrical equipment associated with construction activities is not expected to be of sufficient power rating to generate electromagnetic fields of significant strength. The potential for impacts associated with EMF during the operational phase are limited to public and occupational health effects, and the potential interference of magnetic fields with electronic equipment. For decommissioning, there would be no exposure to EMF emissions. For EMF exposure such as that experienced by workers and those living close to transmission lines, several studies have been undertaken internationally to identify a correlation between EMF and potential health effects. No conclusive evidence is currently available to link occurrences of cancer with transmission lines. Besides the lack of scientific clarity, people's concern about EMF is strengthened since it is an invisible phenomenon covering a risk that cannot freely be avoided by a member of the public. It is also uncertain that public concern towards EMF would reduce even if scientific studies were to definitively prove that the effect of EMF exposure is negligible. The magnitude of the fields in publicly accessible areas would not be significantly different to those presently experienced near other overhead lines in the area.

Occupational Health and Safety Risks for Transmission Line Works

Occupational health and safety hazards specific to electric power transmission and distribution projects primarily include:

- Live power lines
- Working at height
- Electric and magnetic fields
- Exposure to chemicals

Live Power Lines

Workers may be exposed to occupational hazards from contact with live power lines during construction, maintenance, and operation activities. However it is assumed that only trained and certified workers are to be involved in critical activities such as installation, maintenance or repair works, and all necessary protections including grounding etc. are addressed in the design, therefore such risks are minimum to negligible. Best industrial practices will be adopted during execution of such activities and standard procedures will be established prior commencing work. The health and safety plan of the contractor shall address all necessary measures and its monitoring during the construction phase.

Working at height on poles and structures

During construction of all project components including power house, transmission line and grid station, there is a requirement of working at heights. Workers may be exposed to occupational hazards when working at elevation. There are severe impacts of this aspect due to multiple risks associated that may include injuries/ fatalities to workers, loss of equipment and assets etc. Therefore all safety protocols will be adopted during construction activities. The protocol should cover all aspects including height of structures, vulnerability to falling from heights, physical controls and administrative controls. The detailed protocol should be included in health and safety plan to be developed by the construction contractor.

Electric and magnetic fields

Electric utility workers typically have a higher exposure to EMF than the general public due to working in proximity to electric power lines. Occupational EMF exposure should be prevented or minimized through the preparation and implementation of an EMF safety program including the following components:

- Identification of potential exposure levels in the workplace, including surveys of exposure levels in new projects and the use of personal monitors during working activities;
- Training of workers in the identification of occupational EMF levels and hazards;
- Establishment and identification of safety zones to differentiate between work areas with expected elevated EMF levels compared to those acceptable for public exposure, limiting access to properly trained workers; and
- Implementation of action plans to address potential or confirmed exposure levels that exceed reference occupational exposure levels developed by international organizations such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP), and the Institute of Electrical and Electronics Engineers (IEEE).

Personal exposure monitoring equipment should be set to warn of exposure levels that are below occupational exposure reference levels (e.g. 50 percent). Action plans to address occupational exposure may include limiting exposure time through work rotation, increasing the distance between the source and the worker, when feasible, or the use of shielding materials.

8.2.6 Community Health and Safety

Health, safety, security and wellbeing of local communities

The project sites are mostly away from settlements therefore there will be few health and safety risks to local communities (except perhaps for Kukar Chawa and some scattered villages along the transmission line routes). Existing security staff and security systems that have historically been implemented will continue to be implemented.

Increased traffic may also result in road safety risks, however the construction of T4HP means that local communities have been accustomed to the related traffic and potential road safety risks. For further discussion of traffic impacts, see **Chapter 7**. Kukar Chawa community members should be informed of any blasting and the blasting should be scheduled for day time hours.

<u>Community Health and Safety for Transmission Line Works</u>

Community health and safety impacts during the construction and decommissioning of transmission and distribution power lines are common to those of most large industrial facilities. These impacts include, among others, dust, noise, and vibration from construction vehicle transit, and communicable diseases associated with the influx of temporary construction labor. In addition to general health and safety standards outlined in the General EHS Guidelines, the operation of live power distribution lines and substations may generate the following industry-specific impacts:

- Electrocution
- Electromagnetic interference
- Visual amenity
- Noise and Ozone

<u>Electrocution</u>

Hazards most directly related to power transmission and distribution lines and facilities occur as a result of electrocution from direct contact with high-voltage electricity or from contact with tools, vehicles, ladders, or other devices that are in contact with high-voltage electricity. Recommended techniques to prevent these hazards include:

- Use of signs, barriers (e.g. locks on doors, use of gates, use of steel posts surrounding transmission towers, particularly in urban areas), and education / public outreach to prevent public contact with potentially dangerous equipment;
- Grounding conducting objects (e.g. fences or other metallic structures) installed near power lines, to prevent shock.

Electromagnetic Interference

The corona of overhead transmission line conductors and high frequency currents of overhead transmission lines may result in the creation of radio noise. Typically, transmission line rights-of way and conductor bundles are created to ensure radio reception at the outside limits remains normal. However, periods of rain, sleet or freezing rain sharply increases the streaming corona on conductors and may affect radio reception in residential areas near transmission lines.

8.2.7 Other Social Risks

This section assesses the socio-economic, health and safety risks that the Project presents. These differ to the impacts discussed in **Sections 8.2.2** and **8.2.3** by way of their nature. Risks are features that could occur as opposed to impacts, which are expected to occur. A precautionary approach can also be taken to avoid and reduce risks through management measures.

Project induced in-migration

A decision has not been made on the sourcing of the contractors and workforce. At this stage the precise origin of the workforce is unknown although it is expected to include a preference for using local labor. For this Project, “local” is identified as being a resident of Haripur and Swabi districts. Special consideration will be made to employ residents of Kukar Chawa and Ghari Mera because they are closest to the Project and are the most likely to have to deal with construction nuisance.

Influx of workers is likely to be limited because the site has access security measures in place. It is expected that workers will be housed at site on WAPDA land. Hence the influx that accompanies workers (such as family members, entrepreneurs, traders, service providers for the work force) will not be allowed access, which reduces this risk considerably.

However, preliminary mitigation measures which represent good practice for addressing influx have been identified and are set out in **Section 8.4.**.

Risk of socio-cultural unrest and conflict

There are generic risk factors common to this type of Project which can fuel community unrest or dissatisfaction such as:

- Jobs being seen to be given to ‘outsiders’
- Lack of communication and information
- Poor timing or planning of engagement activities

- Expectations being unrealistically high with regards to employment generation for a number of reasons including rumour, false or misleading information disclosure or good intentions at the outset being impossible or too expensive to implement
- Benefits being slow to materialise due to project delays or other reasons.

Community unrest may result from the aforementioned issues. However, T4 has proceeded with limited local dissatisfaction. There is ongoing consultation which should help identify any such risks prior to them becoming significant issues.

8.3 Mitigation and Enhancement Measures

This section presents the measures that will be taken to avoid, reduce and compensate adverse social impacts, and to enhance the beneficial impacts of the Project in all phases. These measures will combine with mitigation and enhancement measures for other disciplines, and will be implemented through the ESMP.

Table 8.8 provides an overview of the mitigation and enhancement measures proposed to manage, address and improve the social impacts. They are discussed in more detail in the following sub-sections. Various measures to mitigate environmental impacts (noise, vibration, dust, waste generation, traffic movements) that could cumulatively lead to construction nuisance have been addressed in **Chapter 7** of this ESA.

Table 8.8: Mitigation and enhancement measures for social impacts

Type of Mitigation	Impacts or risks mitigated or enhanced	Detail
Land acqustion and resettlement	Loss of land, structures and related livelihood impacts	Land Acqusition and Resettlement Framework (LARF) Resettlement Action Plan (RAP) Implementation of RAP
Embedded mitigation[36]	Construction disturbances Employment generation Worker well-being Community health, safety and security	Occupational Health and Safety (OHS) Plan and procedures Human Resource Policy and procedures
Mitigation of significant and insignificant adverse effects	Dust and noise pollution Community and workers health and safety Community grievances Worker grievances Project induced in-migration	Environmental and social management plan (ESMP) Air Quality Managemnet Plan Noise and Vibration Control Plan Traffic Management Plan Worker Code of Conduct Worker Accommodation Plan Project Labor Statement Stakeholder engagement with a project performance grievance mechanism Worker grievance mechanism Influx management strategy as part of ESMP Contractor EHS plan Information sharing and communication
Enhancement measures	Local employment generation and economic development	Local content strategy as part of ESMP Gender strategy as part of the ESMP

[36] Mitigation which is built-in to the project during the design and procurement process.It aims to prevent impacts or risks from occurring.

8.3.1 Managing Potential Disturbance from Construction and Operation Activities

The potential construction and operation related impacts from the project activities on the nearby communities and construction workers can be minimized by the implementation of mitigation measures descried in earlier sections and the plans mentioned in the above Table 8.8.

8.3.2 Enhancing Employment Generation

The generation of local employment has the potential to be a key benefit of the Project. The cooperation and support of the local community is essential if this benefit is to be realized. In order to maximize the employment benefits to local communities and affected people, to manage expectations and to avoid social conflict that might arise in relation to perceived inequity of recruitment approaches, the Project will adopt the following measures:

- The contractor will be contractually bound to disclose the "Recruitment Policy" that specifically includes a requirement to prioritise local employment for unskilled and semi-skilled positions that become available with clear preference for employment of affected persons. The Policy will consider local literacy levels and gender issues and will be based on the principles of non-discrimination and equal opportunity. The Recruitment Policy should consider job availability and recruitment processes for contracting workers from villages within and near the project AoI, the unemployed and the unskilled people employed in the informal sector. The Policy will be disclosed in every village within and near the project AoI to maximise the potential for sharing the Project's benefits with local people.
- The contractor will produce a Project Labor Statement related to upholding labour rights that all Project employers namely subcontractors and service providers will be required to adhere to through contract clauses. It will identify that all workers must have employment contracts, guaranteed minimum wage under Pakistan law, limits on overtime hour use in accordance with International Labour Organisation guidance and local conditions such as during Ramadan, probation periods for new employees, statutory holidays, provision of transportation to and from the work site, provision of meals, and local conditions such as during Ramadanand cover other items that all contractors will be expected to follow so there is standard treatment of workers across the Project.
- The contractor will be contractually responsible for monitoring the labour conditions, working standards, and procedures that subcontractors use to implement the Project Labour Statement.
- Contractors will issue the employment contract, covering the personal particulars, job title, probation period, employment period, wages (at least minimum wage), overtime, deductions, payment method, hours of work, leave arrangements(paid/unpaid, public holidays), sick leave provisions, accommodation provision, free meal or food allowance provision, transport provision, company rules, regulations and procedures, termination of employment and agreement clause to all employees.
- Contractors will provide transportation for workers from villages near or within project AoI to the Project site to encourage them to take up work on the Project.

With the adoption of these measures by the Contractor and the application of them by all subcontractors, in particular the policy to recruit local people, then employment generation is expected to increase the Project benefits for the construction phase.

8.3.3 Safeguarding the Wellbeing, Health and Safety of Workers

Labor policies and procedures will be developed by the main Contractor as part of its environmental, social health and safety (ESHS) plan and procedures to ensure that the wellbeing of its workers and the sub-contractors' workers are protected in accordance with Pakistan Labor Laws and international best practice. These policies and procedures will cover the following:

- Working conditions and management of worker relationships:
  - Contractor to have a human resource policy that meets good international industry practice and is approved by the Engineer.
  - Contractors to issue to all Project staff an individual contract of employment detailing their rights and conditions in accordance with the Labour Laws and the Project Labour Statement. Contracts should cover hours of work, wages, overtime, compensation and benefits such as annual leave. Update the contract when material changes occur. The Contractor will be required to include and enforce clauses to make sure that their sub-contractors do the same.
  - Monitor the labor rights and keep track of the labour profile on a quarterly basis during construction.
  - Quarterly external labour audits.
  - Provide accommodation in accordance with the international best practice to workers. The EPC Contractor will be contractually required to prepare a Workers Accommodation Plan as part of its environmental and social management system to govern the provision of accommodation facilities to international standards at all camps and will cover: provision of adequate and safe drinking water, adequate space, safe food, power, heating, cooling, ventilation, sanitation, water treatment, waste disposal, fire and noise protection, measures to deal with disease-carrying animals, sanitary washing and laundry facilities, cleaning, lighting, storage, basic medical services and transport between accommodation and site, and maintenance and management of sites. The Plan will be implemented after approval from the Engineer.
  - The Contractor will develop a Labor Grievance Mechanism for complaints related to staff treatment, working or living conditions without reprisal and make this available to all their Project workers. The Labour Grievance Mechanism will be approved by the Engineer. The Contractor will allow sub-contractors and lower tier contracts who do not formulate their own grievance mechanisms to be used for this Project. Contractors will be required to provide monthly reports of any labour grievances and how they have been dealt.
  - All contractors will be required to inform WAPDA as soon as possible and no later than 12 hours of any labour protests or strikes or actions that affect labour presence on the work site.

- Contractor to hold toolbox talks on labour law issues and the labour grievance mechanism twice a year during the construction phase.
- Proper Induction programs will be organised on a monthly basis for the site supervisors (local/expatriate) to ensure their understanding of contractual and legal procedures governing interaction with workers and taking any disciplinary action against workers. For termination and laying off of workers, proper procedures will be followed under the contract and law.
- Contractor will be required to hire a social security officer and legal advisor to tackle and deal with the day to day disputes and disciplinary matters under the contract and law in coordination with the Consultant, Employer and labour representative.
- Contractor will follow the law for termination of workers.
- Contractor will prepare a plan for salary increase of his workers after completion of one year of service and will share this increase with the Engineer.
- Contractor will ensure the payment of salary to his workers up to 5th of each month. Proper pay slips will be given to the workers with the distribution of salary. On the salary slip will be mentioned the working days, overtime hours, working on Sundays and national holidays and deductions for the understanding of the workers. Attendance and over time sheets must be filled on sites and signed by each worker before making the salary.
- Contractor will follow the basic rates of wages of local government for the labours.
- The Contractor's employment policy may also define the hazardous chemical handling allowances to his workers.
- Contractor will manage retrenchment and develop a retrenchment plan for workers.

Clauses will be inserted in contractors' agreements to ensure compliance with the following Key Performance Indicators (KPI) documentation and procedures

- Project Labour Statement, Human Resources Policy and procedures
- Issuing of individual worker contracts of employment
- Workers' Accommodation Plan
- Recruitment Policy
- Retrenchment Plan
- Labour Grievance Mechanism
- Worker Code of Conduct
- Worker Health and Safety Plan
- Emergency Preparedness and Response Plan
- Cultural awareness training

8.4 Community Development and Assistance Programs

Community Development Assistance Program. Under T4HP, WAPDA has developed an out-reach program to provide social assistance to the communities in the immediate vicinity of the project construction areas. Schemes for communities were identified through a consultation process and contracts were awarded to local contractors who used local labor thus generating income for communities. These include construction of dispensaries, water supply, drains and class rooms. This Community Development Assistance Program (CDAP) will also be implemented under T5HP and will target the communities located around Tarbela, transmission line and grid station. The works to be covered under this program will be identified through community consultations but are likely to include schemes such as construction of vocational training institutes, separately for boys and girls; maternity clinics, drinking water treatment, drainage and sewerage facilities, access to Sui gas facilities, etc.

8.5 Residual Impacts

Residual impacts are those that remain significant after mitigation or enhancement has been implemented. A summary of impacts considered as major or moderate significance after application of mitigation measures is presented in**Table 8.9**. The residual impacts are beneficial due to generation of construction employment and provision of more electricity.

Table 8.9: Residual impacts

Activity	Potential Impacts and Risks	Sensitivity / Magnitude	Impact Significance	Mitigation/ enhancement measures	Residual Impact Significance
Recruitment	Employment generation	Medium to high / Moderate	Moderate Beneficial	– Disclosed Recruitment Policy – Job and supply chain opportunities provided to local people – Basic skills programme for job-seekers from ACs – Provision of transportation for workers from the ACs to the Project site to encourage them to take up work on the Project – Contract clauses for contractors and sub-contractors to hire people from ACs	Moderate Beneficial
Operation	Provision of electricity	Medium / Major	Major Beneficial	-	Major Beneficial

8.6 Proposed Monitoring

Monitoring of mitigation and enhancement measures will be conducted for the duration of the construction phase. These requirements, along with associated responsibilities and reporting requirements will be detailed in the ESMP. The Environmental Manager of the contractor will ensure the measures included in this report and the ESMP are implemented during the construction of the Project. In particular, from the social perspective, the following issues must be monitored:

- Labour profile
- Labour rights, labour management and working conditions
- Occupational health and safety
- Use of the labour grievance mechanism
- Ongoing stakeholder engagement activities, including information disclosure and consultation activities and events
- Use of the community grievance mechanism.

Statement of Significance

The generation component of the Project will have significant beneficial social and community impacts are anticipated in relation to construction employment and provision of electricity. However, the transmission line component part of the project will have a significant impactdue to land acquisition and related socio-economic impacts. The presence of transmission line towers and line will significantly reduce the market value of the land and its real estate value. Whereas the areas close to the grid station site, due to proximity to Islamabad, are experiencing is lot of private housing development. Hence the impacts associated with the land acquisition are not significant if adequate compensations are paid.

9 Cumulative Impact Assessment

9.1 overview

The GoP is planning to build several hydropower projects in Pakistan including cascade of dams on Indus on upstream of Tarbela, and also to construct new transmission lines and grid stations to transfer from these new hydropower projects. The objective of the current cumulative impact assessmentis to evaluate the combined effects of proposed developments within the influence area of T5HP.

The World Bank has recently carried out a strategic environmental assessment study, “Strategic Sector Environmental and Social Assessment” (2015) to look at the whole Indus Basin for sector wide environmental and social impacts and prioritize the investments in hydropower and storage development options. The study has ranked various proposed hydropower developments in Indus basin based on technical, financial, environmental and social indicators, and cumulative impacts. The study ranked T5HP as a top priority investment with minimal cumulative impacts.

Cumulative impact studies, as part of ESA, have been carried out in the recent past for the World Bank funded Dasu Hydropower Project (2013) and Sindh Barrages Improvement Project (2014). Under Dasu Hydropower Project (DHP), the cumulative impacts were studied for the Indus between Diamer Basha and Tarbela (Upper Indus Basin), while under Sindh Barrages project the impacts were studies for lower Indus on the downstream of Guddu barrage.

As a continuation of the cumulative impact study carried out under DHP, the study in this T5HP ESA focuses on the area downstream of Tarbela dam and Ghazi barrage to the next hydraulic structure on Indus, the Jinnah Barrage. The projects considered for this study are (i) existing Ghazi Barotha and Tarbela Projectsand (ii) proposed hydropower developments on Indus over next 20 years, say until 2035. The most significant valued environmental and social components (VECs) related to the proposed study are considered as river hydrology and morphology, irrigation and biodiversity.

9.2 Existing and Proposed Water Sector Projects

9.2.1 Indus Basin Water System

Indus River and its tributaries[37] through extensive networks of canals in the Indus Plains is the main source of water, hydropower and economic growth. For decades it has been engine of growth for the Pakistani economy. The irrigation system in Indus Basin Water System (IBWS) comprises 19 barrages and head works, 12 link canals, 43 commands and some 107,000 water courses. A schematic diagram of IBIS is shown in **Figure 9.1.**

The Tarbela Dam was commissionedin 1974under the framework of the Indus Basin Water Master Plan. Initially the main purpose of the dam was to supply irrigation water to the densely populated agricultural areas in Punjab and Sindh. For the project 120 villages along the Indus were submerged and a total of 96,000 persons had to be resettled and 33,200 ha of land to be acquired. At present the Tarbela dam is the most upstream constructed hydraulic structure controlling the Indus waters, its main functions are to

[37]The Indus River has six major tributaries, on eastern side, Sutlej, Beas, Ravi, Chenab, and Jhelum, and on western side Kabul rive. Its annual flow is about 182 billion cubic meters (BCM). The Indus River is sixth largest river of the world. In terms of water carried, the Indus flow is three times the Nile’s, ten times the Colorado rivers (in United States and Mexico) and equal to Columbia river’s in Canada and United States.

supply irrigation water to the IBWS as well as generate power. The initial gross storage capacity of Tarbela has been affected by silt and in 2007 the gross and live storage capacity was 9.955 BCM and 8.442BCM respectively.

The Ghazi-Barotha project (1450 MW) was completed in 2004 and comprises a barrage and a small regulating reservoir approximately 7km immediately downstream of the Tarbela dam near Ghazi, a 52km long power channel and a power complex near Barotha. The barrage provides a pond which re-regulates the normal daily discharge from Tarbela by diverting the flow into the power channel. The barrage pond has a normal volume of 70MCM.

Jinnah Barrage, constructed in 1946, is the most upstream barrage on Indus and located about 220 km downstream of Tarbela. Irrigation canals from main Indus river starts at this barrage. In 2013, 96 MW of hydropower is also being generated from this barrage.

9.2.2 Proposed Indus Cascade from Basha to Tarbela

The development of the Indus River system has the potential to provide the long term solution for water and electricity sector and growth for the Pakistani economy. The GOP energy strategy (2013) and WAPDA’s Vision 2025 emphasizes the development of the Indus Cascade (see

Figure 9.2) to add hydropower to the system to bring down the cost of generation which is crucial for the sustainability of the sector.

The first step in this long term plan should to develop the segment of Indus Cascade between the Tarbela Dam up to Diamer-Basha (Basha) and exploit all the water and hydropower resources in this segment, followed by investments further upstream. This segment has an annual water flow of about 60 BCM and an elevation drop of about 700 meters between upstream of DB to the Tarbela reservoirs. At this stage, this segment is planned to be developed by four major structures on the Indus River going upwards from Tarbela Dam, Thahkot, Pattan, Dasu and Diamer-Basha. This part of the cascade can be developed over the next 15-20 years, providing about17,000 Mw of newly installed capacity, 75,000, Gwhs of annual generation at round 4-5 cents/Kwhs (at the installation time that would reduce overtime when debt servicing is completed) and 10.7 BCM of storage capacity for water. This in the can change the fuel mix favoring hydropower and has potential to bring the cost of electricity to single digit.

9.3 Existing and Proposed Transmission Line Network in Pakistan

9.3.1 Existing Transmission Line Network and Grid Stations

NTDC operates and maintains twelve 500 KV and twenty-nine 220 KV Grid Stations, 5078 km of 500 KV transmission line and 7367 km of 220 KV transmission line in Pakistan. The exiting transmission line network map of Pakistan is shown in Figure 9.3. In addition, Pakistan also consists of about 24,000 km of 132 kV lines and 9,100 km of 66 kV transmission lines. Tarbela has three 500 kV transmission lines and two 220 kV transmission lines. Ghazi Barotha has two 500 kV lines and one 200 kV transmission line.

9.3.2 Proposed 500 kV Transmission Line Network and Grid Stations

The planned 500 kV and 765 kV transmission line network for the year 2021-2022 is **show in Figure 9.4**. In addition to the T5HP transmission lines, the proposed grid station at Islamabad West will also receive a 765 kV transmission line from Dasu Hydropower Project.

Figure 9.1: The Indus Basin Water System

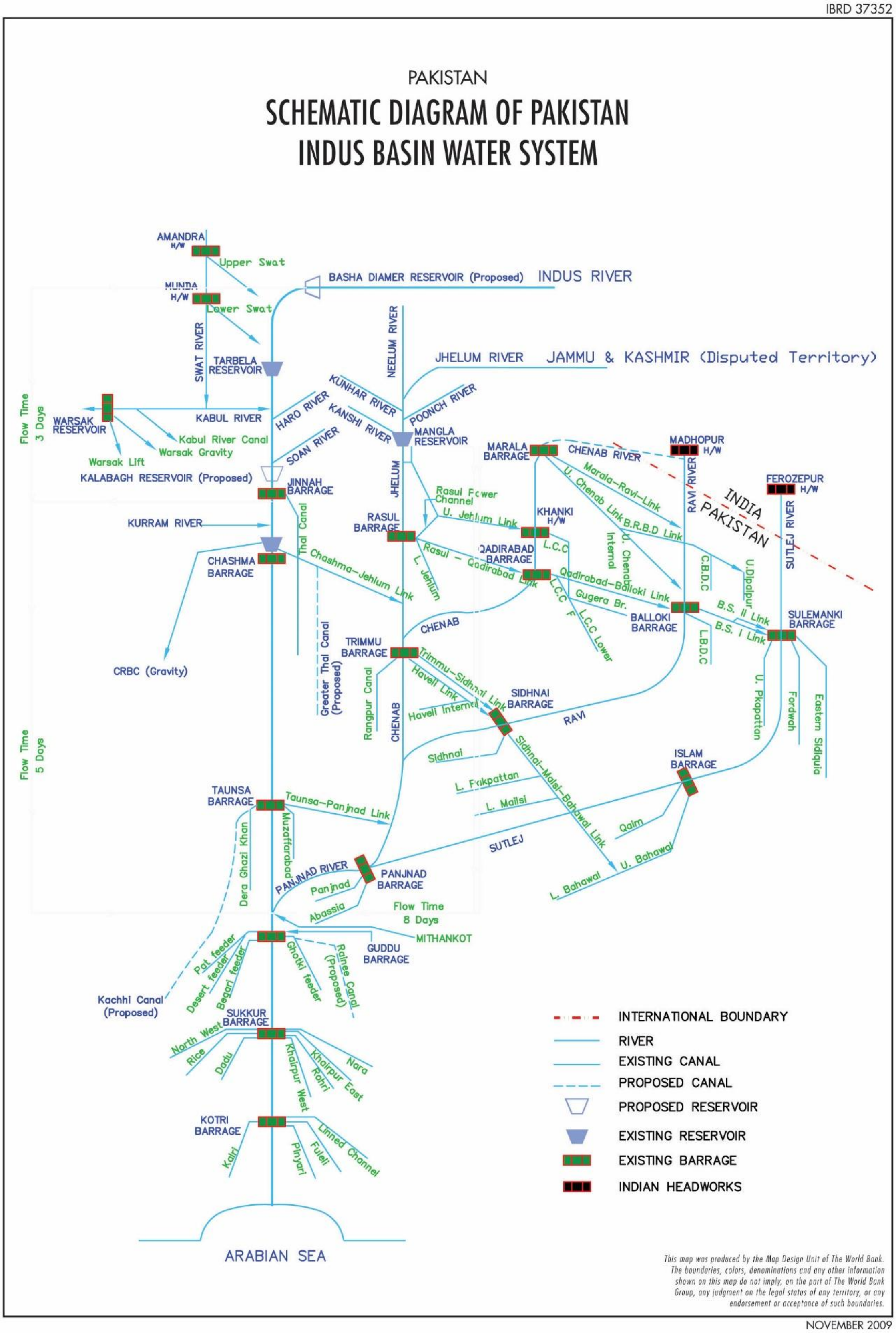
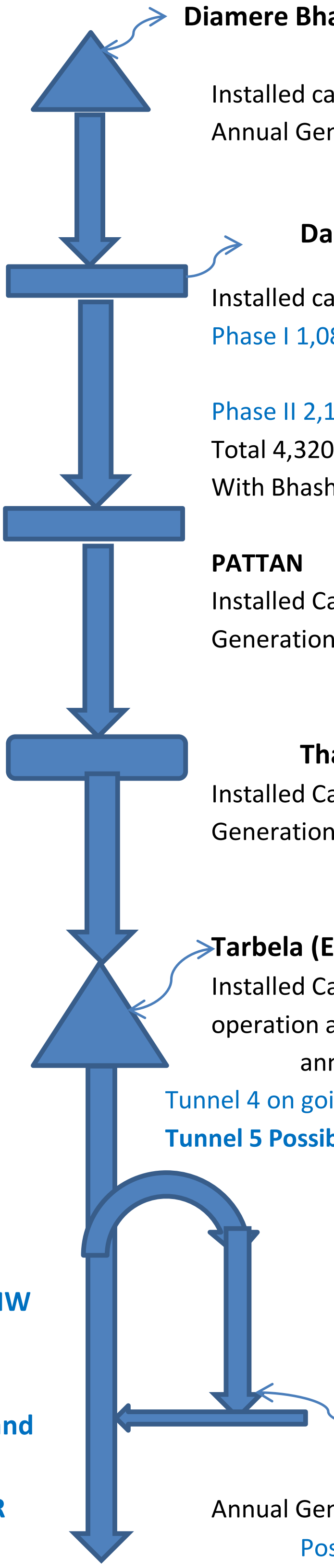


Figure 9.2: Cascade of Hydropower Projects on Indus



Diamere Bhasha (New)

Inflows 49 MAF
Storage 6.0 MAF
Completion about 12-15 yrs

Cost US$13-16 billion

Installed capacity 4,500 MW
Annual Generation 18 Billion units (Kwhs)

Dasu Hydropower dam (New)

Inflow 54 MAF
Storage live0.7 MAF, Dead 0.4 MAF
units
Phase-I complete 5 years (US$3.6 B)
Phase by 6-7 years (US$0.8 B)
Remaining phases depending
Available Financing, 7-8 yrs

Installed capacity total 4,300 MW
Phase I 1,080 MW Generation, 8 Billion

Phase II 2,160 MW -- 12 Billion units
Total 4,320 MW ---- 18 Billion units
With Bhasha 21 Billion Units (Kwhs)

PATTAN (New)

Inflows 58 MAF
Storage about 0.5 MAF
About US$6 billion

Installed Capacity 2,385 MW
Generation 13 Billion units

Thahkot (New)

Inflows 60 MAF
Storage about 0.5 MAF
About US$6 Billion

Installed Capacity 2,500 MW
Generation 12 Billion Units

Tarbela (Existing)

Inflows about 61 MAF
Storage 6.7 MAF

Installed Capacity 3,750 MW already in operation about 14 Billion units generated annually
Tunnel 4 on going 1,410 MW 3 billion units
Tunnel 5 Possible 1,410 MW≈ 1.8 Billion Units

Total Cascade

Installed capacity about 22,000 MW
Generation 89 Billion Units
Over next 15-20 Years
With 17,000 MW New Capacity; and
66 Billion Units thus substantially
Shifting the mix to HYDROPOWER

Ghazi-Brotha (Existing)

1450 MW Installed
Annual Generation about 6.5 B Units
Possible increase by 150 MW

Figure 9.3: Existing Transmission Line Network in Pakistan (June 2015)

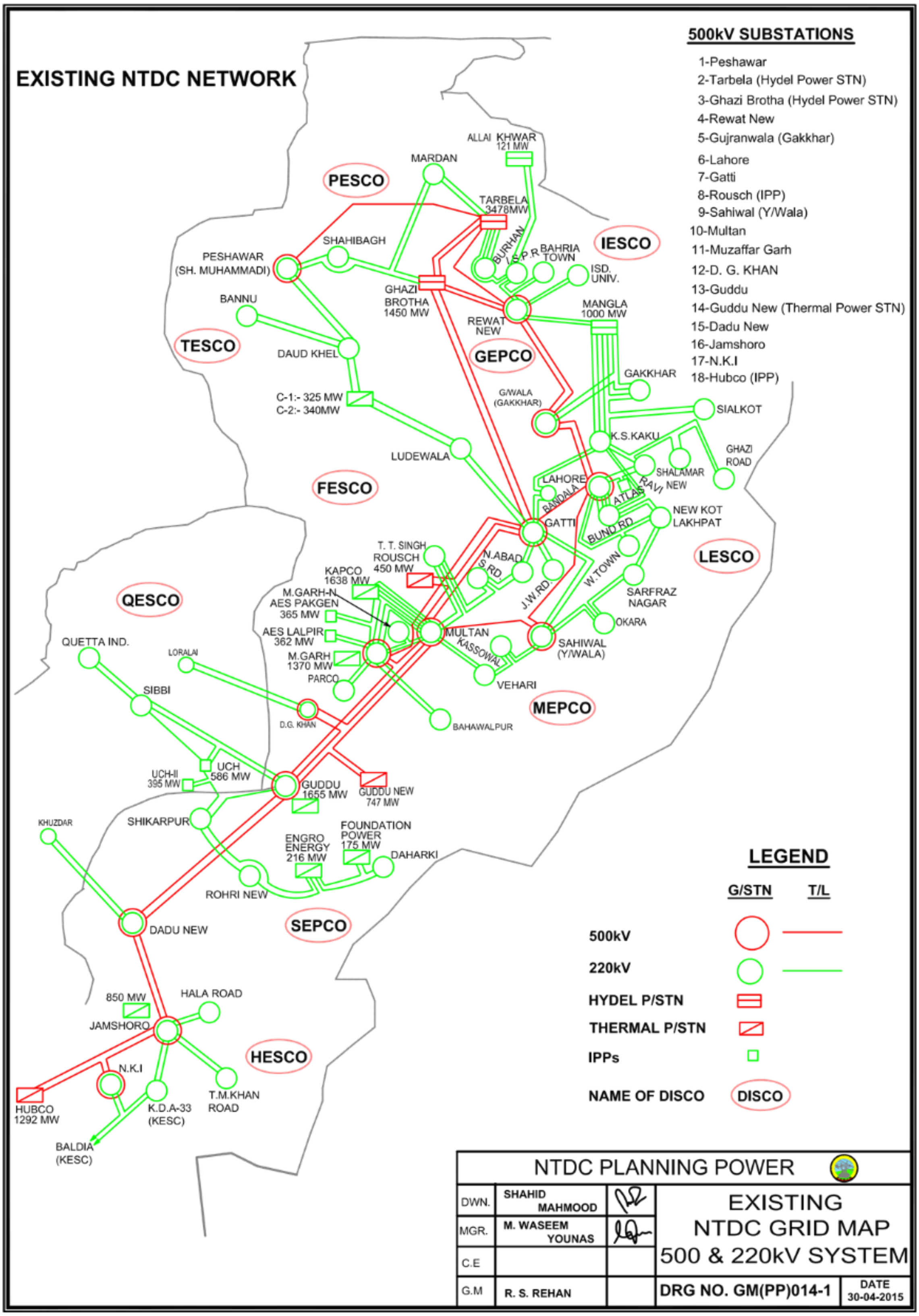
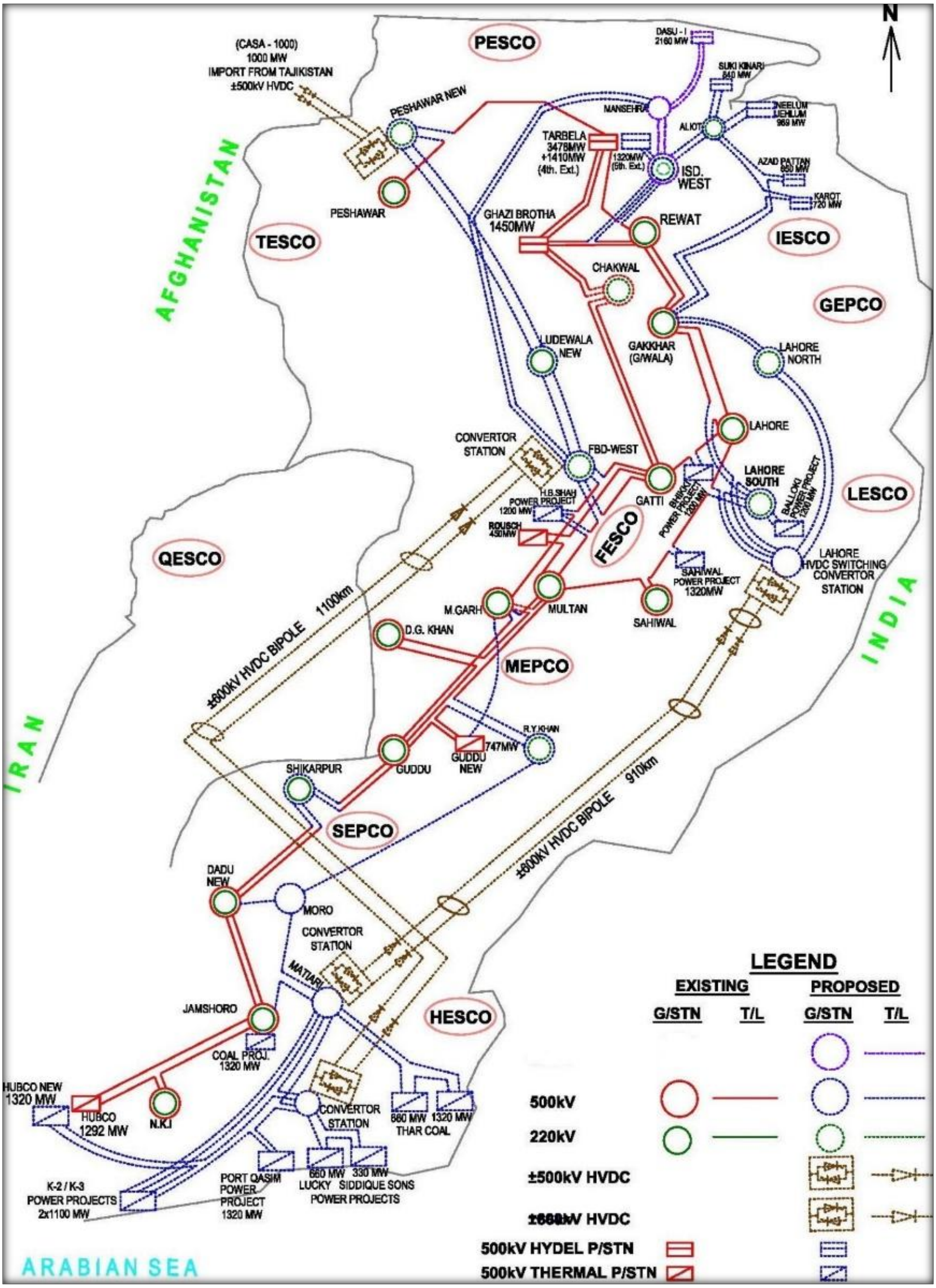


Figure 9.4: Future Planned 500 kV Transmission Line Network in Pakistan (2021-2022)



9.4 Potential Cumulative Impacts

9.4.1 River Hydrology and Morphology

The Indus on the downstream of Tarbela exhibits braided river characteristics with multiple channels and number of river islands (locally known as Belas).

The diversion of water for power generation for Ghazi Barotha project caused a 54 km of dewatered section between Ghazi barrage and tail race of Barotha power. This section is mostly dry in low flow season (October to April). Kabul river joins the Indus about 40 km downstream of Ghazi barrage. The average lowest flow in Indus on downstream of Tarbela 273 m^3/s. To compensate the reduced flow, about 28 m^3/s of environmental flow is released from Ghazi barrage to Indus to meet the requirement of aquatic habitat and drinking water requirements.High releases from Tarbela occur mostly from June to August and during this season, there will be adequate water in Indus on the downstream of Ghazi barrage.

Proposed hydropower and storage projects have the potential to impact river morphology mainly due to the interception of sediments by reservoirs and reduction in water flows downstream of dams.

With construction of Basha, which has a gross storage volume of 7.9 BCM, the storage capability in the Tarbela reservoir could considerably be increased. The change in river hydrology for different scenarios has been determined in a hydrological study for Basha dam carried out by WAPDA in 2012. It has been estimated that by optimizing the operations of Tarbela, Bashaand Dasu about 42 percent more flow during the low flow season could be released from Tarbela and about 19 percent in early kharif period (Table 4.2).

The impact of these extra releases will be very beneficial for irrigated agriculture in the plains. The changes in the river flows will have a positive benefit on the downstream of Tarbela. This extra flow could also mitigate the reductions in the ecological flow, which is often compromised and reduced by overconsumption in agriculture.

Table 9.1: Percent of Change in River Hydrology (Flow Volume) Downstream of Tarbela under Different Hydropower and Storage Scenarios

Hydropower / Storage development scenarios	Low flow (Oct - March)	Early kharif (Apr-May)	High flow (Jun-Sep)
1. Dasu + Tarbela	0	10	-1
2. Basha + Tarbela	42	9	-11
3. Basha + Dasu + Tarbela*)	42	19	-12

Note: *) Through optimizing the operation of the three dams

Incremental Impacts by T5HP alone

The contribution of T5HP to the cumulative impacts on the hydrological regime of the Indus is negligible since it will not alter the reservoir storage capacity or the downstream water flows.

9.5 Irrigation

Indus and its tributaries carry most of their sediment (nearly 97 percent) during high flow season. All hydropower projects will retain these sediments to some extent behind the dams. Thus the sediment content on the downstream flows of the dams will be reduced. This could increase the erosive capacity of the river flows. However, sedimentation in the reservoirs of cascades will have positive impacts on the downstream dams through increased storage. The construction of Bashawill have a considerable beneficial impact on both Dasu and Tarbela reservoir in extending the life of both reservoirs. The Bashareservoir with a large storage volume will then act as a sediment trap and the inflow in Dasu reservoir will be reduced to 46 million ton of sediment (mainly fine fraction). The cumulative impacts on sediment transport of both Dasu and Basha together will have a considerable positive impact on water quality and aquatic ecology in downstream areas and on sediment deposition in the Tarbela reservoir. The strong decrease in sedimentation may extend the life of the reservoir with another 50 years (15 years due to the retention of sediments in Dasu and 35 years due to retention in the Basha reservoir).

The changes in the river flows above Tarbela will have a positive benefit on the downstream of Tarbela through alleviation of water shortages for irrigation especially in the beginning of the kharif season, which is a crucial period for development of the summer crops in Punjab and Sindh. The enhanced supplies downstream of Tarbela reservoir, in tandem operation with Basha and Dasu reservoirs, in low flow period is expected to increase the irrigation supplies by 42 percent during October to March and by 19 percent during early Kharif. During high flow season the average flow is 11-12 percent lower, which is also beneficial for downstream areas, since irrigation demand is low and the occurrence of floods caused by monsoon rains in the Northwest of the country is high.

Incremental Impacts by T5HP alone

The contribution of T5HP to the cumulative impacts on the hydrological regime of the Indus is negligible since it will not alter the reservoir storage capacity or the downstream water flows. However, due to raise in the intake level of T5, the life of the T5 will be increased by another 10 years from the risk of blocking of intake by the sedimentation.

9.6 Aquatic Biodiversity

Hydropower and storage projects have the potential to impact aquatic ecology primarily by creating a barrier to fish migration but also through changes in sedimentation and alteration of the flow regime.

As explained earlier, diversion of water for power generation for Ghazi Barotha project caused a 54 km of dewatered section between Ghazi barrage and tail race of Barotha power plant in low flow season (October to April). Kabul river joins the Indus about 40 km downstream of Ghazi barrage. About 28 m3/s of compensation water is released from Ghazi barrage to Indus to meet the requirement of aquatic habitat and drinking water requirements.

WAPDA Environment Cell (WEC) has carried out various environmental studies including environmental monitoring in relation to the Ghazi Barotha project. The monitoring included surveys of fish species in the 41km river section downstream of the Ghazi Barrage in order to assess the adequacy of environmental flows. The main findings regarding the presence of fish species are summarized in**Table 9.2**.

Table 9.2: Fish Catch Details on Downstream of Ghazi Barrage

Fish Species	1993-94	2001-02	2014-15
Cirrhina Mirgala (Mrigal/White Carp)	-	5%	-
Clupisoma Garua (Catfish)		-	3%
Cyprinus carpio (Gulfam)	10%	22%	45%
Labeo dero (Torki)	7%	5%	35%

Mastcambelus Armatus (Bam)	4%	1%	-
Oreochromus Mozambicus (Tilapia)	-	3%	-
Puntius Sarana (Olive Barb)	-	-	8%
Schizothorax plagiostomus (snow carp, Mullah)	54%	48%	-
Tor putitora (Mahseer)	19%	10%	7%
Others	6%	6%	2%
Total annual average fishing catch	**14.2 M Tons**	**18.83 M Tons**	**20.11 M Tons**

The trends in percentage comparison of various fish species throughout the span of 20 years demonstrates that self-propagating and hardy species, just like Cyprinus carpio and *Labeo dero* gradually increased in catches and now comprise 80% of total fish. The number of both full time and part time fisherman working in the area has also increased over this time period.However, the native Indus cold water fish species *Schizothorax plagiostomus* (snow carps), whose catch is more than 50 percent before construction of Ghazi barrage has now drastically reduced.

WEC concluded that the findings demonstrate sound management and provision of adequate environmental flows in the impacted reach in the low-flow period.

Incremental Impacts by T5HP alone

T5HP will not introduce a new barrier to fish movement and will not influence the low season releases from Tarbela since it will be operated only in high flow season.

9.7 Social and Biodiversity Impacts of Transmission Lines

Cumulative impacts of transmission lineswill include impact on agricultural lands, loss of property value, life safety issues and collision and electrocution of migratory birds. These potential effects and risks may be outweighed by the benefits of the power transmission lines to the urban and industrial centers of country

Agricultural lands will be affected by the construction of transmission line towers and grid stations. Livelihood of the farmers will be affected if there is a reduced access to the lands occupied by the towers. Transmission lines will seriously affect the real estate value of the property that it passes through. Lands with transmission lines will have less market values compared to the neighboring properties. Community Health and Safety Hazards associated with transmission lines are: potential danger for electrocution, from direct contact with high voltage electricity or from contact with tools, vehicles, ladders that are in contact met high voltage transmission

Indus valley is flyway for migratory birds from Central Asia to Indian Subcontinent. Thousands of birds will travel through this for wintering grounds in sub-continent. Development of many transmission lines along Indus will affect the birds through collision and electrocution. Electromagnetic waves from the transmission lines may also affect the health of nearby population. In addition, environmental and social issues outlined above for DHP would apply to transmission lines for all planned hydroelectric projects. Smaller lines that supply power to communities near the projects would likely induce urban and industrial development and increase risk of environmental and social effects from such development.

9.8 Recommendations to address Cumulative Impacts

Mitigation measures to address cumulative impacts of proposed hydropower development in Indus cascade were recommended in Dasu Hydropower Project. These mitigation measures and additional mitigation measures proposed under T5HP are given in the following sections.

9.8.1 Recommendations from Previous Studies

Ecological/Biodiversity Management of Upper Indus Basin

The activities to be carried out under this component include

- Update detailed environmental and ecological baseline information;
- Prepare and implement robust management plans on fisheries (hatcheries and restocking), wildlife conservation, forest rejuvenation, avian risks, watershed protection, and other pertinent issues in light with the impact assessment presented in Dasu ESA;
- Prepare and implement the above management plans, update and develop detailed baseline data on flora and fauna of the project area in order to improve the understanding of the ecological landscape in relation with the DHP and other hydropower projects in the Indus Cascade;
- Capacity Assessment and assistance in capacity building of local, provincial institutions and WAPDA; and implementation of the capacity building programs

Early Flood Warning and Climate Monitoring Program

For safety of public, improved management of flood waves and safe operation of hydropower projects, it is imperative to have an early warning system for early flood warning in the major catchment areas of the project. A flood telemetry network consisting of 18 automatic rain and river level recording stations were recommended in UIB.

Fish Hatchery and Stocking

A fish hatchery for production of native cold water fish species, snow carps and stocking of fish in the tributaries, reservoirs and downstream Indus is recommended to compensate the loss of fish habitat on the downstream and to address potential downstream impacts. This requires maintenance of an onsite fish hatchery of snow carps for the production of the targeted numbers of fingerlings from hatchery and hauling of the fish fingerlings for open water stocking in the river. The hatchery could be used to stock the fish in the affected areas of other hydropower projects in UIB.

Sediment Management Plan for the Basin and Tarbela

Under the Water Capacity Building Project (WCAP) the World Bank is also assisting the GoP and WAPDA to understand the sediment management issues for the basin and at Tarbela Dam

9.9 Recommendations under T5HP

A detailed ecological baseline study is recommended for the 54 km section of Indus on the downstream of Tarbela. The objective of the study is to understand the impacts already caused by Tarbela and Ghazi Barotha projects on the aquatic and riparian ecology of the Indus, and predict future impacts associated with development of Indus Cascade. The study will prepare detailed management plans to address these impacts. The study will be carried out in the first year of implementation of the project and the plans will be implemented from the second year onwards.

10 Environmental and Social Management Plan – Power Generation Facilities

The primary objective of an Environmental and Social Management Plan (ESMP) is to safeguard the environment, site staff and the local population from site activity which may cause harm or nuisance. This ESMP for the power generation facilities of T5HP is intended to provide a framework to ensure transparent and effective monitoring, prevention, minimization, mitigation, off-setting and enhancement measures to address the environmental and social impacts associated with the Project. The mitigation measures described within this ESMP will be applied to the Project and its associated infrastructure.

This ESMP will form the basis of the environmental and social protection measures implemented by WAPDA and the Contractors (and sub-contractors). The implementation of the ESMP will ensure that environmental and social performance is in accordance with international standards (including the relevant World Bank Operational Policies (OP's), World Bank Group General Environmental, Health and Safety (EHS) guidelines, International Labor Organization (ILO) conventions and good international industry practice (GIIP).

10.1 Objectives

The primary objective of the ESMP is to manage and monitor adverse impacts of Project interventions in a way which minimizes adverse environmental and social (E&S) risks and impacts in the Project Area of Influence (AoI)[38]. The specific objectives of the ESMP are to:

- Facilitate the implementation of the mitigation measures identified in the ESA
- Maximise potential Project benefits (enhancements) and manage adverse risks and impacts
- Define responsibilities for the Project Proponent, contractors, and other members of the Project team for E&S management of the Project
- Define a monitoring mechanism and identify monitoring parameters in order to:
  - ensure the complete implementation of all mitigation measures
  - ensure the effectiveness of the mitigation measures
- Propose post-project environment monitoring plans to ensure that the ESMP achieves its desired objectives
- Maintain essential ecological process, preserving biodiversity and where possible restoring degraded natural resources
- Assess environmental training requirements for different stakeholders at various levels.

The ESMP will be managed through measures set out herein and site specific management plans. The management will clearly describe the responsibility of various staff and stakeholders involved in planning, construction and operation of the Project.

10.2 ESMP Components

The ESMP contains the following components which describe the environmental management system framework broadly aligned to (but not certified to) ISO14001:

[38] Please see Section 1.4 for AoI.

- Organisational Responsibilities and Communication – describes the structure of responsibilities within the organisation and the relevant communication channels/interfaces between staff
- Management and Monitoring Activities – details the E&S risks and impacts, along with proposed outline mitigation measures for the construction and operational phases
- Training and Awareness – outlines the process to be undertaken in identifying staff training needs
- Record Keeping – details the arrangements to be applied for maintaining records
- Performance Monitoring, Reporting and Auditing – describes the monitoring, reporting and auditing process
- Grievance Mechanism – sets out the process for logging grievances.

10.3 Lessons Learned from T4HP

T4HP is similar in location, scale and nature to the Project and experience is therefore considered of direct relevance. A lessons-learned exercise from T4HP has been carried out to inform E&S practice on the Project and findings are presented in **Table 10.1**.

Table 10.1:Key Lessons Learned

	Issues at T4HP	Reasons	Lesson Learned for the Project[39]
1	• Implementation of ESMP by the contractor.	• ESMP was not attached to the signed contract document	• It will be ensured that the ESMP shall be made part of the contract document.
2	• High sedimentation of river	• Sedimentation ponds poorly maintained and often left too full.	• To comply with this ESMP the Contractor is required to ensure sedimentation ponds are appropriately located and sized and well maintained. Any discharges from sedimentation ponds must meet surface water quality standards.
3	• No specific staff to manage environment, health, social and safety (ESMU) issues. • Late recruitment by Contractor of its ESMU staff. • Health and Safety inspectors not deputed at working sites.	• The degree of input required by the contractor's ESMU staff was not specified (i.e. part time or full time role). • No detail was provided about the requirement for health and safety inspectors at each working site.	To comply with this ESMP • Contractors are required to provide full time ESMU staff for the management of E&S issues on site. Roles should be in line with those identified in this ESMP. Contractor ESMU staff shall be a bill of quantities item. • It is a requirement that environmental managers have the authority to ensure best practice is adhered to across the work site and worker accommodation camps. • Social staff's inclusion by the Contractor is essential to maintain community liaison, manage labour issues and disseminate information.

[39] All lessons learned are captured in the mitigation plans detailed in this ESMP.

4	• No preference for local labour	• The term "local" was not defined fully in the ESMP. The Contractor considered local as Pakistanis rather than those within the Project AoI	To comply with this ESMP: • A clearly defined Project Recruitment Policy shall be implemented • Contract clauses shall be put in place requiring the Contractor to hire people from Affected Communities • Regular bulletins shall detail descriptions of employment and supply chain opportunities to local people and businesses, including information about required skill levels, indicative timeframes for recruitment and likely duration of contracts. • Bulletins shall be distributed in nearby villages and printed in local newspapers and the Recruitment Policy is to be referred to in job adverts.
5	• Labour issues regarding working hours, wage structure, holidays, over time and leave arrangements.	• The Contractor was not bound to provide detail of employment contract to labourers during induction.	To comply with this ESMP: • Individual contracts of employment shall be provided for all workers. These shall detail workers' rights and conditions related to hours of work especially during Ramadan, wages (at least minimum wage will be paid), wages, overtime, compensation and benefits such as maternity or annual leave. Contracts shall be updated when material changes occur. • Monitoring of labor rights and workforce profile is required quarterly. • Toolbox talks shall be held frequently on safety and labor issues and a review of the labor grievance mechanism shall be undertaken twice a year during the construction phase. • A supply chain review shall be undertaken quarterly to identify issues of child or forced labor and Occupational Health and Safety (OHS) risks. • Adequate provisions will be made for clean drinking water on site, rest areas and medical aid.
6	• Labour rights and working conditions	• Anecdotal evidence of negative impacts on worker well-being in relation to the camp where Pakistani workers were accommodated. • Ventilation was inadequate, kitchen facilities unhygienic, open	• All camps shall provide similar standards of accommodation in line with international guidance, typified by the International Finance Corporation's (IFC) worker accommodation guidance. • A bill of quantities item shall be implemented in the contract to ensure the T4HP worker camp is refurbished if

		gutters attracted mosquitos, garbage containers were left uncovered, and there were complaints about clean water for drinking, food quantity and limited entertainment facilities (TVs) in the camps. • On site, there was irregular use of some PPE like gloves.	re-used. • It shall be ensured that food available is of a good standard.
7	• No formal monitoring of labour working conditions	• Labour issues were not adequately monitored and changes were made as a result of complaints	• Help facilitate an annual external audit of working conditions. Adopt any recommendations emerging from the audit.

10.4 Organizational Responsibilities and Communication

10.4.1 Inclusion of the ESMP in Contract Documents

In order to make Contractors fully aware and responsible of the implications of the ESMP and to ensure compliance, it is recommended that E&S measures be treated separately in the tender documentation and that payment milestones should be linked to E&S performance, measured by execution of the prescribed mitigation measures. Such a procedure would help ensure adequate management of Project impacts is carried out during the construction and operation phases, where a consistent approach will be expected on behalf of the Contractor and its sub-contractors so that data and information collected from monitoring programs is comparable with baseline monitoring data.

The Contractor shall be made accountable through contract documents and/or other agreements for fulfilling E&S obligations and delivering on the E&S components of the Project. Contractors shall be prepared to co-operate with the executing agency, project management unit, supervising consultants and local population for the mitigation of adverse impacts. After the ESMP's inclusion in the contract documents, the Contractor will be bound to implement the ESMP and will hire appropriately trained E&S management staff to ensure the implementation and effectiveness of the mitigation measures.

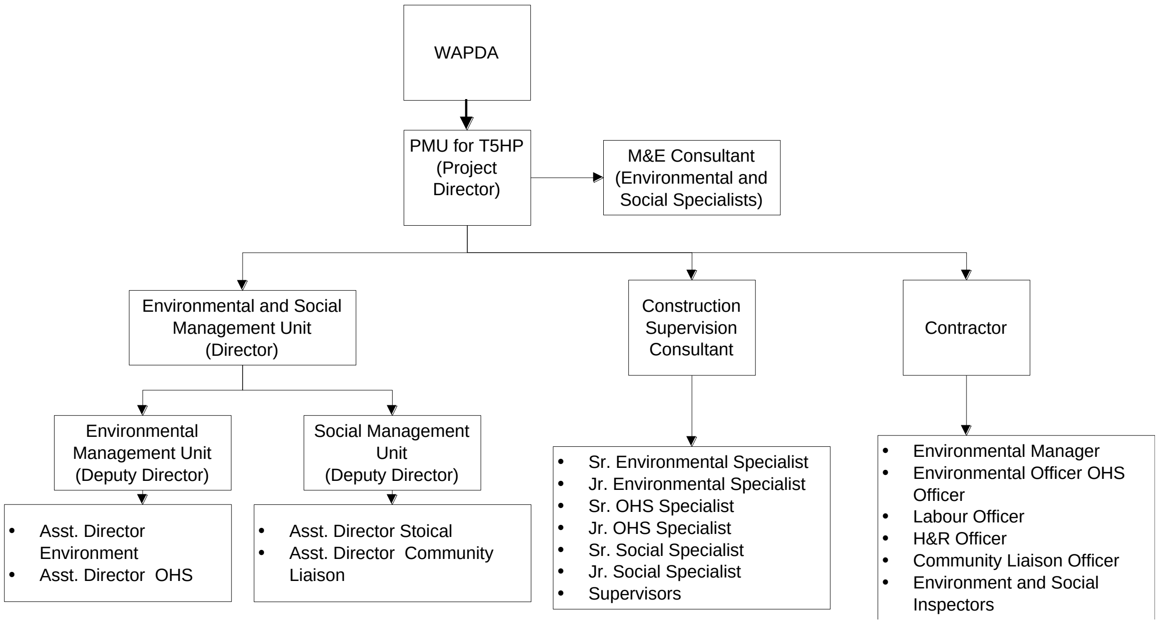
The Contractor is required to bid for executing the ESMP including the recommended mitigation measures and monitoring programs, as part of its Bill of Quantities (BoQ).

A new ESA will be carried out in advance of any decommissioning or refurbishment works in line with international ESA requirements at that time.

10.4.2 Implementation Responsibility

Project Management Offices (PMU) would be responsible for all aspects of project implementation including technical, operational and financial management, and overseeing the implementation of ESMP. It is the responsibility of PMU as the Project Proponent to ensure implementation of the ESMP through consultants and contractor(s). The Project Proponent's staff, the Construction Supervision consultants (hereafter referred to as the Engineer), the Monitoring and Evaluation (M&E) consultants and the Contractor will be responsible for ensuring the implementation of the ESMP and each party shall be required to have the capability and capacity to manage E&S obligations. Training and workshops shall be arranged involving the Project Proponent, consultant and contractor to share Project experience and best practice for E&S protection. An organogram illustrating the interfaces among the Project Environmental and Social Management (ESMU) teams is provided in **Figure 10.1**. The proposed units and staff will be established during the first year of project implementation, 2016-2017.

Figure 10.1: ESMU Structure of of PMU for Power Generation



10.4.3 Construction: Establishment of Environmental and Social Management Unit

An Environmental and Social Management Unit (ESMU)will be established supervise ESMP implementation for T5HP in PMU, the Project Supervision and Implementation Assistance Consultants (the Engineer) and the Contractor relevant to the Project. The ESMU will arrange bi-monthly meeting to discuss the progress on the ESMP implementation.

The following Sections detail the proposed ESMU staff requirements for WAPDA, the Engineer and the Contractor. Senior representatives from these teams will form the Project ESMU. Details of the independent Monitoring and Evaluation (M&E) Consultants that will carryout independent supervision of the implementation of the ESMP are also provided.

WAPDA PMU's ESMU Staff for the Project

PMU's ESMU (W-ESMU) unit will be headed by a Director and consists of one environmental management unit and one social management unit. Details of the staff in the W-ESMU are given in **Table 10.2**. Further details on W-ESMU resources are provided later in the Chapter.

Table 10.2: Composition W-ESMU

	Designation	Total Positions	Input
1.	Director	1	Full time
2.	Deputy Director Environment	1	Full time
3.	Deputy Director Social	1	Full time
4	Assistant Director Environment	1	Full time
5	Assistant Director OHS	1	Full time

6	Assistant Director Social with special expertise in labour issues	1	Full time
7	Assistant Director/ Community Liaison Officer	1	Full time

Key responsibilities and role requirements of the PMU - ESMP team and its environmental and social staff are provided in **Table 10.3**.

Table 10.3: W-ESMU Responsibilities

Team / Role	Key responsibilities
PMU - ESMU team (all members)	• Ensuring all commitments/requirements of the ESA and ESMP are met during construction • Co-ordination with WAPDA and the KP-EPA during the construction and operation phases • Implementation of the ESMS during operation • Oversight of all on-site E&S staff during construction and operation • Environmental training for on-site E&S staff during construction and operation.
Environmental staff	• Take prime responsibility for the environmental management of the Project as a whole in compliance with requirements of the World Bank OP's and the EHS guidelines • Review reporting and compliance audits undertaken by contractor's environmental engineers • Review and report on performance of the contractor to the KP-EPA (as required) • Prepare compliance reports on progress of achieving obligations identified in the WAPDA ESMP for submission to the World Bank • Report on a daily basis any ESMP non-compliances to the Contractor General Manager • Act as public liaison officer representative for WAPDA.
Social staff	The role of the social staff is to develop and maintain good working relationships with the local communities. The job will involve listening and responding to local concerns and suggestions and therefore the social staff must have the following qualities and skills: • Good communication and people’s management skills • A good understanding of the local language and community/cultural dynamics • Open-mindedness and respect for the views of others. • Experience in designing and implementing community based projects • Experience in social mobilization and community organisation • Good knowledge of community-based participatory approaches • Good knowledge of integrating gender and vulnerability issues in community participation • A solution-oriented approach • A high integrity/degree of trustworthiness One of the key responsibilities of the CLO will be to manage and implement community level components of the Project’s Stakeholder Engagement Plan (SEP). This will include (but will not be limited to) the following activities: • Being the main point of contact for community stakeholders to request

	information or lodge grievances which the CLO must process and work to resolve in a timely and satisfactory manner according to the Project's grievance mechanism • Disclosing all relevant information as specified in the ESA (for example the Project employment policy, proposed mitigations, grievance mechanism), meeting with stakeholders and documenting all interactions • Organising meetings with stakeholders (except for media), especially the local group leaders (for instance there are women's groups, youth groups, village elders, religious leaders) and the elected and appointed local authorities to provide a regular opportunity to discuss any issues or concerns stakeholders may have • Support with development of local community business ideas that could apply for grants from the Municipalities. The CLO will also be responsible for managing the other social commitments included within this ESMP.In order to be effective, the CLO needs to have the authority to negotiate on behalf of WAPDA. This requires a clear reporting structure and clarification as to which decisions the CLO can take unilaterally, and which are to be passed on to higher levels within the company. Direct reporting lines should be used to enable senior managers to more effectively control risks by being kept informed of field-level information in a timely manner. The more likely it is that the concerns of local stakeholders might pose a risk or reputation issue for the Project; the more important it is for the CLO to have a direct channel to senior managers. The Social staff will also assist in community consultations to identify schemes for the Community that will be implemented under a Community Development Action Plan. They will help conduct village-level planning for such schemes, form local committees for consulting on the design and management of schemes and ensuring that communities are involved in their operation and maintenance.

The Engineer'sESMP Staff

The Engineer or the Construction Supervision Consultant (CSC) shallemploy a qualified team for the supervision and monitoring of ESMPissues on site on a regular basis. The team will directly report to the PMU PD and will coordinate with the Contractor's ESMU team (C–ESMU).

The proposed team members of the Engineer's ESMUteam (E–ESMU) are presented in **Table 10.4**. The E–ESMU willmonitor the implementation of the ESMP and assist the W-ESMU team in its capacity building through invitation to regular monitoring of the ESMP at site.

Table 10.4:Composition E–ESMU

	Designation	Total Positions	Input
1	Senior Environmental Specialist	1	Full time site based
2	Senior Social Specialist	1	Full time site based
3	Senior Health and Safety Manager	1	Full time site based
4.	Junior Environmental Specialist	1	Full time site based
5	Junior Social Specialist with expertise in labour issues	1	Full time site based
4	Junior Health and Safety Manager	1	Full time site based
5	Supervisors	4	Full time site based

Monitoring and Evaluation Consultants (Independent Monitoring Consultants or Third Party Monitoring Consultants)

WAPDA will appoint Monitoring and Evaluation (M&E) consultantsfor the T5HP. The M&E consultants will have their own dedicated M&E ESMU team (M&E–ESMU) to carryout independent supervision of the implementation of the ESMP. The M&E consultants will monitor progress against all aspects of the project including technical, institutional, procurement, and ESMP obligations.The proposed make-up of the M&E–ESMUteam is presented in **Table 10.5**.

Table 10.5: Composition M&E–ESMU

	Designation	Total Positions	Input
1	Environmental Specialist	1	Intermittent office based with regular visit of site
2	Senior Sociologist / Social Development Specialist	1	Intermittent office based with regular visit of site
3	Environmentalist/ Environmental Engineer	1	Full time site based
4	Sociologist/ community liaison officer	1	Full time site based
5	Jr. environmental and social staffwith at least one staff that has expertise in labour issues.	2	Full time site based

Contractor Environmental and Social Management

The contractor will adhere to the principles of ISO 14001:2004and OHSAS 18001:2007or equivalent if not already accredited. These standards place strong emphasis on the need for continuous improvement of EHS management systems and EHS management performance.

The appointed contractor will be required to agree to the following actions:

- Develop a Construction Environmental Action Plan (CEAP) with site specific management plans, the framework for which is set out later in the Chapter.
- Elaborate other parallel sub plans which have been identified in in this ESMP (discussed later in the Chapter)
- Implement the requirements of the mitigation activities in the ESMP and CEAP
- Provide a construction site layout plan that identifies key activity area including lay down, accommodation and parking prior to commencement of works
- Produce detailed method statements relating to key activities that include specific reference to requirements of the plans contained herein during the Project progression
- Provide all training necessary to oversee and implement ESMP and CEAPrequirements
- Be responsible for producing a comprehensive suite of EHS management and coordination procedures
- Be responsible for overseeing the implementation of appropriate labour laws

- Identify and employ an appropriately qualified and experienced full time ESMU team on site with dedicated EHS responsibilities to oversee works on site (detailed later in the Section)

The Contractor will also be responsible for the ESMP performance of sub-contractor(s)' including subcontractor(s) adherence to the requirements of the ESMP and the CEAP. All major sub-contractor(s) will be required to have dedicated environmental and social staff to implement the ESMP and CEAP and to monitor and manage this on an on-going basis (smaller subcontractor will have ESMU focal points). The sub-contractor(s) staff will be required to liaise closely with the Contractor's ESMU staff and obligations will include the provision of monthly reports and participation in weekly construction review meetings.

Contractors ESMUTeam (C–ESMU)

Contractors shallemploy a qualified team for managing ESMUissues at site on daily basis within a week of the signing of the agreement. The team members of C–ESMU are given in **Table 10.6**. C–ESMUwill assess the risks to worker health and safety and implement preventive and protective measures on regular basis and will work under the supervision of the E–ESMU.

The C–ESMU will have the following responsibilities:

- Implementing the ESMP and CEAP during the construction phase
- Supervising the construction activities for the environmental, social, and safety aspects
- Take prime responsibility for practical implementation of E&S management measures
- Oversee and ensure the implementation of the ESMP and CEAP and parallel management plans (with support from the Contractor Construction Site Manager and ensure all subcontractor(s) are in compliance with the ESMP and CEAP requirements
- Review and report performance to the Construction Site Manager and E–ESMU
- Review sub–contractor(s) E&S protection/mitigation measures to ensure compliance with the ESMP and CEAP
- Report on a daily basis any ESMP and CEAP non-compliances to the Construction Site Manager
- Carry out regular ESMP awareness sessions/toolbox talks and assist personnel in applying E&S standards on site
- Conduct regular audits and inspections to check that committed impact mitigation measures are being implemented
- Act as the first point of contact on E&S matters for the Contractor, government authorities, other external bodies and the general public.

Table 10.6:Members of the Contractor's ESMU team

	Designation	Number of Staff	Input
1	Environmental Manager	1	Full time
2	Environmental Officer	1	Full time
3	OHS Officer	1	Full time
4	Labour Officer	1	Full time
5	Human Resources Officer	1	Full time
6	Community Liaison Officer	1	Full time
7	Environmental and Social Supervisors	As required	Full time
8	Health and Safety Inspector (s)	One for each construction site*	Full time
9	Bachelor of Medicine/ Bachelor of Surgery (MBBS) Doctor	1	As required
10	First Aiders	With a minimum of 1:50 workers*	Full time
* Staff number to be decided and approved by the Engineer.			

Contractor Construction Site Manager

The Contractor Construction Site Manager will coordinate ESMP actions based on inputs from the C–ESMUfor applying the ESMP and CEAP on site. It is envisaged that the Construction Site Manager will:

- Ensure that the C–ESMU is adequately staffed and qualified to understand and implement the ESMP and CEAP
- Nominate personnel to assist the C–ESMU as required
- Be responsible for communications with the Engineer with regard to ESMU issues and non-compliances.

10.4.4 Operation: The WAPDA Environment Cell

During the operation period, the WAPDA Environmental Cell (WEC), which is a permanent unit in WAPDA based in Lahore, will be solely responsible for the E&S performance of the operational hydropower station. WEC has sufficient capacity/resources and capability to deliver the commitments set out in this ESMP. The proposed organizational structure for the operational phase will be largely similar to that proposed for the construction phase. An operational phase ESMP will be developed in alignment with the principles of ISO14001.Communication

WAPDA will establish and maintain procedures for the following levels of communication:

- Internal communication between the various levels and functions of the organisation and between WAPDA, WEC and ESMU (ESMU to be responsible for communication with consultants and contractors relating to environmental issues)
- Receiving, documenting and responding to relevant communication from external interested parties, in particular a procedure for managing environmental complaints that are received from the public or government organisations through a community grievance mechanism (discussed later in the Chapter)
- All complaints received by the General Plant Management should be handled in a responsive manner, through a labour grievance mechanism.

10.5 Environmental and Social Management and Monitoring

This section introduces the proposed activities for managing and monitoring the potential E&S effects associated with the Project. The impacts and mitigations identified for the decommissioning phase are considered to be sufficiently similar to the construction phase to conclude that a separate ESMP for the decommissioning phase is not required at this stage.

10.5.1 Mitigation Plans

Various environmental and social mitigation plans to address the environmental and social impacts described in the previous chapters are detailed in **Table 10.7.** These plans are:

- Construction Environmental and Social Management Plan (CEAP)
- Operational Environmental and Social Management Plan (OESMP)
- Construction Traffic Management Plan
- Materials and Waste Management Plan
- Spoil Management Plan
- Noise and Vibration Control Plan
- Air Quality Management Plan
- Blast Management Plan
- Oil and Chemical Spill Response Plan
- Sediment, Erosion and Landslip Control Plan
- Chance Finds Procedure
- Water quality management plan
- Ecological Management Plan
- Habitat Removal and Restoration Plan
- Tarbela Occupational Health and Safety Plan / Contractor ESHS Plan
- Emergency preparedness and response plan
- Worker Accommodation Plan
- Stakeholder Engagement Plan
- Community grievance mechanism
- Worker grievance mechanism
- Gender Strategy
- Project Labour Statement
- Recruitment Policy
- Retrenchment Plan
- Human Resources Policy
- Local Content Strategy
- Workers' Code of Conduct
- Communication Strategy

The above mitigation plans are presented in **Table 10.7**and contains the following information:

- Summary of the key plans and procedures required for the Project, which were determined through the ESA process
- Relevant fundamental mitigation measures for each policy, plan or procedure, which must be adhered to. Mitigation measures have been developed in line with the World Bank OP's and GIIP
- List of impacts the plans, policies and procedures are designed to address (mitigate)

- An implementation schedule detailing the timings in which policies, plans or procedures should be implemented
- The 10-13rganization(s) responsible for executing the mitigation.

Table 10.7: Plans and Procedures during Construction and Operation

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
Environmental					
Construction Environmental and Social Management Plan (CEAP)	• To implement mitigation activities relevant to the construction phase of the Project and to avoid, mitigate and minimise environmental and social impacts during the construction phase. • Contractor will be required to adopt the CEAP which will strictly follow and comply with the World Bank Group's General Environmental, Health and Safety Guidelines and other sector specific EHS Guidelines during construction activities at all sites as well as incorporate specific mitigation as identified through the ESA process.	-	• The CEAP will be supplemented by various separate sub-plans and procedures (as detailed below in this table) which will be developed to address key E&S aspects identified during the ESA process for which detailed control procedures and associated responsibilities for implementation by PMU and its contractors will be defined. • It will be ensured that the ESMP shall be made part of the contract document • Contractors are required to provide full time ESMU staff for the management of E&S issues on site. Roles should be in line with those identified in earlier in the Chapter. Contractor ESMU staff shall be a bill of quantities item. • It is a requirement that environmental managers have the authority to ensure best practice is adhered to across the work site and worker accommodation camps	• Prior to any site preparation and construction works • At tender stage	• Contractor • PMU
Operational Environmental and Social Management Plan (OESMP)	• Intended to guide the development of the programs by which WAPDA will ensure operation activities are carried out in a way that meets the goals of the WAPDA Environmental & Social principles/policies. • The OESMP will include a series of management plans, or sub-plans, that are intended to control various aspects of operation that could lead to specific adverse impacts.	-	• An overarching OESMP will be prepared in prior to the operation of the Project. The structure and objectives of the report will largely be the same as the CEAP. WEC and WAPDA will be responsible for ensuring the Project complies with mitigation measures outlined within this document for the operational phase.	• Prior to operation commencing.	• PMU
Construction Traffic Management Plan (TMP)	• To define the requirements that should be implemented to mitigate any potential negative risks to the environment, workers or the	• Increase in general traffic (cars and trucks) volumes and abnormal loaded vehicles	• Undertake a road conditions assessment prior to and following the peak construction period, to assess any damage to road infrastructure that can be attributed to Project construction.	• Prior to any site preparation and construction works	• Contractor responsible for producing CTMP and its

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
	community resulting from construction traffic. • The Traffic Management Plan will advise and inform site Contractors and external suppliers of equipment and materials of access and entry points along with other key information such tipping areas and wash-out areas. • Intended to compliment and work alongside relevant CEAP. The TMP will be classed as "live" and therefore be subjected to updates as required.	• Nuisance (dust, noise and vibration) as a result of traffic • Driver delay, pedestrian delay, severance, pedestrian amenity/ fear and intimidation • Community road safety • Improve transport infrastructure to handle the Project traffic movements and loads	• Repair damage as appropriate or enter into a voluntary agreement with the relevant roads authority to reimburse the cost of any repairs required to the public road network as a result of the Project. • Spoil dump sites located close to Project site to minimise journey distance and limit movements to site access roads. • Concrete mixing plant located at Project site limiting traffic movements associated with concrete delivery to site access roads • Construction of worker accommodation on site to reduce light vehicle movements relating to travel to/ from the site • Provision of bus/minibus services for personnel living in nearby settlements • Movements of construction workers will be planned to avoid the busiest roads in Ghazi and Topi and times of day when traffic is at its greatest. • Schedule deliveries and road movements to avoid peak periods • Road maintenance fund to leave a useful asset for communities after the construction phase. • Driver training for HGV drivers and refresher course every six months for Project drivers • Speed restrictions for project traffic travelling through communities (to be agreed with National Highway Authority) • Run a safety campaign to improve the people's knowledge of the traffic hazard on their roads, public information and other activities to address the issues. • Run a pedestrian awareness programme • Temporary signage • Community liaison scheme to facilitate formal communication channel between contractor and		implementation ; PMU to review contractors document

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			community		
Materials and Waste Management Plan (WMP)	• To identify measures for minimisation of waste and safe disposal of construction wastes • To identify measures for the storage, handling and use of materials.	• Non-hazardous waste generated as a result of general construction activities, including concrete offcuts, scrap ferrous and no ferrous metals, packaging materials (plastics, cardboard, pallets) • Hazardous waste generated from general construction activities including fluorescent tubes, batteries, solvents and medical waste from camps. Contaminated material generated from fuel spills and leaks.	**Materials Management** Materials management procedures will require: • Re-using materials on site wherever possible. • Instituting good housekeeping and operating practices, including inventory control to reduce the amount of waste resulting from materials that are out-of-date, off-specification, contaminated, damaged, or excess to plant needs • Instituting procurement measures that recognise opportunities such as ordering the correct amount of materials to be delivered when needed, reducing the amount of packaging used by suppliers and establishing a take back system with suppliers • Substituting raw materials or inputs with less hazardous or toxic materials wherever economically and technically feasible. • Materials handling and storage areas need to be: – Located away from sensitive receptors – Not at risk from theft or vandalism – Designed to include measures preventing spoil by the elements – Easily accessible in a safe manner – Well ventilated – Unlikely to be damaged – Located next to any required personal protective equipment (PPE) (as necessary for irritants and hazardous materials) – Bunded and located next to spill kits (as necessary for hazardous liquids). • Control measures to minimise the likelihood of incidents, including: – Identification of the necessary PPE	• Prior to any site preparation and construction works • Prior to operation	• Contractor for construction (approved by the Engineer) • WAPDA for operation

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			requirements – Identification of the necessary bunding and spill kit requirements – Details of the correct procedure for handling and storing any hazardous materials – A map showing the material storage locations – Training requirements (as necessary) with respect to materials handling procedures – The correct procedure for reporting any environmental incidents related to spills / leakages and how to deal with any spills / leakages – The specific regulatory reporting requirements as they relate to materials storage. • Temporary waste storage handling facilities designed to include the following: – Waste segregation in designated storage areas, such that hazardous and non-hazardous wastes are not mixed and to allow for recycling and reuse where appropriate. – Hazardous waste segregation from other waste types to avoid cross contamination – Correct identification and sound environmental storage of all wastes pending collection/transfer for reuse, recovery, recycling or disposal – Separate skips for each waste stream to allow segregation in order to maximise re-use and recycling opportunities – A suitable cover for all skips – Waste storage areas located on areas of impermeable hard standing. Liquid wastes/oil/chemicals to be stored in tanks or drums located in bunded areas which can hold 110% of the total storage volume.		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			Secondary containment for drum storage will be provided by a drip tray which will be able to contain either 25% of the total volume of the containers or 110% of the largest container, whichever is the greater. – Spill kits to be available at all times – Store hazardous waste in closed containers away from direct sunlight, wind and rain in designated storage areas – Provide adequate ventilation where volatile wastes are stored – Handling and storage shall be carried out by trained staff – Provide readily available information on chemical compatibility to workers including labelling each container and demarcation of the area (eg on a facility map / site plan) – Conduct periodic inspections of waste storage areas and document the findings – Prepare and implement spill response and emergency response plans to address accidental releases and leakage – Avoid underground storage tanks and underground piping of hazardous waste. Readily available information will be provided to workers on chemical compatibility including labelling each container, demarcation of the area (e.g. on a facility map / site plan) **Waste Management (including waste materials)** • Will include identification of likely waste arising and appropriate handling, reuse and recycle opportunities and, as a last resort, disposal methods. The waste management plan will be prepared in accordance Pakistani waste regulations, the European Waste Catalogue and the World Bank Group's EHS Guidelines for		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			Construction Materials Extraction and General EHS guidelines. • The WMP will follow the waste management hierarchy: – Waste prevention – Recycling and reuse – Treatment and disposal in accordance with the relevant statutory requirements, guidelines, and GIIP. • The WMP will require processes to be designed and operated in accordance with the following strategy to prevent or minimise waste and hazards associated with the wastes generated: – Substituting raw materials or inputs with less hazardous or toxic materials, or with those where processing generates lower waste volumes – Applying manufacturing processes that convert materials efficiently and provide higher product output yields. This may include modification of the production process, operating conditions and / or process controls – Instituting good housekeeping and operating practices, including inventory control to reduce the amount of waste resulting from materials that are out-of-date, off specification, contaminated, damaged, or excess to plant needs – Instituting procurement measures that recognize opportunities to return usable materials such as containers and which prevent the over ordering of materials – Minimizing hazardous waste generation by implementing stringent waste segregation to prevent the co-mingling of non-hazardous and hazardous wastes. • The WMP will define procedures for: on-site		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			sorting, temporary storage and collection by recycling contractors to recover inert, reusable and recyclable materials before disposal off-site. • The frequency of skip emptying or removal should be sufficient to prevent overflow of wastes. • Construction phase materials and waste management strategy will include the following provisions: • Procedures for the reduction of waste production (e.g. blending high-quality rock with poor rock) • Only permitted contractors will be selected and used or alternatively transport of wastes will be undertaken by the Contractor themselves; Handling and storage shall be carried out by trained staff • Spill response equipment will be made available and maintained in areas where hazardous wastes may be spilt and an appropriate number of site personnel will be trained in spill response techniques. • Waste treatment or disposal facilities used will be appropriately permitted, or if not available, based on the most suitable site in consultation with the Swabi district council and KP Environmental Protection Agency (KP-EPA) • Contaminated soils, if any, should be appropriately handled and disposed of in accordance with the relevant international (GIIP) and local requirements. Confirmation from the local environmental authorities should be sought to confirm the acceptability of reuse of contaminated soils on site. Prior to reusing potentially contaminated soils as backfill. Appropriate risk mitigation measures shall be implemented to avoid environmental		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			contamination and impacts on health. • The Contractor Site Manager will not release the waste if there is concern about the standard of transport or destination of the waste • WAPDA should identify and take action to strengthen regional and/or local waste management capacity for example with regard to recycling (e.g. use of community-based recycling organisations within the Project AoI). • A detailed operational waste management procedure will be produced to embed best practice waste management in the operational philosophy of the Project. The waste management procedure will highlight the relevant policy and legislation of Pakistan and include a Site Waste Management Plan (SWMP). It will also include: – A waste management philosophy based on the waste hierarchy of prevention, reduction, reuse, recovery, recycling, removal and disposal of wastes – A map showing each temporary waste storage location for the Project – A description of each waste generated by the operation of the facility, the appropriate handling methodology, the correct approach for temporary storage and the correct route for removal/disposal off site – Staff training requirements with respect to waste handling procedures – Waste generation data collection for each waste stream by volume, according to the EWC. This should include the proportion of each waste stream going for reuse, recycling or disposal. Any unusual waste volumes should be investigated – Any waste monitoring as deemed to be necessary		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			– An audit schedule which details the frequency of waste management audits and those responsible for undertaking them – A section related to continuous improvement and corrective actions where audit findings can be recorded and incorporated into the waste management procedure. This will also highlight any new and feasible reuse or recycling opportunities which may arise over time – A mechanism by which to routinely track waste consignments from the originating location to the final waste treatment and disposal location – The correct procedure for reporting any environmental incidents related to waste – The specific regulatory reporting requirements as they relate to waste. – In addition, a valid copy of all waste carriers' licences will be kept on site. All transfer notes related to waste uplifts will be completed in full and contain an accurate description of the waste and be signed by the producer and carrier before waste leaves the site. • Specific issues to be covered in the OWMP include: – To minimise the effects of using the landfill areas at Topi and Ghazi, as part of the development of its operational waste management plan WAPDA should consider the potential to develop an international standard landfill site within its property/ TDP site and dispose all non-recyclable waste there according to international best practice. – WAPDA should review existing practices for the treatment and disposal of sanitary and sewerage effluents and identify and		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			implement a solution in accordance with GIIP. This may require the development of new or rehabilitation of existing waste water treatment plants on site in accordance with GIIP. – If it is necessary to use Gas Insulated Switchgear, ensure management procedures are in place for installing, maintaining and operating the GIS and that the procedures are in line with GIIP. – Medical wastes will be stored and transported as follows: – Colour coded medical waste containers will be used. These will be puncture-proof (usually made of metal or high-density plastic) and fitted with covers – Bags and containers for infectious waste will be marked with the international infectious substance symbol – Wastes will be stored in a waste management area – Wastes will be transported to a medical facility with a licence for waste incineration		
Spoil Management Plan	• To define the requirements that should be implemented to manage and monitor any potential negative risk and impacts to the environment, workers or the community resulting from the excavation, blasting, handling, transportation and / or disposal of spoil.	• Dust as a result of excavation, blasting and transportation of earthen materials • Landslide from stockpiling, vegetation removal, excavation and blasting. • Erosion and sedimentation from the flow of rainwater into the Ghazi Barotha pond • Landscape and landuse	• Topsoil, overburden, and low-quality materials should be properly removed, stockpiled near the site, and preserved for rehabilitationThe Contractor will ensure that all temporary spoil waste disposal sites adjacent to excavation areas are engineered such that: – They allow for the sorting and grading of spoil, removal of excess waters through filtration, and, if necessary, are covered to prevent dust emissions. • The Contractor will ensure that spoil wastes will not be mixed or contaminated with any other type of waste generated on site.	• Prior to site any site preparation and construction	• Contractor

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
		changes	• The Spoil Management Plan will include a description of the control measures at each spoil disposal site (such as spot checking of spoil loads) to ensure that only material excavated from each of the Project's components is deposited there. • The Contractor will develop specific method statement and risk assessment for each spoil waste disposal site. • Where practical, topsoil will be reused on site upon re-instatement and landscaping of cut / excavated areas.		
Noise and Vibration Control Plan	• To guide the means by which WAPDA and the contractor will control noise and vibration caused by construction, traffic, operations, and other activities to ensure noise does not exceed applicable standards at the site boundary and beyond. • Single or separate Plans may be developed for construction, operation, or both.	• Noise impacts as a result of site preparation excavation and foundations, construction and blasting / tunnelling • Vibration impacts as a result of blasting • Noise impacts (nuisance) as a result of site traffic movements to and from site, including abnormal loads	• Avoiding or minimising project transportation through community areas. • Unnecessary revving of engines will be avoided and equipment will be switched off when not in use • Timing of deliveries to avoid sensitive times of the day • Internal haul routes will be kept well maintained • Use of effective exhaust silence systems or acoustic engine covers as appropriate • Plant will always be used in accordance with manufacturers' instructions. Care will be taken to site equipment away from noise-sensitive areas. Where possible, loading and unloading will also be carried out away from such areas • Regular and effective maintenance by trained personnel will be undertaken to keep plant and equipment working to manufacturers specifications • Procedures for handling noise and vibration complaints • Prior to the commencement of construction operations, a detailed pre-construction building condition survey of buildings identified at risk	• Prior to any site preparation and construction works	• Contractor

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			shall be conducted; buildings surveyed are also to include buildings up to 200m from the blast site within the AoI for precautionary reasons, even if they are out of the zone of possible impact. • Blasting will be avoided where possible, although it is recognised a number of key activities will require blasting to take place. Where unavoidable, blasting shall be in accordance with control techniques according to the Blasting Act in Pakistan. Contractor will prepare a Blast Management Plan.		
Air Quality Management Plan	• To define the minimum requirements that should be implemented to mitigate any potential negative risks to the environment, workers or the community resulting from air emissions that arise during the construction phase of the Project	• Deterioration of air quality as a result of – Site preparation; tunnelling; land clearing; quarrying; road construction; spoil deposition; general construction activities – Traffic and vehicle movements on site roads – Transportation of spoil to disposal sites • Construction traffic and machinery	• Controlling dust emissions from drilling activities at the source by dust extractors, collectors, and filters, and adopting wet drilling and processing whenever possible • Controlling dust emissions from processing equipment (e.g. crushers, grinders, screens, conveyors and bins) through dust collectors, wet processing, or water spraying. Dust control applications should consider the final use of extracted material, for example, e.g. wet-processing stages are preferred when wet materials or high water contents would not negatively affect their final use • Implementing dust suppression techniques to minimize dust from vehicle movements and stockpiles. Techniques may include water spraying and surface treatment (e.g. hygroscopic media, such as calcium chloride, and soil natural–chemical binding agents) of roadways and exposed stockpiles using a sprinkler system or a ”water-mist cannon” • Where possible vehicles to use defined access roads/tracks. • Where travelling off road, keep vehicle movements to a minimum. • Managing emissions from mobile sources (on-	• Prior to any site preparation and construction works	• Contractor

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			site vehicles) by requiring contractors to use modern, well-maintained vehicles that comply with applicable emission limits • Avoiding open burning • Planning land clearing, removal of topsoil and excess materials, location of haul roads, tips and stockpiles, and blasting with due consideration to meteorological factors • Designing, installing and applying a simple, linear layout for materials-handling operations to reduce the need for multiple transfer points, • Preferring use of mobile and fixed-belt transport and conveyors over hauling the material by trucks through internal roads • Compacting and periodically grading and maintaining internal roads • Vegetating exposed surfaces of stockpiled materials • Generators used should be of a modern design and well-maintained to minimise air pollutant emissions. • Using personal protective equipment (PPE), such as dust masks, where dust levels are excessive • Equipping excavators, dumpers, dozers, wagon-drills, and other automated equipment with air conditioned, dustproof, and soundproof cabs. • Particular measures for managing dust issues from blasting: – Alternatives to blasting, such as hydraulic hammers or other mechanical methods – If blasting is necessary, planning of the blasting (arrangement, diameter, and depth and direction of blast holes) will be implemented as per Blast Management Plan – Correct burning of explosive, typically composed of a mixture of ammonium nitrate		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			and fuel oil, will be ensured by minimising the presence of excess water and avoiding incorrect or incomplete mixing of explosive ingredients • Particular measures for managing dust issues from the blending, packing, loading, unloading and use of bulk cement: – Containment of dusty processes: containment and arrestment is the preferred option for control of emissions to air from processes handling cement – Suppression of dust using water or proprietary suppressants. Where water is used for dust suppression, processes require an adequate supply of water. To demonstrate an adequate water supply on tanks that are not fed from the mains, a low level alarm will be fitted. It is noted that water-based suppression has caused issues with mud production on the T4HP site and therefore alternative chemical-based suppression options could be pursued in certain locations. – Protection of external sources, such as stockpiles and external conveyors, from wind whipping is necessary. There are various methods that may be used to this end. Crushed rock, sand or coarse aggregate, can be delivered, stored and handled so as to minimise dust emissions, for example by dampening or covering		
Blast Management Plan	• A blast management plan (BMP) is a risk control plan used in explosive blasting. It aims to ensure blasts do not harm people in the area and limit damage to the environment. • A BMP is the recommended method for planning safe use of explosives.	• Risk of blasting activities resulting in accidents, injuries, or noise and vibration that cause damage or result in a nuisance	• Blasting shall be in accordance with the control technique of Blasting Act in Pakistan. Contractor will prepare a Blast Management Plan • Prior to the commencement of construction operations, a detailed pre-construction building condition survey of buildings identified at risk shall be conducted; buildings surveyed are also	• Prior to any site preparation and construction works	• Contractor

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			to include buildings up to 200m from the AoI for precautionary reasons, even if they are out of the probable zone of possible impact • Identify and document risks through appropriate risk assessment. • Develop and maintain safe blasting procedures • Security arrangements in place, such as access to authorised persons only and secured area with guarded gate. • Ensure shot firers are licensed • Train personnel in explosives products and blast design • Develop and implement procedures to check training and competency • Set up exclusion zones • Use appropriate firing method and types of explosives • Vibration during blasting should be measured in terms of PPV in millimetres/second and using velocity transducers. Measurements should be made on hard ground as close as possible to affected receptors. The peak value should be recorded during each blasting event for comparison with the criteria given above. Where levels indicate potential risks of the onset of building / infrastructure damage then measures to reduce vibration should be implemented. • To minimise air quality issues, ensure the following: – Alternatives to blasting are considered, such as hydraulic hammers or other mechanical methods – If blasting is necessary, planning of the blasting (arrangement, diameter, and depth and direction of blast holes) will be implemented		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			– Correct burning of explosive, typically composed of a mixture of ammonium nitrate and fuel oil, by minimising the presence of excess water and avoiding incorrect or incomplete mixing of explosive ingredients.		
Oil and Chemical Spill Response Plan	• To define the requirements and procedures to be followed during the handling and storage of chemicals, lubricants, solvents, oil and fuel throughout the project as well as the prevention and response to land-based spills.	• Pollution caused by improper materials handling and storage. • Contaminated material generated from fuel spills and leaks.	• Develop in accordance with local Emergency Response regulations, GIIP and IFC and HSE guidance. The following requirements will be included in the plan: • Undertake soil and groundwater quality baseline assessment for the Project area, including soil and groundwater contamination testing. • Establish baseline values for the site to compare with future monitoring and to identify conditions the site should be returned to in future when the power station has closed and is to be decommissioned. • Establish a complete inventory of hazardous materials (chemicals, oils and fuels) stored on-site so that in the event of a spill, information is available on volumes present • Maintain copies of Material Safety Data Sheets (MSDS) for all hazardous materials held on-site so that in the event of a spill information is available on potential risks, both to nearby receptors and the health and safety of construction workers • Ensure the appropriate storage and transfer requirements are in place at site • Undertake regular inspections of equipment and facilities to check for leaks or faulty equipment. This includes checking for dents and rust. • A single page quick guide spill response procedure will be included (based on the stop, contain notify system or similar) that will be reproduced and displayed at all locations on site where a spill is possible. If possible, the spill	• Prior to any site preparation and construction works • Prior to operation	• Contractor for construction (Approved by PMU) • WAPDA for operation

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			response procedure and ERP should be aligned. • All vehicles to carry fire extinguishers and spill kits.		
Sediment, Erosion and Landslip Control Plan	• To provide the basis for WAPDA and the contractor to manage and control erosion caused by construction activities and to minimise impacts on water quality and aquatic habitat erosion and sedimentation.	• Vegetation loss and compaction, resulting in erosion of soils • Deposition of dust on surfaces where it may cause damage and/or lead to a need for increased cleaning or repair • Adverse health effects from excessive inhalation of fine particles • Complaints from the public relating to dust or emissions • Impacts on vegetation from dust deposition • Sedimentation of drainage systems resulting in impacts to water quality, ecology and /or drainage control • Sedimentation of water courses resulting in contamination and impacts on ecology and downstream water users. Landslide.	**Sediment and Erosion Control measures** • Work sites and access roads will be carefully selected so that the risk of surface runoff entering the river is minimised. Measures such as rip rap and slope protection will be adopted where appropriate. • Surface water runoff to be controlled by the construction of temporary drainage channels terminating in sediment traps/ soak away ponds. • Sedimentation ponds must be appropriately located and sized and well maintained. Any discharges from sedimentation ponds must meet surface water quality standards. • Slope breakers to be installed where the potential for rill erosion is identified/observed. • Top soil to be stripped and stockpiled where practical. • Temporary stockpiles to be protected from erosion. • If required, quarries and borrow pits following completion of works re-contoured and top soil reinstated and vegetation re-established through sewing of suitable grass seed if dormant seeds in top soil do not contain viable native seed stock. This is to be in accordance with the Habitat Reinstatement Plan • Plant new trees and vegetation in the areas subjected to erosion in accordance with the Habitat Reinstatement Plan • Other measures to be employed as needed including straw bales, silt fences, stilling ponds, erosion protection matting, bio-engineering. • All waste water requiring treatment will be	• Prior to any site preparation and construction works • Prior to construction	• Contractor for construction (Approved by PMU) • WAPDA for operation

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			processed in the dedicated wastewater treatment facility if it is operational or collected and treated off site, in accordance with the procedures in the Water Quality Management Plan. **Landslip management** • Slope supports or mitigation measures will be employed to ensure that the slopes remain stable with design to appropriate standards. • Contractor will monitor engineering slopes and landslides near the powerhouse, including deformation, stress and strain, seismic response, blasting vibration. • Removal of the overburden deposits at the powerhouse site that are currently considered unstable • As a rule, cutting and removal of the soil/rock mass should be performed from upper to lower portion to maintain the slope stability. • After the excavation of slope, timely sealing and protective measures shall be adopted for soft rock slope surface • Geological work (assessing conditions encountered) will continue throughout construction • Temporary works shall be designed to be safe, reliable, and adequate for all loads and uses. • Blasting should be avoided where practicable. Contractor will prepare a Blast Management Plan. • Contractor responsible to undertake proper maintenance of all roads being used by the Contractor and Employer during the entire construction period including removal of slides, road surface repair and drainage system cleaning and upgrading. • ERP to include landslide risks.		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
Chance Finds Procedure	• Project-specific procedure that outlines what will happen if previously unknown heritage resources, particularly archaeological resources, are encountered during project construction or operation.	• Damage to unrecorded archaeological and cultural heritage features.	• If any unexpected finds are encountered during earthworks or excavation works the following mitigation approaches will be employed by the Project: – Work will be immediately stopped in the area – The find(s) will be demarked and protected via fencing / blocking off and the site manager and Project Environmental Officer will be contacted – The cultural authority will be informed in order to seek guidance and specialist advice for management of the find(s) and how best to proceed, given its nature and extent – All finds will be recorded.	• Prior to any site preparation and construction works	• Contractor
Water quality management plan	• To guide the means by which WAPDA and the Contractor will ensure that the Project and its activities do not cause unacceptable contamination or impacts to water resources and that process and potable water meet applicable standards.	• Pollution caused by the discharge of industrial process water (effluent) to a water resource • Pollution caused by the discharge of sewage to a water resource • In-river construction works contributing to a deterioration in water quality • Sedimentation as a result of blasting, excavation and spoil disposal, vegetation clearance • Deterioration of groundwater quality from blasting and tunnel boring	• The required irrigation releases and flood management releases (if required) will be provided during the tunnel closure period via the other tunnels. • Work sites and access roads will be carefully selected so that the risk of surface runoff entering the river is minimised. • Sewage will be pre-treated prior to discharge by installation of septic tanks or a pilot activated treatment plant at sewage generating sources. A sewage collection system is also envisaged to avoid the spillage of sewage in open areas • To mitigate water quality impacts[40] pre-treatment will be required to maintain net BOD levels below the standards for effluent discharges to surface waters. • Oil and water separators and settling / sedimentation ponds will be installed where appropriate to minimise the risk of contaminated construction water entering the river or groundwater and degrading water	• Prior to any site preparation and construction works • Prior to operation	• Contractor for construction (Approved by PMU) • WAPDA for operation

[40] In line with Pakistani and WHO standards,

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			quality. • Settling / sedimentation ponds will be appropriately located and sized and well maintained. Any discharges from sedimentation ponds must meet surface water quality standards. • Upon completion of construction phase, disturbed areas will be contoured and re-vegetated in accordance with the Habitat Restoration Plan to minimize the potential for soil erosion and water quality related impacts. • An Oil and Chemical Spill Response Plan will be developed to provide the controls that should be implemented in the event of an accidental spill or leak incident.		
Ecological Management Plan	• To detail the contractor's commitments to managing and monitoring impacts on flora and fauna. • The EMP will cover construction only. The objective is to protect biodiversity for the construction phase of the project in the project area.	**Construction** ***Terrestrial fauna:*** • Habitat loss/degradation • Disturbance (presence of people, artificial lighting and noise) • Injury or death owing to construction works (including trapping in deep excavations) and increased traffic • Temporary habitat fragmentation ***Aquatic habitats and species:*** Construction activities leading to: • Changes in water quality ***Aquatic habitats and species:*** Construction activities	Generalmeasures • The plan must include: • Survey of the area by qualified biologist(s) ahead of ROW clearing, as well as strict prohibition for the workforce on killing or capturing any of the species Details of the local NGO or consultancy, and the specialists that will undertake some of the activities that require specialist and local knowledge • Description of the biodiversity monitoring methods and sites to be used during construction. • Prevention of the introduction and spread of non-native and invasive species • Contractor to monitor all known non-native and invasive plant species in the AoI during construction and will identify and report new invasive species establishing in the Project AoI during construction • Other species known to be invasive in Pakistan and globally will also be monitored if they are recorded on the construction sites.	• One month prior to any site preparation and construction works • Restoration should start at the end of construction and prior to operation	• Contractor for construction (Approved by PMU) • WAPDA for operation

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
		leading to: • Changes in water levels **<u>Operation</u>** ***Terrestrial habitats and flora:*** • Dust deposition and run off from increased vehicle movements • Permanent habitat fragmentation (low scale) ***Terrestrial and riparian fauna:*** • Permanent habitat fragmentation (low scale) • Increased disturbance, noise, dust • Increased risk of road kills ***Aquatic habitats and species:*** • Changes in water quality (sediments) • Changes in water quality (chemicals due to pollution events) • Changes to the water levels • Entrainment	• A local botanist will be employed to undertake the monitoring or will be contacted to confirm the identification of invasive species. • Construction and operational activities will comply with international guidelines on the prevention and management of alien invasive species (AIS) (IPIECA & OGP (2010). Alien invasive species and the oil and gas industry. Guidance for prevention and management. OGP Report Number 436) • Preventative, control and monitoring measures will need to be implemented with regard to the following aspects of the Project. Not all measures will need to be implemented; a risk screening will be undertaken by the contractor for each construction site and this will inform the implementation of the most appropriate prevention and control measures. The risk screening process will be included in the EMP: • Packaging and movement of materials: • Minimise traffic and the distance it has travelled • Source goods/materials locally where possible • Contain any AIS and report their presence. • Vehicles and plant: • 'As-new' wash-down is essential before entering non-infested areas and after working in infested areas • Train and raise awareness regarding AIS • Pressure wash vehicle tyres in a contained area • Contain and destroy residue • Record and report the presence of any AIS. • Soil and vegetation: • Minimise disturbance to, or movement of, soil and vegetation • Prevent soil damage and erosion • Ensure imported soil/other materials are safe		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			and free of AIS (source from a reputable supplier, request information on the soil's origin and certification of AIS-free status if possible) • Prevent AIS establishment on exposed stored soil (do not store bare soil near known sources of AIS, consider using matting to cover exposed soil) • Ensure infested material is disposed of safely • Retain as much natural vegetation as possible. • Habitat reclamation: • Use native plants for reinstatement and landscaping • Assess any non-native species (to be used in landscaping) for AIS potential • Consider that some AIS may be soil-based • Avoid altering soil and water body properties. • Linear elements (transmission lines, roads, waterway): • Plan the timing of activities to avoid impacts on AIS • Minimise spread width • Minimise vehicle-related impacts • Contain existing AIS • Minimise entry and exit points. • Measures to prevent or minimise the introduction/spread of invasive fish species, including the non-native carp species will be adopted, including awareness raising and education programmes for the local communities • Terrestrial and riparian animal species • Noise reduction: • Avoidance of unnecessary revving of engines and switch off equipment when not in use • Vehicles and equipment will be properly		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			maintained to meet the manufacturers' noise rating levels. Any silencers or bearings which become defective would be replaced as soon as possible • Using reverse warning systems incorporating broadband noise where practicable • Using enclosures for noisy plant such as pumps or generators • Minimising drop height of materials • Limiting the use of particularly noisy plant or vehicles where practicable • Plant and vehicles will be operated with noise control hoods closed. • Reduction and control of artificial lighting. Artificial lighting used on construction sites and camps at night will be shaded and directed downwards to avoid light spillage and disturbance to nocturnal birds, bats and other wildlife. • Ban on hunting and poaching: • All construction and operation staff will be required to follow company rules and code of conduct • Signage will be installed illustrating the hunting ban on any species throughout the Project areas • Measures will be implemented by both the Contractor and the client, who will employ suitable environmental staff to audit compliance • Mitigation for breeding, foraging and wintering birds: • Vegetation clearance outside the breeding period if possible. Where this is not possible, the areas to be cleared will be checked for breeding birds prior to the clearance and if nesting birds are found, appropriate mitigation measures will be implemented. This may		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			involve avoiding construction within 50m of the active nest until the chicks have fledged. • Installation of bird diverters 7m to 10m spacing41 on power lines • Aquatic habitats and species • Management control measures to reduce, capture, and treat soil erosion. For example: • Exposed work areas near watercourses or in the riparian zones will be reinstated with suitable vegetation as soon as possible. Where possible, reinstatement will be undertaken using the same species present in the area before construction • During construction, riparian vegetation adjacent to the water courses will be retained where possible to act as buffer zones to assist in trapping sediments before reaching the water course. • No direct discharges of any pollutants to the river. There will be no direct discharges of any pollutants to the river, and the river should not be used to clean machinery or for any other purpose where pollutants may be released. Fuel storage, asphalt manufacturing, explosives and other potentially polluting activities must occur away from rivers and have adequate pollution control measures. • Fish catch and release must be carried out prior and during the dewatering period of the Dhal Dara channel. Catch and release methods must be reviewed and approved by the Engineer before being implemented on site. The Contractor will need to ensure that expected fish numbers are calculated and sufficient resources are available.		

[41] Avian Power Line Interaction Committee (APLIC), (2012). Reducing Avian Collisions with Power Lines: The State of the Art in 2012. Edison Electric Institute and APLIC. Washington, D.C.

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			• Awareness and education • Sponsor awareness raising programmes for the local communities to explain why and how invasive species of plants and animals (especially invasive fish) affect native biodiversity. Measures to reduce overgrazing and soil erosion will also be explained to the local communities. These programmes will be implemented by a local NGO to be employed by WAPDA. • Other Mitigation Measures • All pits, trenches and excavations will be covered overnight or fenced to avoid animals falling in. Pits and trenches will be checked prior to refilling. • Vegetation clearance will be carried out in a methodical manner so that any fauna present in these areas can disperse. Where clearance of dense scrub is required, it will be preceded by a hand search for mammal and/or reptile species which may be present in the sward. The dense vegetation will only be cleared once it has been established that any individuals present have fled. The incidental creation of pockets of habitat or islands will be avoided. Before and during vegetation clearance or tree felling, any animals found will be removed and released to safe refuge. • In sensitive areas, notices will be put up along the site roads to highlight the risk of collision with mammals and other animals		
Habitat Removal and Restoration Plan (HRRP)	• To establish mitigation and good practice for terrestrial habitats and flora.	**Construction** ***Terrestrial habitats and flora:*** • Loss and degradation of terrestrial and riparian habitat • Introduction or spread	A Habitat Removal and Restoration Plan (HRRP) will be produced by the Contractor and reviewed by a qualified ecologist before start of construction. The HRRP will set out the minimum requirements in relation to the clearance and restoration of natural habitats, and the removal, storage and reinstatement of soil.	• One month prior to any site preparation and construction works • Restoration should start at	• Contractor for construction (Approved by PMU)

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
		of non-native invasive species	The HRRP is likely to include the following practices: • Where practical, soil removed from construction sites will be stored and used in the restoration • Habitats affected temporarily during construction will be restored/reinstated on a 'like-for-like or better principle', using the species recorded during the baseline surveys (native species only) • Specifications for a tree inventory of all trees to be removed or affected by the works. The inventory will be undertaken pre construction and pre-vegetation clearance and will include an assessment of the tree species to be affected, their size and condition • All species used in the habitat restoration will be native. No introduction of non-native plant species will be allowed. Where restoration of natural habitat is not possible on site (e.g. under the footprint of the permanent structures), similar habitat will be created off-site. The client will investigate options for compensation land in the same district. The following two approaches could be considered: 1. One option is for the client to commission a forest restoration or similar plan to replace the habitats permanently lost by the Project in an offsite location. A local ecologist should be employed to determine a suitable offsite area and restoration works should be undertaken under a defined restoration plan. The restoration plan should include instruction on the preparation of the area identified, to sourcing of soil and trees of local provenance and a defined management and monitoring plan to ensure the habitats created are established successfully for the long-term viability of the habitat.	the end of construction and prior to operation	

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			2. A second option is for the client to provide financial and logistical support to existing afforestation programmes by the Forest Department. The afforestation supported by the client will be commensurate with the habitat areas to be permanently lost under the different components of the project To ensure the habitats restored on-site or created off site are established successfully, they will be maintained and monitored for at least five years		
Health and Safety					
Tarbela Occupational Health and Safety Plan / Contractor ESHS Plan	• To implement a safe working environment, procedures and culture during the construction phase. Further policies / procedures to be developed if need identified through site audits. • Health and safety risks: – Risks or changes to community health (including through changes to local traffic conditions), safety and security including public health and access to health services • Risks associated with occupational health and safety (OHS)	• Occupational health and safety risks, including: – exposure to physical hazards from use of heavy equipment including cranes – trip and fall hazards – exposure to dust, noise and vibrations – falling objects – exposure to hazardous materials; and exposure to electrical hazards from the use of tools and machinery – working around large water bodies; – working at height, with live power equipment and lines • exposure to electro-magnetic fields (EMFs).	• Proper use of personal protective equipment (PPE) by all workers, PPE use in workers' code of conduct • Contractor to have an appropriately equipped first aid room and staff to address workers' health and manage community health interactions • Reservoir use and safety awareness including barriers, signage and sensitisation, especially near the dam and where risk of slippage and drowning near the reservoir is high • Monitoring and reporting of accidents, injuries, lost-time incidents, near misses and community interactions on health issues • Worker accommodation monitoring • Tool box talks on hygiene and sanitation at least every six months • Good housekeeping on site to prevent pooling of water • Control and quality assurance of drinking water • Pest and vector control activities • Information dissemination and sensitisation campaigns on venomous snakes directed to workers and provision of additional doses of snake and rabies serum to health facilities on site	• System in place prior to construction, additional plans and policies developed as needed	• Contractor (ESHS Plan) • WAPDA (OHS Plan)

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			• Driver first aid kits in all vehicles.		
Emergency preparedness and response plan	• To manage potential emergencies during the construction, operation and decommissioning of the Project. The EPRP will form part of the wider suite of plans to be implemented by the W-ESMU and C-ESMU teams.	• Accidental and emergency situations	• Plan to be prepared to follow international practice and World Bank *'Operational Policy 4.37 – Safety of Dams'*, utilising the World Bank *'Regulatory Frameworks for Dam Safety, 25069'* as far as practicable for an 'on-site' plan for dealing with incidents directly associated with the dam. Alternatively, the existing EPRP for the Tarbela dam may be reviewed and updated as applicable taking into account the implementation of the Project. • The new / updated Tarbela dam EPRP will: – Identify and evaluate emergencies – Determine preventative action – Highlight trigger events and measures to implement plan • A Project specific EPRP will also be produced to cover the specific HSE risks associated with the Project construction activities.	• Prior to any site preparation and construction works • Prior to operation	• Contractor for construction (Approved by WEC) • WAPDA for operation
Worker Accommodation Plan	• To ensure that all Project accommodation areas are designed, constructed and maintained as healthy, clean and pleasant locations for workers to live in.	Hygiene, safety and security risks • To address issues on T4HP: • Anecdotal evidence of negative impacts on worker well-being in relation to the camp where Pakistani workers were accommodated. • Ventilation was inadequate, kitchen facilities unhygienic, open gutters attracted mosquitos, garbage containers were left uncovered, and there were complaints about	Prior to the construction works, WAPDA and the Contractor(s) will commit to: • Meeting the requirements set out in the guidance note by IFC and EBRD on workers' accommodation: processes and standards (2009). • In particular, the provision of accommodation will meet international good practice in relation, but not restricted, to the following: – Practice for charging for accommodation – Provision of minimum amounts of space for each worker – Provision of sanitary, laundry and cooking facilities and potable water – Location of accommodation in relation to the workplace – Any health, fire, safety or other hazards or	• Prior to construction of the worker accommodation. • Maintained throughout the project lifecycle	• Contractor for construction (Approved by PMU) • WAPDA for operation

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
		food and limited entertainment facilities (TVs) in the camps. • On site, there was irregular use of some PPE like gloves.	disturbances and local facilities – Provision of first aid and medical facilities – Heating and ventilation • Workers freedom of movement to and from the employer-provided accommodation will not be unduly restricted • Liability for security clearance for staff to enter site will be with the employer • A bill of quantities item shall be implemented in the contract to ensure the T4HP worker camp is refurbished if re-used. • It shall be ensured that food available is of a good standard.		
Social					
Stakeholder Engagement Plan (SEP)	• Describes the means by which the Project as part of the larger Tarbela Project will ensure continuous engagement with affected people and other interested parties, especially with regards to disclosure of construction information and ongoing sustainability reporting to the wider public, key stakeholders and the public	Broad community support		• Prior to construction	• Community Liaison Officer (CLO) Contractor
Community grievance mechanism[42]	• Ensures the timely resolution of community grievances	• Broad community support	• Identifies structured process to review the validity, responsibility and response/action of community grievances	• Prior to construction	• Contractor CLO
Worker grievance mechanism	• Ensures the timely resolution of worker grievances to prevent lost time incidents	• Employment generation	• Identifies structured process to review the validity, responsibility and response/action of labour grievances	• Prior to construction	• Contractor Human Resource (HR) Manager
Gender Strategy	• Raise gender awareness of the different roles and responsibilities within the community, the economy	• Employment generation Broad community support	-	• Prior to construction	• PMU and Contractor HR Manager

[42] Normally this mechanism is part of the stakeholder engagement plan however it can also be a stand alone document.

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
	and agricultural production • Implement a gender mainstreaming component in all Project related plans and programmes • Suggest practical and measurable gender actions and targets to be achieved as a result of the Project and related programmes				
Project Labour Statement Recruitment Policy Human Resources Policy Local Content Strategy	• Identifies that all T5 employers will meet national labour laws and uphold labour rights, especially in relation to having signed contracts, not using excessive overtime use • Commits to equity in local employment benefits and equal employment opportunities across ethnicities and women. • Prohibits the use of child and forced labour / promote non-discrimination and equal opportunities. • To help promote the participation of national companies, local businesses and local workers in the service and equipment procurement opportunities. •	• Employment generation • Minimises social conflict • To address issues on T4HP: • No preference for local labour • Labour issues regarding working hours, wage structure, holidays, over time and leave arrangements.	• Prevents workforce discontent and labour protests • A clearly defined Project Recruitment Policy shall be implemented • Contract clauses shall be put in place requiring the Contractor to hire people from Affected Communities • Regular bulletins shall detail descriptions of employment and supply chain opportunities to local people and businesses, including information about required skill levels, indicative timeframes for recruitment and likely duration of contracts. • Bulletins shall be distributed in nearby villages and printed in local newspapers and the Recruitment Policy is to be referred to in job adverts. • Individual contracts of employment shall be provided for all workers. These shall detail workers' rights and conditions related to hours of work, wages, overtime, compensation and benefits such as maternity or annual leave. Contracts shall be updated when material changes occur. • Monitoring of labor rights and workforce profile is required quarterly. • Toolbox talks shall be held frequently on safety and labor issues and a review of the labor grievance mechanism shall be undertaken twice	• Prior to construction	• WAPDA • Contractor HR Manager

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			a year during the construction phase. • A supply chain review shall be undertaken quarterly to identify issues of child or forced labor and Occupational Health and Safety (OHS) risks.		
Workers' Code of Conduct	• Governs the behaviour of workers on site, in their accommodation and in the local communities	• Employment generation Minimises social conflict	-	• Prior to construction	• Contractor HR Manager
Communication Strategy	• Will identify how best to communicate project's benefits and its work	• Clearer public perception about the project	Lack of awareness among local communities and public in general about the project	• During the project	• WAPDA and contractor

10.5.2 Environmental Code of Practices (ECPs)

The environmental codes of practice (ECPs) are generic, non-site-specific guidelines. The ECPs consist of environmental management guidelines and practices to be followed by the contractors for sustainable management of all environmental issues. The contractor will be required to follow them and also use them to prepare site-specific management plans (Construction Environmental and Social Management Plan, CEAP). In addition to the ESMP, the ECPs will also be attached to the construction contracts and will be monitored for compliance. The ECPs are listed below and attached in **Annex5.**

- ECP 1: Waste Management
- ECP 2: Fuels and Hazardous Substances Management
- ECP 3: Water Resources Management
- ECP 4: Drainage Management
- ECP 5: Soil Quality Management
- ECP 6: Erosion and Sediment Control
- ECP 7: Top Soil Management
- ECP 8: Topography and Landscaping
- ECP 9: Borrow Areas Management
- ECP 10: Air Quality Management
- ECP 11: Noise and Vibration Management
- ECP 12: Protection of Flora
- ECP 13: Protection of Fauna
- ECP 14: Protection of Fisheries
- ECP 15: Road Transport and Road Traffic Management
- ECP 16: Construction Camp Management
- ECP 17: Cultural and Religious Issues
- ECP 18: Workers Health and Safety.
- ECP 19: Tunneling and Underground Construction Works

10.5.3 Social Management

Addressing Outstanding Claims of Tarbela and Ghazi Barotha Projects

The social legacy program of T4HP will be continued under T5HP. Under T4HP, only 15 cases were resolved by the Resettlement Claims Committee against 450 claims received. The committee will be reinstated.

Community Development Assistance Program

Under T4HP, WAPDA has developed an out-reach program to provide social assistance to the communities in the immediate vicinity of the project construction areas. Schemes for communities were identified through a consultation process and contracts were awarded to local contractors who used local labor thus generating income for communities. These include construction of dispensaries, water supply, drains and class rooms. This Community Development Assistance Program (CDAP) will also be implemented under T5HP and will target the communities located around Tarbela, transmission line and grid station. The works to be covered under this program will be identified through community consultations but are likely to include schemes such as construction of vocational training institutes, separately for boys and girls; maternity clinics, drinking water treatment, drainage and sewerage facilities, access to Sui gas facilities, etc.

10.5.4 Compliance Monitoring

This Section describes the compliance monitoring activities of the Project parties. For construction, the monitoring and reporting regime is broadly summarised as follows:

- 1st party monitoring: undertaken by the Contractor (C-ESMU) of its own compliance and that of its sub-contractors and supply chains with results documented in monthly monitoring reports.
- 2nd party monitoring: undertaken by the Project Proponent (W-ESMU), with support from the Engineer (E-ESMU) in order to verify the C-ESMU monitoring findings.
- 3rd party independent monitoring: by the lenders and their consultants, to verify the findings of the above two layers and to assess overall compliance with lender requirements.

During the operations phase, ongoing monitoring requirements will need to be assumed primarily by WAPDA.

The Contractor's Compliance Monitoring and Reports

The Contractor will undertake on a daily/weekly basis, compliance monitoring of the construction sub-contractors E&S activities as per the World Bank General EHS Guidelines (2007) and this ESMP.

The Contractor shall prepare monthly reports for issue to the Project Proponent. These reports will summarize the following:

- Progress in implementing the ESMP and other management plans
- Findings of the monitoring programmes, with emphasis on any breaches of the control standards, action levels or standards of general site management
- Outstanding Non-Compliance Reports (NCRs)
- Summary of any complaints by external bodies and actions taken/to be taken
- Relevant changes or possible changes in legislation, regulations and international practices.

Any breaches of the acceptable standards specified by law/construction permits and/or this ESMP should be reported to the Project Proponent, using a NCR Form.

The Contractor shall carry out internal audits of its own performance on a bi-monthly basis. Audit findings will be actioned and tracked to close out through a Corrective Action Plan.

Project Proponent'sMonitoring of Construction Activities

The W-ESMU on behalf of Project Proponent (supported by the Engineer) will undertake compliance monitoring of the Contractor's E&S activities on a regular basis as per the World Bank General EHS Guidelines (2007) and this ESMP. Internal compliance audits (supported by the Engineer) will be undertaken within two months of commencement of construction and thereafter every three months focusing on the performance of the implementation of this ESMP. Audit findings will be actioned and tracked to close out through a Corrective Action Plan.

Any breaches of the acceptable standards specified by law/construction permits and/or this ESMP through the Project Proponent's monitoring of the Contractor and subcontractor(s) should be reported using a NCR Form. A copy of each completed NCR (whether prepared by the Contractor or otherwise) should be held on file by the Project Proponent'sEHS department, to be replaced by the reply copy when it is received. A record of corrective actions should also be made and tracked to their completion.

Project Proponent's Monitoring of Operational Activities

The E&S impacts that will occur during the operation phase have been assessed through the present ESA. Impacts will be managed and monitored through the commitments outlined in this ESMP. The Project Proponent's EHS Director should prepare annual reports for issue to the lenders summarizing progress against implementation of the Project Proponent's ESMP obligations throughout the operational phase. This will include full reporting of monitoring results where relevant.

Project Proponent's External Reporting for Regulatory Compliance

A register of all necessary external stakeholder reporting requirements under Pakistan Legislation and for regulatory compliance purposes will be developed where appropriate. The frequency of reporting, the required reporting format and the person(s) responsible for producing the report (along with any necessary specialist service providers/constructors required to assist for data collection or interpretation purposes) is to be noted in the register.

The Project Proponent will need to ensure that all the necessary reports are produced and submitted in a timely fashion in order to achieve on-going regulatory compliance throughout the life of the Project. Meeting regulatory reporting requirements is to also form part of the scope for any internal audits and management reviews.

Project Proponent's Lenders Reporting Requirements

During the construction phase, the Project Proponent will undertake quarterly reporting, based on their monitoring results as a project requirement. Operational monitoring will be undertaken annually throughout the loan period.

10.5.5 External Audits (Third Party Validation)

As a minimum, on an annual basis throughout the first three years of the construction works and operation activities, arrangements should be made for the M&E consultants to carry out an independent audit of the existing practices against the requirements of the ESMP. The key objectives of the audit should be as follows:

- Report on the practical implementation of the ESMP and progress since the last visit
- Establish feasible improvement objectives for completion before the next visit.

The following aspects will be covered under the external audit:

- The ESMP is being adequately implemented
- Mitigation measures are being implemented and their effectiveness monitored
- The compliance and effects monitoring are being conducted
- Environmental and social trainings are being conducted
- Complete documentation is being maintained.

These audits should be used to re-examine the continued appropriateness of the ESMP and to provide advice on any up-dates required. Attention should be given to lessons learnt in the light of experience. In particular, consideration should be given to the monitoring programs in place to determine whether their purpose has been served and they can therefore be terminated or reduced in frequency

Monitoring of social issues will be important, especially with regards to worker management, workers' terms and conditions, occupational health and safety and grievances. External monitoring will need to verify that the Project commitments to worker's rights are implemented, in particular with regards to:

- Use of child labour
- Not employing forced labour
- Payment of minimum wages and overtime
- Not taking any action to prevent employees from exercising their right of association and their right to organise and bargain collectively
- Ensuring no workers are charged fees to gain employment on the Project
- Implementation of plans, procedures and training for occupational health and safety
- Non-discrimination and equal opportunity
- Meaningful use of the labour grievance mechanism
- The existence of human resource policies, job descriptions, written contracts
- Provision of information to labour force regarding rights and working conditions
- Employee training activities.

Annual monitoring reports of any independent advisor should be made available for public disclosure on the Project Proponents website and the World Bank's website.

10.5.6 Management Reviews

WAPDA Management should review the results of internal and external audits and provide commitment and resources to tackling outstanding issues.

WAPDA Management should support the proposed ESMU in mechanisms to manage financial payments to contractors based on performance against the items identified in the ESMP.

10.5.7 Monitoring Predicted Effects

The ESA predicts the impacts of the proposed project on the basis of information available at the time of conducting the assessment and the natural processes that link various environmental and social parameters. Based on this prediction, mitigation measures are introduced such that the predicted residual effects do not exceed acceptable levels. However, there can be an element of uncertainty in such predictions, for example, due to insufficient information on the processes, limitations in prediction techniques, or inadequate data on the environment. This is true for the physical, biological, as well as socioeconomic environment. Consequently, it is possible that even if the mitigation measures are implemented fully, the negative impacts of the Project could exceed predicted levels or acceptable limits.

In order to address the above concerns, effects monitoring will be undertaken during the Project activities, with the overall objective of proper management of environmental and social risks and uncertainties. Broadly, effects monitoring has the following objectives:

- To verify that the Contractor is implementing all of the management plans developed for the project
- To verify that the impacts of the proposed project are within acceptable limits, thus establishing credibility (public assurance)

- To immediately warn the Project proponents (and the regulatory agencies, if required) of unanticipated adverse impact or sudden changes in impact trends so that corrective actions can be undertaken, which may include modifications in the proposed activities, or the inclusion of modified or additional mitigation measures
- To provide information to plan and control the timing, location, and level of certain project activities so that the effects are minimized
- To facilitate research and development by documenting the effects of the proposed project that can be used to validate impact-prediction techniques and provide a basis for more accurate predictions of future projects.

The effects monitoring plan is provided in **Table 10.8**. The detailed methodologies will be developed during the detailed design phase of the Project when the specific information on field activities will be known. The monitoring table below focuses primarily on the construction phase and monitoring responsibilities primarily attributable to the Contractor.

Table 10.8: Effects Monitoring Plan

Management Plan	Monitoring Parameter	Monitoring Locations	Frequency	Responsibility	Documentation
ESMP	• ESMP review and approval (including all sub-plans, policies, statements etc.)	• N/A	• Immediately prior to construction	• WAPDA	-
Construction Traffic Management Plan (TMP)	• Speed limits of vehicles, traffic congestion on main roads near project sites	• Working areas	• Daily	• C-ESMU	• Visual observations
	• Trucks conditions and maintenance	-	• Monthly	• C-ESMU	• Visual observations
	• Vehicular accident records	-	• Monthly	• C-ESMU	• Maintain accident / incident records
	• Vehicle safety signals (flares, warning lights, reflectors)	-	• Monthly	• C-ESMU	• Visual observations
	• Vehicle fuelling procedures	-	• Monthly	• C-ESMU	• Visual observations
	• Vehicle loading / off-loading procedures	-	• Monthly	• C-ESMU	• Visual observations
	• Vehicle daily checks	-	• Monthly	• C-ESMU	• Visual observations
Materials and Waste Management Plan (MWMP)	• Implementation of all mitigation	• Working areas and site compounds	• Daily • Weekly	• C-ESMU • E-ESMU	• Visual observation
	• Records of waste volumes generated by the site and indicate the final disposal option for each waste stream	• Site compound	• Monthly	• C-ESMU	• Waste volume record
	• Records of consignment and waste transfer notes	• Site compound	• Monthly	• C-ESMU	• consignment and waste transfer notes
	• Audit of waste management practices	• Working areas and site compounds	• Quarterly	• E-ESMU	•
Spoil Management Plan	• Site walkover	• Spoil disposal sites	• Daily	• C-ESMU	• Visual observation for erosions and landslides
	• Routine inspections	• Spoil disposal sites	• Fortnightly	• E-ESMU	• Visual observation
	• Record volumes of spoil generated for spoil production	• Spoil disposal sites	• Observe daily and report monthly	• C-ESMU	• Spoil disposal material record

Management Plan	Monitoring Parameter	Monitoring Locations	Frequency	Responsibility	Documentation
	and stockpiling.				
Noise and Vibration Control Plan (including blast management plan)	• Noise and vibration	• Kukar Chawa • The labor camp • At locations representative of sensitive receptors in the vicinity • buildings identified at risk up to 200m from the Aol	• A baseline noise survey at the sensitive receptors immediately prior to construction • A detailed pre-construction building condition survey of buildings identified at risk up to 200m from the Aol • At monthly intervals throughout construction, but not at pre-arranged times • As and when required, during critical phases of construction, i.e. when possible exceedance of the project noise and vibration criteria is anticipated • In response to reasonable noise complaints being received • For blasting activities each and every blast shall be monitored for noise and vibration by the blasting contractor at high risk receptors.	• C-ESMU • E-ESMU	• Maintain monitoring records. • Record and investigate complaints using sound level meter / PPV via the community grievance mechanism.
	• National Environmental Quality Standards[43] (NEQS) thresholds for noise and vibration	• Kukar Chawa • The labour camp	• Daily	• C-ESMU	• Using sound level meter at the nearest residential properties to construction activities and compare it with NEQS and record in a monitoring report.
	• Implementation of mitigation measures	•	• Daily • Weekly	• C-ESMU • E-ESMU	• Visual observations
Oil and Chemical Spill Response Plan	• Soil and groundwater quality baseline, including soil and	• At each temporary and permanent construction	• Pre-construction	• C-ESMU	• Monitoring report

[43]If monitoring demonstrates continued exceedences of NEQS, site practices and mitigation measures should be reviewed to reduce construction related impacts.

Management Plan	Monitoring Parameter	Monitoring Locations	Frequency	Responsibility	Documentation
	groundwater contamination.	area			
	• Check and approval of: • Inventory of hazardous materials (chemicals, oils and fuels) stored on-site so that in the event of a spill, information is available on volumes present • Material Safety Data Sheets (MSDS) for all hazardous materials held on-site • A single page quick guide spill response procedure	-	• Pre-construction and ongoing during construction as content is revised	• E-ESMU	• Review records
	• Implementation of mitigation measures	-	• Daily • Weekly	• C-ESMU • E-ESMU	• Visual observations
Air Quality Management Plan	• Air quality monitoring at T4HP project locations will continue as described in the T4 EMP and will inform the evolution of the Project air quality baseline	• Ghazi Market • Topi-By Pass • Outlet Tunnel No.4	• Bi-annually	• T4 C-ESMU	• Monitoring report
	• NEQS thresholds for ambient air quality	• T5 labour camp • powerhouse • Kukar Chawa village	• Bi-annually	• C-ESMU	• Monitoring report
	• PM2.5 and PM10 levels	• Site 3	• Immediately prior to construction	• C-ESMU	• ESA baseline data to be corroborated through a monitoring survey as part of the construction monitoring programme
	• Implementation dust mitigation measures	-	• Daily • Weekly	• C-ESMU • E-ESMU	• Visual observations • Maintain a record of high dust incidents and record any violations were observed. • If high dust levels are as a result of poor site management contractor to

Management Plan	Monitoring Parameter	Monitoring Locations	Frequency	Responsibility	Documentation
					impose disciplinary action on construction subcontractor.
Sedimentation and Erosion Control Plan	• Engineering slopes and landslides including deformation, stress and strain, seismic response, blasting vibration	The powerhouse	• Weekly inspection • Blasting as necessary	• C-ESMU	• Monitoring report
	• Implementation of mitigation measures		• Daily • Weekly	• C-ESMU • E-ESMU	• Visual observations
Water Resources Management Plan	• Surface water quality monitoring at T4HP monitoring locations will continue as described in the T4HP EMP and will inform the evolution of the Project water quality baseline up to and during construction	• Tarbela Dam Reservoir • Ghazi Barrage Pond • Downstream Ghazi Barrage	•	• T4 C-ESMU	• Monitoring report
	• NEQS thresholds for water supply - monitoring at the sites sampled for the Project baseline together with monitoring of wastewater discharges into the river.	• The plunge pool • Dall Dara • Ghazi Pond • The T5 intake	• Bi-annually throughout construction	• C-ESMU	• Monitoring report
	• Implementation of mitigation measures		• Daily • Weekly	• C-ESMU • E-ESMU	• Visual observations
Ecological Management Plan (including HRRP)	• Fish (together with water quality monitoring)	• Tarbela reservoir in the vicinity of the Tarbela 5 intake structure • The plunge pools • Downstream of the weir in the Dhal Dara channel • Central area of the Ghazi Barrage head pond	• Three seasonal surveys will be undertaken pre during and after monsoon pre-construction, construction and for the first three years of operation	• C-ESMU	• Survey records

Management Plan	Monitoring Parameter	Monitoring Locations	Frequency	Responsibility	Documentation
	• Fish population[44]	• Dhal Dara channel	• Pre and during construction and for the first three years of operation	• W-ESMU	• Ecological Management Plan
	• Trees	• All trees to be removed or affected by the works	• Pre-construction and pre-vegetation clearance	• C-ESMU	• Tree inventory; including an assessment of the tree species to be affected, their size and condition.
	• Habitats	• All restored or created habitats	• Monitoring will start six months after the completion of habitat restoration or creation at each site and will continue every six months for five years	• C-ESMU	• Bi-annual monitoring reports
	• Birds, mammals and herpetofauna	• Undertake pre-construction surveys using transects and survey points in the footprint of the Project components which were not surveyed in 2015.	• Surveys for different species to be carried out at appropriate times of year in advance of construction at each location. Where there is no seasonal dependency, surveys to be completed at least one month prior to construction at each location to ensure mitigation can be included in Contractor method statements.	• PMU-ESMU	• Pre-construction monitoring reports, including any site specific mitigation.
	• Invasive plant species	• Working areas and site compounds	• Every three months	• C-ESMU	• Visual observations
	• Implementation of mitigation measures	•	• Daily • Weekly	• C-ESMU • E-ESMU	• Visual observations
OHS Plan / ESHS Plan	• Accidents, injuries, lost-time incidents, near misses and community interactions on health issues	• Working areas and site compounds • Project affected area	• Monthly	• C-ESMU	• Monitoring report
	• First aid room use	• Working areas and site	• Monthly	• C-ESMU	• Monitoring statistics

[4444]No fish screens have been included in the design; however it is proposed that monitoring of the fish populations in the plunge pools should be undertaken. Fish screens could be introduced retrospectively if considered appropriate.

Management Plan	Monitoring Parameter	Monitoring Locations	Frequency	Responsibility	Documentation
		compounds			
	• OHS target accident rate of zero	• Working areas and site compounds	• Monthly	• C-ESMU	• Compile data from monitoring report and statistics
	• Implementation of mitigation measures	•	• Daily • Weekly	• C-ESMU • E-ESMU	• Visual observations
Stakeholder engagement plan (SEP)	• Develop / disclose compliant plan to local communities • Appoint Community Liaison Officer (CLO) • Implement plan during construction	• Local government offices • Within local communities	• Prior to construction • Monthly • Update prior to operations and on an ongoing basis as new stakeholders are identified	• W-ESMU (plan development/ update) • C-ESMU (implementation) CLO	• SEP • CLO employment contract and job description • Minutes and photographs of meetings
Community grievance mechanism	• Grievance mechanism in SEP • Signage providing grievance contact details • Grievance logging	• Site perimeter • Grievance log in site office	• Prior to the start of construction • Monthly	• C-ESMU CLO	• SEP • Grievance logs and investigation reports
Worker grievance mechanism	• Signage providing grievance contact details • Grievance logging • Worker verification interviews	• Within site and worker accommodation • Grievance log in site office	• Prior to the start of construction • Monthly	• C-ESMU	• Grievance logs and investigation reports
Implement gender strategy	• Ration of female to male employees in semi-skilled or managerial positions in accordance with plan developed by W-ESMU • Measures to raise gender awareness • Economic empowerment measures for local women in the community	• Site office • Local communities	• Monthly	• W-ESMU (plan development) • C-ESMU (implementation)	• Workforce profile statistics • Write ups of consultation with local women
Project labour statement Recruitment policy	• Inclusion of policy details in employee contract documentation • Policies being accessible to staff	• Site offices and common area •	• Prior to the start of construction • Monthly	• C-ESMU	• Timesheets (no excessive overtime) • Payslips (paid on time)

Management Plan	Monitoring Parameter	Monitoring Locations	Frequency	Responsibility	Documentation
Human resources policy Workers code of conduct	via signage or in common areas • Employment generation to the location community				• Labour grievance register
Local content strategy	• Local advertisements for employment / procurement opportunities • Ratio of local to migrant workers • Ratio of local to migrant procurement contracts	• Site offices	• Prior to the start of construction • Monthly	• C-ESMU	• Advertisements • Workforce profile statistics • Procurement and supply chain profile statistics
Worker accommodation plan	• Sleeping space per worker • Number of ablution facilities per worker • No. ambulances and medical facilities per worker • Quality of food provision • Recreational facilities • Worker grievance logs	• Workers accommodation areas	• Prior to the start of construction • Weekly	• C-ESMU	• Statistics in relation to parameters and investigation reports • Grievance logs • Photographs
External audit of labour issues	• Wages • Contract • Working conditions	• At all sites	• Annual	• WAPDA, M&E	• Annual labour reports

10.6 Trainings and Awareness Raising

10.6.1 Overview

In achieving the approach to environmental management described in previous sections, it is implicit that all staff (WAPDA, Engineer and Contractor) receive the required training in both general and job-specific terms. This training should not be considered a stand-alone exercise, but must form an integral part of on-going training programs. Arrangements must also be provided for training of all new recruits and continual refresher courses for established staff put in place.

E&S training will help to ensure that the requirements of the ESA and ESMP are clearly understood and followed by all project personnel throughout the project period. E&S training programs will also ensure that all site personnel, as applicable to their job responsibilities fully understand:

- The environmental requirements of the Project and how they will be implemented and monitored on site
- The potential impacts of the Project, the mitigation measures that have been adopted to address those impacts and how and where to apply these measures
- Any environmentally or socially sensitive areas in the vicinity of the construction site
- The procedures for responding to the media, to unauthorized visitors to the site and enquiries from the public
- Any defined seasonal ecological sensitivities and restrictions (timing or methods) for construction activities
- Know how to deal with unforeseen environmental incidents
- Are aware of the roles of WAPDA, the Engineer and the Contractor with respect to environmental issues.

The primary responsibility for providing training to all project personnel will be that of the ESMU. The E&S training program will be finalized before the commencement of the project, during the detailed design phase. Training will cover all staff levels, ranging from management and supervisory personnel to the skilled and unskilled workforce. Training details have been provided in the following section. The training requirements are summarized in**Table 10.9**.

Table 10.9: Training Requirements

Contents	Participants	Responsibility	Schedule
• General E&S awareness/toolbox talks • E&S sensitivity of the project area • Key findings of the ESA • Mitigation measures • ESMP • Social and cultural values of the area.	Design team; Selected WAPDA management staff	ESMU (for W-ESMU staff, training in environmental and social management plans and OHS related issues must have been completed (as discussed in Section 10.6.4) prior to carrying out training of others)	Prior to the start of the project activities. (To be repeated as needed.)
• General E&S awareness/toolbox	All site personnel	ESMU	Prior to the start of the field activities.

Contents	Participants	Responsibility	Schedule
talks • E&S sensitivity of the project area • Mitigation measures • Community issues • Awareness of transmissible diseases • Social and cultural values.			(To be repeated as needed.)
• ESMP • Waste Disposal	Construction staff	Contractor	Prior to the start of the construction activities. (To be repeated as needed.)
• Road safety • Defensive driving • Waste disposal • Cultural values and social sensitivity.	All drivers	Contractor	Prior to and during the field operations. (To be repeated as needed.)
• Camp operation • Waste disposal • Natural resource conservation • Housekeeping	All site personnel	Contractor	Prior to and during the field operations. (To be repeated as needed.)
• Restoration requirements • Waste disposal	Contractor	Contractor	Prior to restoration activities.

10.6.2 General Awareness Training

All staff members will be required to attend an in-house training course on general environmental awareness (site induction training). This will be delivered in a consistent structure, irrespective of the staff designations attending. The main objective of this type of training is to provide:

- A general understanding of the environmental risk associated with the Plant
- Local, national and international actions which are required to combat these risks
- Clarification of the WAPDA Environmental Policy and its practical implementation, stressing that it carries implications for the working methods and responsibilities for all employees.

Continual awareness of environment matters should be maintained. The Environmental Policy Statement should be on permanent display in prominent positions around the Project sites, such as the administration block, reception area, the control room, staff catering facilities and construction site offices.

The site induction training will be carried out by all staff before they commence work on site. As a minimum the training will include but will not be limited to:

- The purpose and objectives of the ESMP and sub-plans

- The reason why the requirements set out in the ESMP and sub-plans are important
- The requirements for due diligence and duty of care
- WAPDA, Engineer and Contractor's environmental personnel and other key contacts
- Methods for implementing environmental controls included within the ESMP and sub-plans
- Procedure for reporting environmental incidents
- Procedures for responding to the media, to unauthorised visitors to the site, and enquiries from the public
- Details of site emergency and response plans where these apply to environmental emergencies (e.g. chemical / fuel spillage).

In addition to the site induction training personnel will not be allowed to perform hazardous operations before they have completed appropriate additional training in this regard.

Job Specific Trainings. In addition to the site induction training additional specific environmental and social training will be provided focused on small, discrete groups of employees who carry out the same, or similar, roles such as the Contractor(s) ESS supervisors.

Specialist environmental and social training will also be provided for construction workers as applicable to their job responsibilities. Selected workers will be responsible for emergency responses to major oil and chemical spills and will receive the appropriate training.

WAPDA, the Engineer and the Contractor will maintain a training needs matrix and associated training program to identify which specific job roles for their respective organizations require such additional specialist training. Specialist training will either be performed by suitable qualified in-house personnel or by approved specialist external training providers.

10.6.3 Toolbox Talks

It is the responsibility of the C-ESMU to implement a program of toolbox talks for all construction personnel during the construction phase. This will be assisted by W-ESMU and E-ESMU personnel if necessary. At least fortnightly toolbox talks will be performed for all workers on-site; these will be done in groups with talks made relevant to their construction roles on site. Either WAPDA, the Engineer or the Contractor's senior management may call additional toolbox talks should the need arise to further discuss safety or environmental and social aspects.

The topics of the talks will cover all environmental, social and safety issues; they will be focused on issue relevant to forthcoming construction works or related to any non-compliance that have recently occurred. When performing the talks C-ESMU will ensure that they are kept interesting, less than fifteen minutes and relevant to the current on site construction activities.

10.6.4 T5HP W-ESMU

As discussed in Section 10.4.3, WAPDA will assign adequate resources to the Project W–ESMU team. There is also a requirement for capacity building for these staff to ensure the staff that will be employed to implement the ESMP and manage ESMU issues during the construction and operational phases, in accordance with the roles and responsibilities set out inSection 10.4.3, will have the relevant skills and knowledge.

The numbers of W-ESMU personnel will be kept under review by WEC to ensure that sufficient resources are available throughout construction and operation.

It shall be ensured that all W-ESMU team members are provided with sufficient IT resources. As a minimum this is expected to include the provision of a laptop computer of modern standard to each team member as well as a printer to serve the team on site and a supply of printer ink.

Additional training (in addition to that presented in this Section) of the T5HP on-site W-ESMU staff will be undertaken in order to ensure they have adequate skills and knowledge to fulfil their roles. It is a requirement that all relevant W-ESMU staff undertake a training program on the implementation of environmental and social management plans and OHS related issues. The training program is required to be practical and of short duration, drawing on international best practice. It is expected that an overseas course is therefore likely to be most suitable.

10.7 Record Keeping

10.7.1 Monitoring Records

Proper arrangements are necessary for recording, disseminating and responding to information which emerges from the various E&S management and monitoring plans/programs. Records are also necessary for rendering the ESMS “auditable”. The primary focus must however remain the pragmatic control of pollution, not the creation of complex bureaucratic procedures.

10.7.2 Quantitative Physical Monitoring

The objective of quantitative physical monitoring is to ensure that the mitigation measures designed to prevent, reduce and where possible offset any significant adverse impacts on the environment are being implemented throughout the Project lifecycle. A database should be developed by ESMU for storing the results of the quantitative monitoring. The facility should be capable of producing tabulated weekly and monthly reports that provide the following information:

- Sampling points
- Dates and times of sample collection
- Test results
- Control limits
- “Action limits” (circa 80% of the control limits) at which steps must be taken to prevent the impending breach of the control limit
- Any breaches of the control limits, including explanations if available.

The monitoring data should be continually processed as it is received, so as to avoid a build-up of data.

10.7.3 General Site Inspections and Monitoring

A Site Inspection Checklist for recording the findings of the general site condition surveys should be developed by the contractor and should be developed in line with the Environmental Management and Monitoring Plan described earlier in this chapter. This should cover all the ESMP commitments as provided in this ESMP. The Site Inspection Checklist should be supported by maps/plans, as necessary.

10.7.4 Complaints Records

A tabulated standard form should be prepared for recording any environmental complaints that are received from the public or government organizations by whatever medium i.e. visits to the Project site, telephone calls or correspondence.

The form should concisely list the following information:

- Date of the complaint
- Name and contact address of the complainant
- Brief description of the complaint, with a file reference to any correspondence from the complainant
- Brief description of the action taken by the Plant Management to investigate the cause of the complaint and bring about corrective action, if justified
- Date of reply to the complainant, with a file reference to any correspondence.

All complaints received by the Plant Management should be handled in this way.

10.7.5 Information Sources

A complete and up-to-date file of all relevant sources of information should be maintained by the all ESMUs. This file should be readily accessible and include, as a minimum, copies of the following documents:

- Current environmental permits and consents
- All relevant Pakistan regulations, international guidelines and codes of practice
- Material safety data sheets (MSDS) for all hazardous substances used on the Project
- Manufacturers' operating manuals for all the environmental monitoring equipment
- Current calibration certificates for all the equipment that requires calibration by an external organisation
- The latest version of this ESMP.

10.7.6 Non-Compliance Report

Any breaches of the acceptable standards specified, should be reported to the Engineer, using a standard form, i.e. a Non-Compliance Report (NCR).

A copy of each completed NCR should be held on file by the ESMU, to be replaced by the reply copy when it is received. A record of corrective actions should also be made and tracked to their completion.

10.7.7 Monthly and Quarterly Reports

The C-ESMU and W-ESMU team should prepare a monthly and a quarterly report for issue to the Project General Manager. These reports should summarize the following:

- Progress in implementing this ESMP
- Findings of the monitoring programmes, with emphasis on any breaches of the control standards, action levels or standards of general site management
- Any emerging issues where information or data collected is substantially different from the baseline data reported in the ESA
- Outstanding NCRs
- Summary of any complaints by external bodies and actions taken / to be taken

- Relevant changes or possible changes in legislation, regulations and international practices.
- Any trainings conducted.

10.7.8 Training Records

Records of all training provided and the associated attendees should be maintained in line with the requirements of an ISO 14001 Environmental Management System.

Staff should complete and sign an attendance sheet for all courses attended, including the staff awareness training. It would also be prudent to ask staff to complete a course evaluation sheet at the end of each course in order to assess the effectiveness of the training delivered.

All records, including the course evaluation sheets and attendance sheets, should be held centrally, possibly by the Human Resources Team or the Environmental Officer.

10.8 Grievance Redress Mechanism

10.8.1 Overview

A grievance can be defined as an actual or perceived problem that might give grounds for complaint. As a general policy, the Project will work proactively towards preventing grievances through the implementation of impact mitigation measures (as identified by the ESA and this ESMP) and community liaison.

Anyone will be able to submit a grievance to the Project if they believe a practice is having a detrimental impact on the community, the environment, or on their quality of life. They may also submit comments and suggestions.

The sections below consider confidentiality and anonymity and present the project's grievance resolution process.

10.8.2 Confidentiality and Anonymity

The Project will aim to protect a person's confidentiality when requested and will guarantee anonymity in any public reporting. Individuals will be asked permission to disclose their identity. Investigations will be undertaken in a manner that is respectful of the aggrieved party and the principle of confidentiality. The aggrieved party will need to recognize that there may be situations when disclosure of identity is required for processing claims and the Project will identify these situations to see whether the aggrieved party wishes to continue with the investigation and resolution activities.

10.8.3 Grievance Reporting and Resolution

Grievances will be logged in a formal logging system. This will be the responsibility of a staff member with community liaison officer responsibility. People may register grievances using by contacting the PMU Community Liaison Officer (CLO) or reporting to their village representative. Contact details for the CLO will be included in appropriate project communication materials.

The CLO will classify grievances according to **Table 10.10**. Where investigations are required, project staff and outside authorities as appropriate, will assist with the process. The CLO will collaborate with its management to identify an appropriate investigation team with the correct skills to review the issue raised. Investigations will aim to identify whether the incident leading to the grievance is a singular occurrence or likely to reoccur.

Identifying and implementing activities, procedures, equipment and training to address and prevent reoccurrence will be part of the investigation activities.

Table 10.10: Grievance Classification Criteria

Classification	**Risk Level (to health, safety or environment)**	**Response**
Comment (not a grievance)	None or low	CLO to identify whether the comment can be answered or the request can be accommodated. If it can, an action plan to implement will be developed.
Low	None or low	CLO will conduct an investigation, document findings and provide a response.
Medium	Possible risk and likely a one off event	CLO and an appropriate investigation team will conduct an investigation. The Site Manager or Occupational Health and Safety Manager may decide to stop work during the investigation to allow the corrective preventive actions to be determined. The CLO will provide a response.
High	Probable risk and could reoccur	CLO will get the contractor to organise a Major Investigation Team for prompt investigation and resolution. Work may be stopped in the affected area. The CLO will provide a response.
Very High	Any damaging event already occurred	CLO will get the contractor to assess the actual damages and make all necessary compensations also take all preventive actions to avoid the chances of recurrence. CLO will prepare and submit a report of the incident and measures taken

The CLO will explain in writing or orally in person (especially where literacy is an issue) to the complainant the review process, the results, and any changes to activities that will be undertaken to address the grievance and how the issue is being managed to meet appropriate environmental and social management standards. In some cases, it will be appropriate for the CLO to follow up at a later date to see if the person or organization is satisfied with the resolution or remedial actions.

The CLO will summarize grievances weekly during construction. The procedure will be at no cost and without retribution to project affected persons and stakeholders. The procedure for processing grievances is depicted in **Figure 10.2**

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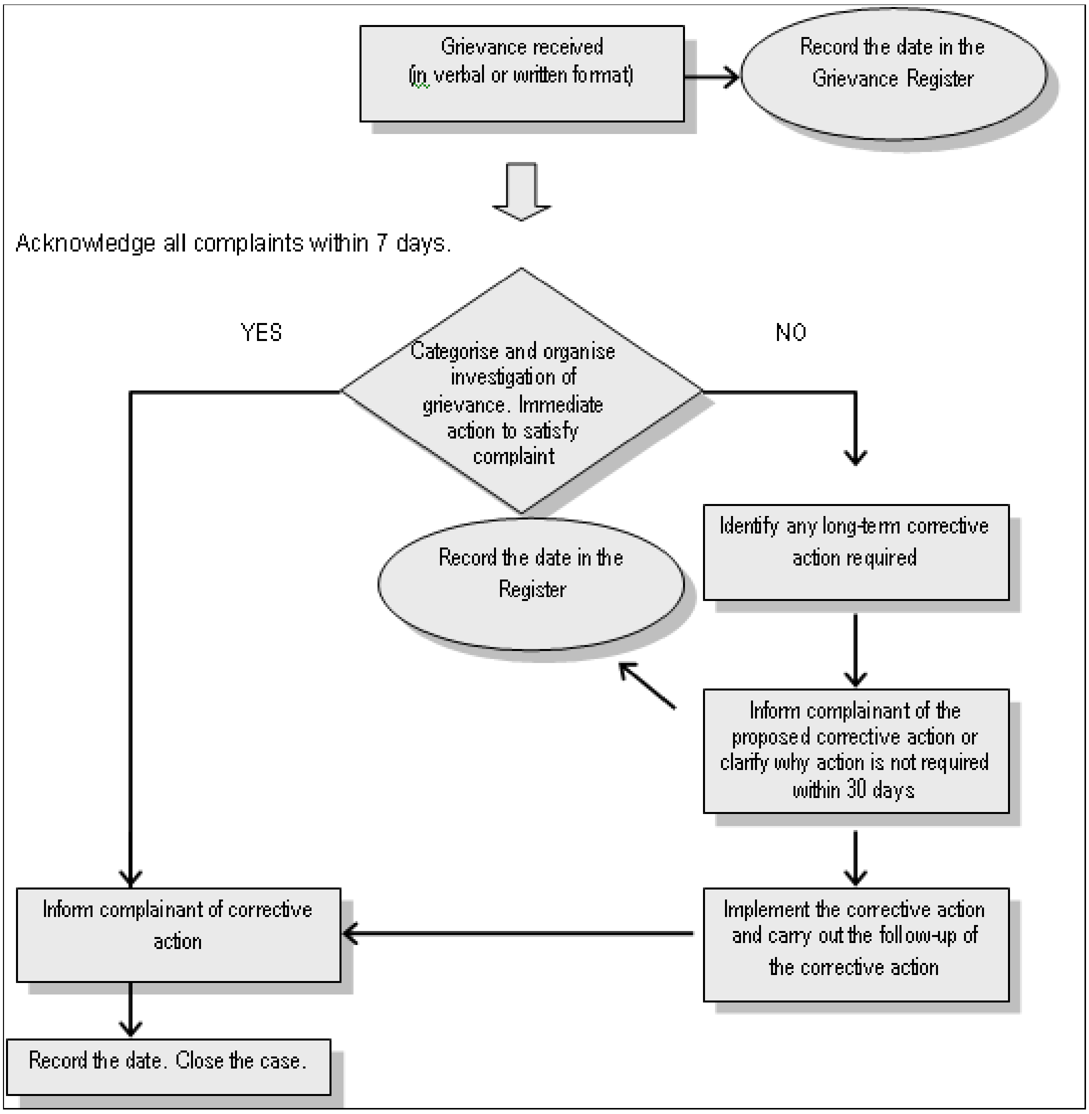
Figure 10.2: Grievance Process



10.9 ESMP Implementation Cost

10.9.1 Indicative Budget

The overall indicative total E&S budget for construction, assuming a construction period of 39 months (with the possibility of construction of the raised intake continuing for a further 19 months) totals USD 15.7m. An E&S budget for a typical operational year has also been considered and is estimated at USD 1.2m. **Table 10.11** shows the budget distribution over the different areas covered in this ESMP. The total for construction will be required to be split appropriately into annual budgets. For both construction and operational budgets, it is important to note that at the beginning of each phase a more significant proportion of that phases' budget will be required in order to cover the planning and set up costs.In addition, USD 4.2 million will be used for community development assistance programs. The works to be covered under this program include construction of vocational training institutes, separately for boys and girls; maternity clinics, drinking water treatment, drainage and sewerage facilities, access to Sui gas facilities, etc.

Table 10.11: Indicative ESMP Budget (m USD)

ESMP Budget (million USD)	**Construction (Total)**	**Operation (annual Total)**
Implementing the suite of environmental and social management plans set out in **Table 10.7**	5.0	0.2
Environmental and social monitoring as set out in **Table 10.8.**	2.0	0.2
Environmental staff (W-ESMU, C-ESMU, E-ESMU, WEC, External ESMU auditors)	3.0	0.2
Establishing and maintaining ESMU plans, procedures and management systems (including WEC and W-ESMU team IT equipment)	0.2	0.1
Environmental and social enhancement measures*	1.5	0.1
Cumulative Impact Assessment VEC measures	0.5	0.1
E&S training and capacity building	2.0	0.1
Contingency	1.5	0.2
TOTAL	**15.7**	**1.2**

*Identification of environmental and social enhancement measures not part of present scope but allowance included

10.9.2 Reallocation of Funds / Update of Budgets

A number of costs have been estimated on the basis of the information available at the time of the preparation of the ESA documentation. It is expected that the cost associated with some measures may change. Although a provision was always made when the budget was prepared, it is possible that budgets allocated prove to be either under-estimated or over-estimated. WAPDA will propose twice per year an update of the overall environmental and social budget with suggestions on the way to reallocate funds. These suggestions will be presented to lenders for review.

11 Environmental and Social Management Plans – Power Evacuation Facilities

The primary objective of an Environmental and Social Management Plan (ESMP) is to safeguard the environment, site staff and the local population from site activity which may cause harm or nuisance. This ESMP for the power evacuation facilities of Tarbela 5th Extension Hydropower Projectis intended to provide a framework to ensure transparent and effective monitoring, prevention, minimization, mitigation, off-setting and enhancement measures to address the environmental and social impacts associated with the Project. The mitigation measures described within this ESMP will be applied to the Project and its associated infrastructure.

This ESMP will form the basis of the environmental and social protection measures implemented by NTDC (the Project Proponents) and the Contractors (and sub-contractors). The implementation of the ESMP will ensure that environmental and social performance is in accordance with international standards (including the relevant World Bank OPs, World Bank Group sectoral and General Environmental, Health and Safety (EHS) guidelines, International Labor Organization (ILO) conventions and good international industry practice (GIIP).

11.1 Objectives

The primary objective of the ESMP is to manage and monitor adverse impacts of Project interventions in a way which minimizes adverse environmental and social (E&S) risks and impacts in the Project Area of Influence (AoI)[45]. The specific objectives of the ESMP are to:

- Facilitate the implementation of the mitigation measures identified in the ESA
- Maximise potential Project benefits (enhancements) and manage adverse risks and impacts
- Define responsibilities for the Project Proponent, contractors, and other members of the Project team for E&S management of the Project
- Define a monitoring mechanism and identify monitoring parameters in order to:
    - ensure the complete implementation of all mitigation measures
    - ensure the effectiveness of the mitigation measures
- Propose post-project environment monitoring plans to ensure that the ESMP achieves its desired objectives
- Maintain essential ecological process, preserving biodiversity and where possible restoring degraded natural resources
- Assess environmental training requirements for different stakeholders at various levels.

The ESMP will be managed through measures set out herein and site specific management plans. The management will clearly describe the responsibility of various staff and stakeholders involved in planning, construction and operation of the Project.

[45] Please see Section 1.4 for AoI.

11.2 ESMP Components

The ESMP contains the following components which describe the environmental management system framework broadly aligned to (but not certified to) ISO14001:

- Organisational Responsibilities and Communication – describes the structure of responsibilities within the organisation and the relevant communication channels/interfaces between staff
- Management and Monitoring Activities – details the E&S risks and impacts, along with proposed outline mitigation measures for the construction and operational phases
- Training and Awareness – outlines the process to be undertaken in identifying staff training needs
- Record Keeping – details the arrangements to be applied for maintaining records
- Performance Monitoring, Reporting and Auditing – describes the monitoring, reporting and auditing process
- Grievance Mechanism – sets out the process for logging grievances.

11.3 Organizational Responsibilities and Communication

11.3.1 Inclusion of the ESMP in Contract Documents

In order to make Contractors fully aware and responsible of the implications of the ESMP and to ensure compliance, it is recommended that E&S measures be treated separately in the tender documentation and that payment milestones should be linked to E&S performance, measured by execution of the prescribed mitigation measures. Such a procedure would help ensure adequate management of Project impacts is carried out during the construction and operation phases, where a consistent approach will be expected on behalf of the Contractor and its sub-contractors so that data and information collected from monitoring programs is comparable with baseline monitoring data.

The Contractor shall be made accountable through contract documents and/or other agreements for fulfilling E&S obligations and delivering on the E&S components of the Project. Contractors shall be prepared to co-operate with the executing agency, project management unit, supervising consultants and local population for the mitigation of adverse impacts. After the ESMP's inclusion in the contract documents, the Contractor will be bound to implement the ESMP and will hire appropriately trained E&S management staff to ensure the implementation and effectiveness of the mitigation measures.

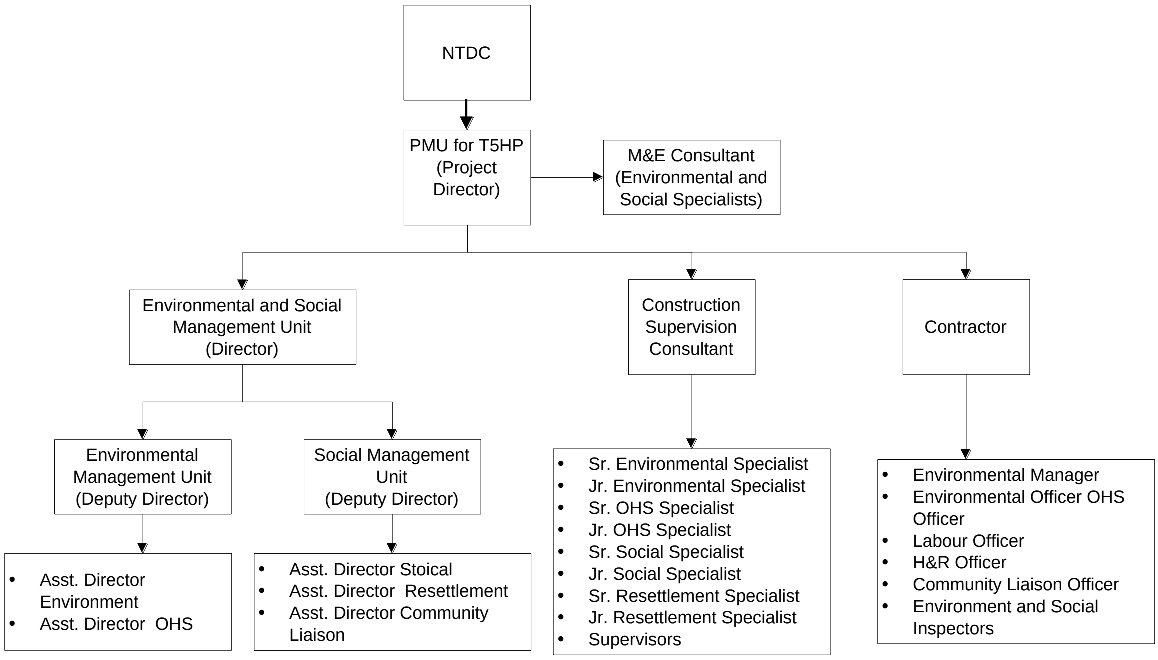
The Contractor is required to bid for executing the ESMP including the recommended mitigation measures and monitoring programs, as part of its Bill of Quantities (BoQ).

A new ESA will be carried out in advance of any decommissioning or refurbishment works in line with international ESA requirements at that time.

11.3.2 Implementation Responsibility

Ultimately, it is the responsibility of NTDC as the Project Proponent to ensure implementation of the ESMP through consultants and contractor(s). The Project Proponent's staff, the Construction Supervision consultants (hereafter referred to as the Engineer), the Monitoring and Evaluation (M&E) consultants and the Contractor will be responsible for ensuring the implementation of the ESMP and each party shall be required to have the capability and capacity to manage E&S obligations. Training and workshops shall be arranged involving the Project Proponent, consultant and contractor to share Project experience and best practice for E&S protection. A PMU will be established by NTDC for implementation of power evacuation works of T5HP. An organogram illustrating the interfaces among the Project Environment, Health, Social, and Safety (ESMU) teams is provided in **Figure 11.1**. The proposed units and staff will be established during the first year of project implementation, 2016-2017.

Figure 11.1: ESMU Structure of of PMU for Power Evacuation Component



11.3.3 Construction: Establishment of Environmental and Social Management Unit

It is recommended that an Environmental and Social Management Unit (ESMU) is established, which is responsible for the supervision of the ESMP implementation for the power evacuation facilities. The ESMU should be specially designated for the Power Evacuation Facilities and include representatives from NTDC, NTDC's Engineer who is assisting with supervision and implementation of the Power Evacuation Facilities and the main Contractor for the works.

The ESMU should arrange bi-monthly meetings to discuss the progress on the ESMP implementation.

The following sections detail the proposed environmental, health, safety and social (ESMU) staff requirements for NTDC, NTDC's Engineer and the Contractor.

NTDCESMUStaff for Power Evacuation Facilities

For T5HP, PMU will establish an ESMU (N-ESMU) unit headed by a Director and consists of one environmental management unit and one social management unit. Details of the staff in N-ESMU are given in the **Table 11.1**.

Table 11.1: Composition N-ESMU

	Designation	Total Positions	Input
1.	Director	1	Full time
2.	Deputy Director Environment	1	Full time
3.	Deputy Director Social	1	Full time
4	Assistant Director Environment	1	Full time
5	Assistant Director OHS	1	Full time
6	Assistant Director Social	1	Full time
7	Assistant Director Resettlement	1	Full time
8	Assistant Director/ Community Liaison Officer	1	Full time

The key responsibilities of the N-ESMU team will include:

- Ensuring all commitments/requirements of the ESA for the T5HP Power Evacuation Facilities are met
- Co-ordination with NTDC and the provincial environmental protection agencies (EPAs) during the construction and operational phases
- Implementation of the ESMP and its sub-plans and oversight of all on-site E&S staff
- Environmental training for on-site E&S staff
- Ensuring management of community grievances during the construction phase by the Contractor
- Management of community grievances during the operational phase.
- Take prime responsibility for the environmental management of the Power Evacuation Facilities as a whole in compliance with requirements of the World Bank OP's and the EHS guidelines
- Review reporting and compliance audits undertaken by Contractor's environmental engineers
- Review and report on performance of the Contractor to the Pak-EPA (as required)
- Prepare compliance reports on progress of achieving obligations identified in the NTDC ESMP for submission to the World Bank
- Report on a daily basis any ESMP non-compliances to the Contractor General Manager.
- Act as public liaison officer representative for NTDC.

Training for proposed on-site environmental engineer(s) from NTDC will be undertaken in order to ensure they have adequate skills and knowledge to fulfil their roles.

The Engineer's ESMU Staff

The NTDC-PMU's Engineer shallemploy a qualified team for the supervision and monitoring of ESMUissues on site on a regular basis. The team will directly report to the PD and will coordinate with the Contractor's ESMU team (C–ESMU).

The proposed team members of the Engineer's ESMUteam (E–ESMU) are presented in **Table 11.2.** The E–ESMU willmonitor the implementation of the ESMP and assist the N-ESMU team in its capacity building through invitation to regular monitoring of the ESMP at site.

Table 11.2: Composition E–ESMU

	Designation	Total Positions	Input
1	Senior Environmental Specialist	1	Full time site based
2	Senior Social Specialist	1	Full time site based
3	Senior Health and Safety Manager	1	Full time site based
4.	Junior Environmental Specialist	1	Full time site based
5	Junior Social Specialist	1	Full time site based
4	Junior Health and Safety Manager	1	Full time site based
5	Supervisors	4	Full time site based

Monitoring and Evaluation Consultants (Independent Monitoring Consultants or Third Party Monitoring Consultants)

NTDC will appoint Monitoring and Evaluation (M&E) consultantsfor the power evacuation facilities of T5HP. The M&E consultants will have their own dedicated M&E ESMU team (M&E–ESMU) to carryout independent supervision of the implementation of the ESMP. The M&E consultants will monitor progress against all aspects of the project including technical, institutional, procurement, and ESMU obligations.The proposed make-up of the M&E–ESMUteam is presented in **Table 11.3.**

Table 11.3: Composition M&E–ESMU

	Designation	Total Positions	Input
1	Environmental Specialist	1	Intermittent office based with regular visit of site
2	Senior Sociologist / Social Development Specialist	1	Intermittent office based with regular visit of site
3	Environmentalist/ Environmental Engineer	1	Full time site based
4	Sociologist/ Resettlement Specialist	1	Full time site based
5	Jr. environmental and social staff	2	Full time site based

Contractor ESMU Management

The contractor will adhere to the principles of ISO 14001:2004and OHSAS 18001:2007or equivalent if not already accredited. These standards place strong emphasis on the need for continuous improvement of EHS management systems and EHS management performance.

The appointed contractor will be required to agree to the following actions:

- Develop a Project specific Construction ESMP (CEAP), the framework for which is set out later in the Chapter.

- Elaborate other parallel sub plans which have been identified in in this ESMP (discussed later in the Chapter)
- Implement the requirements of the mitigation activities in the ESMP and CEAP
- Provide a construction site layout plan that identifies key activity area including lay down, accommodation and parking prior to commencement of works
- Produce detailed method statements relating to key activities that include specific reference to requirements of the plans contained herein during the Project progression
- Provide all training necessary to oversee and implement ESMP and CEAP requirements
- Be responsible for producing a comprehensive suite of EHS management and coordination procedures
- Identify and employ an appropriately qualified and experienced full time ESMU team on site with dedicated EHS responsibilities to oversee works on site (detailed later in the Section)

The Contractor will also be responsible for the ESMP performance of sub-contractor(s)' including subcontractor(s) adherence to the requirements of the ESMP and the CEAP. All major sub-contractor(s) will be required to have dedicated environmental and social staff to implement the ESMP and CEAP and to monitor and manage this on an on-going basis (smaller subcontractor will have ESMU focal points). The sub-contractor(s) staff will be required to liaise closely with the Contractor's ESMU staff and obligations will include the provision of monthly reports and participation in weekly construction review meetings.

Contractors ESMU Team (C–ESMU)

Contractors shallemploy a qualified team for managing ESMUissues at site on daily basis within a week of the signing of the agreement. The team members of C–ESMU are given in **Table 11.4**. C–ESMUwill assess the risks to worker health and safety and implement preventive and protective measures on regular basis and will work under the supervision of the E–ESMU.

The C–ESMU will have the following responsibilities:

- Implementing the ESMP and CEAP during the construction phase
- Supervising the construction activities for the environmental, social, and safety aspects
- Take prime responsibility for practical implementation of E&S management measures
- Oversee and ensure the implementation of the ESMP and CEAP and parallel management plans (with support from the Contractor Construction Site Manager and ensure all subcontractor(s) are in compliance with the ESMP and CEAP requirements
- Review and report performance to the Construction Site Manager and E–ESMU
- Review sub–contractor(s) E&S protection/mitigation measures to ensure compliance with the ESMP and CEAP
- Report on a daily basis any ESMP and CEAP non-compliances to the Construction Site Manager

- Carry out regular ESMP awareness sessions/toolbox talks and assist personnel in applying E&S standards on site
- Conduct regular audits and inspections to check that committed impact mitigation measures are being implemented
- Act as the first point of contact on E&S matters for the Contractor, government authorities, other external bodies and the general public.

Table 11.4: Members of the Contractor's ESMU Team

	Designation	Number of Staff	Input
1	Environmental Manager	1	Full time
2	Environmental Officer	1	Full time
3	OHS Officer	1	Full time
4	Labour Officer	1	Full time
5	Human Resources Officer	1	Full time
6	Community Liaison Officer	1	Full time
7	Environmental and Social Supervisors	As required	Full time
8	Health and Safety Inspector (s)	As required*	Full time
9	Bachelor of Medicine/ Bachelor of Surgery (MBBS) Doctor	1	As required
10	First Aiders	With a minimum of 1:50 workers and at least one person on each tower crew will be trained in first aid *	Full time
* Staff number to be decided and approved by the Engineer.			

Contractor Construction Site Manager

The Contractor Construction Site Manager will coordinate ESMP actions based on inputs from the C–ESMUfor applying the ESMP and CEAP on site. It is envisaged that the Construction Site Manager will:

- Ensure that the C–ESMU is adequately staffed and qualified to understand and implement the ESMP and CEAP
- Nominate personnel to assist the C–ESMU as required
- Be responsible for communications with the Engineer with regard to ESMU issues and non-compliances.

11.3.4 Mitigation Plans

Various environmental and social mitigation plans to address the environmental and social impacts described in the previous chapters are detailed in **Table 12.4**These plans are:

- Construction Environmental and Social Management Plan (CESMP)
- Construction Traffic Management Plan
- Materials and Waste Management Plan
- Spoil Management Plan
- Noise and Vibration Control Plan

- Air Quality Management Plan
- Oil and Chemical Spill Response Plan
- Sediment, Erosion and Landslip Control Plan
- Chance Finds Procedure
- Ecological Management Plan
- Habitat Removal and Restoration Plan
- Tarbela Occupational Health and Safety Plan / Contractor ESHS Plan
- Emergency preparedness and response plan
- Worker Accommodation Plan
- Stakeholder Engagement Plan
- Community grievance mechanism
- Worker grievance mechanism
- Gender Strategy
- Project Labour Statement
- Recruitment Policy
- Retrenchment Plan
- Human Resources Policy
- Local Content Strategy
- Workers' Code of Conduct
- Community health and safety

The above mitigation plans are presented in **Error! Reference source not found.** and ontains the following information:

- Summary of the key policies, plans and procedures required for the Project, which were determined through the ESA process
- Relevant fundamental mitigation measures for each policy, plan or procedure, which must be adhered to. Mitigation measures have been developed in line with the World Bank OP's and GIIP
- List of impacts the plans, policies and procedures are designed to address (mitigate)
- An implementation schedule detailing the timings in which policies, plans or procedures should be implemented
- The organization(s) responsible for executing the mitigation.

Table 11.5: Policies, Plans and Procedures during Construction and Operation

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
Environmental					
Construction Environmental and Social Management Plan (CESMP)	• To implement mitigation activities relevant to the construction phase of the Project and to avoid, mitigate and minimise environmental and social impacts during the construction phase. • Contractor will be required to adopt the CESMP which will strictly follow and comply with the World Bank Group's General Environmental, Health and Safety Guidelines and other sector specific EHS Guidelines during construction activities at all sites as well as incorporate specific mitigation as identified through the ESA process.	-	• The CEAP will be supplemented by various separate sub-plans and procedures (as detailed below in this table) which will be developed to address key E&S aspects identified during the ESA process for which detailed control procedures and associated responsibilities for implementation by NTDC and its contractors will be defined. • It will be ensured that the ESMP shall be made part of the contract document • Contractors are required to provide full time ESMU staff for the management of E&S issues on site. Roles should be in line with those identified earlier. Contractor ESMU staff shall be a bill of quantities item. • It is a requirement that environmental managers have the authority to ensure best practice is adhered to across the work site and worker accommodation camps	• Prior to any site preparation and construction works • At tender stage	• Contractor • NTDC
Construction Traffic Management Plan (TMP)	• To define the requirements that should be implemented to mitigate any potential negative risks to the environment, workers or the community resulting from construction traffic. • The Traffic Management Plan will advise and inform site Contractors and external suppliers of equipment and materials of access and entry points along with other key information such tipping areas and wash-out areas. • Intended to compliment and work alongside relevant C ESMP. The TMP will be classed as "live" and therefore be subjected to updates as	• Increase in general traffic (cars and trucks) volumes and abnormal loaded vehicles • Nuisance (dust, noise and vibration) as a result of traffic • Driver delay, pedestrian delay, severance, pedestrian amenity/ fear and intimidation • Community road safety • Improve transport	• Undertake a road conditions assessment prior to and following the peak construction period, to assess any damage to road infrastructure that can be attributed to Project construction. • Repair damage as appropriate or enter into a voluntary agreement with the relevant roads authority to reimburse the cost of any repairs required to the public road network as a result of the Project. • Spoil dump sites located close to Project site/corridor to minimise journey distance and limit movements to site access roads. • Concrete mixing plant located at Project site limiting traffic movements associated with concrete delivery to site access roads • Construction of worker accommodation on site to	• Prior to any site preparation and construction works	• Contractor responsible for producing CTMP and its implementation; NTDC to review contractors document

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
	required.	infrastructure to handle the Project traffic movements and loads	reduce light vehicle movements relating to travel to/ from the site • Provision of bus/minibus services for personnel living in nearby settlements • Movements of construction workers will be planned to avoid the busiest roads near Ghazi, Topi, Wah, and Hasanabdal, and times of day when traffic is at its greatest. • Schedule deliveries and road movements to avoid peak periods • Road maintenance fund to leave a useful asset for communities after the construction phase. • Driver training for HGV drivers and refresher course every six months for Project drivers • Speed restrictions for project traffic travelling through communities (to be agreed with National Highway Authority) • Run a safety campaign to improve the people's knowledge of the traffic hazard on their roads, public information and other activities to address the issues. • Run a pedestrian awareness programme • Temporary signage • Community liaison scheme to facilitate formal communication channel between contractor and community		
Materials and Waste Management Plan (WMP)	• To identify measures for minimisation of waste and safe disposal of construction wastes • To identify measures for the storage, handling and use of materials.	• Non-hazardous waste generated as a result of general construction activities, including concrete offcuts, scrap ferrous and no ferrous metals, packaging materials (plastics, cardboard, pallets)	**Materials Management** Materials management procedures will require: • Re-using materials on site wherever possible. • Instituting good housekeeping and operating practices, including inventory control to reduce the amount of waste resulting from materials that are out-of-date, off-specification, contaminated, damaged, or excess to plant needs • Instituting procurement measures that recognise opportunities such as ordering the correct amount of materials to be delivered when needed, reducing the	• Prior to any site preparation and construction works • Prior to operation	• Contractor for construction (approved by the Engineer) • NTDC for operation

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
		• Hazardous waste generated from general construction activities including fluorescent tubes, batteries, solvents and medical waste from camps. Contaminated material generated from fuel spills and leaks.	amount of packaging used by suppliers and establishing a take back system with suppliers • Substituting raw materials or inputs with less hazardous or toxic materials wherever economically and technically feasible. • Materials handling and storage areas need to be: – Located away from sensitive receptors – Not at risk from theft or vandalism – Designed to include measures preventing spoil by the elements – Easily accessible in a safe manner – Well ventilated – Unlikely to be damaged – Located next to any required personal protective equipment (PPE) (as necessary for irritants and hazardous materials) – Bunded and located next to spill kits (as necessary for hazardous liquids). • Control measures to minimise the likelihood of incidents, including: – Identification of the necessary PPE requirements – Identification of the necessary bunding and spill kit requirements – Details of the correct procedure for handling and storing any hazardous materials – A map showing the material storage locations – Training requirements (as necessary) with respect to materials handling procedures – The correct procedure for reporting any environmental incidents related to spills / leakages and how to deal with any spills / leakages – The specific regulatory reporting requirements as they relate to materials storage. • Temporary waste storage handling facilities designed to include the following: – Waste segregation in designated storage areas,		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			such that hazardous and non-hazardous wastes are not mixed and to allow for recycling and reuse where appropriate. – Hazardous waste segregation from other waste types to avoid cross contamination – Correct identification and sound environmental storage of all wastes pending collection/transfer for reuse, recovery, recycling or disposal – Separate skips for each waste stream to allow segregation in order to maximise re-use and recycling opportunities – A suitable cover for all skips – Waste storage areas located on areas of impermeable hard standing. Liquid wastes/oil/chemicals to be stored in tanks or drums located in bunded areas which can hold 110% of the total storage volume. Secondary containment for drum storage will be provided by a drip tray which will be able to contain either 25% of the total volume of the containers or 110% of the largest container, whichever is the greater. – Spill kits to be available at all times – Store hazardous waste in closed containers away from direct sunlight, wind and rain in designated storage areas – Provide adequate ventilation where volatile wastes are stored – Handling and storage shall be carried out by trained staff – Provide readily available information on chemical compatibility to workers including labelling each container and demarcation of the area (eg on a facility map / site plan) – Conduct periodic inspections of waste storage areas and document the findings – Prepare and implement spill response and emergency response plans to address accidental		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			releases and leakage – Avoid underground storage tanks and underground piping of hazardous waste. Readily available information will be provided to workers on chemical compatibility including labelling each container, demarcation of the area (e.g. on a facility map / site plan) **Waste Management (including waste materials)** • Will include identification of likely waste arising and appropriate handling, reuse and recycle opportunities and, as a last resort, disposal methods. The waste management plan will be prepared in accordance Pakistani waste regulations, the European Waste Catalogue and the World Bank Group's EHS Guidelines for Construction Materials Extraction and General EHS guidelines. • The WMP will follow the waste management hierarchy: – Waste prevention – Recycling and reuse – Treatment and disposal in accordance with the relevant statutory requirements, guidelines, and GIIP. • The WMP will require processes to be designed and operated in accordance with the following strategy to prevent or minimise waste and hazards associated with the wastes generated: – Substituting raw materials or inputs with less hazardous or toxic materials, or with those where processing generates lower waste volumes – Applying manufacturing processes that convert materials efficiently and provide higher product output yields. This may include modification of the production process, operating conditions and / or process controls – Instituting good housekeeping and operating practices, including inventory control to reduce the amount of waste resulting from materials that		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			are out-of-date, off specification, contaminated, damaged, or excess to plant needs – Instituting procurement measures that recognize opportunities to return usable materials such as containers and which prevent the over ordering of materials – Minimizing hazardous waste generation by implementing stringent waste segregation to prevent the co-mingling of non-hazardous and hazardous wastes. • The WMP will define procedures for: on-site sorting, temporary storage and collection by recycling contractors to recover inert, reusable and recyclable materials before disposal off-site. • The frequency of skip emptying or removal should be sufficient to prevent overflow of wastes. • Construction phase materials and waste management strategy will include the following provisions: • Procedures for the reduction of waste production (e.g. blending high-quality rock with poor rock) • Only permitted contractors will be selected and used or alternatively transport of wastes will be undertaken by the Contractor themselves; Handling and storage shall be carried out by trained staff • Spill response equipment will be made available and maintained in areas where hazardous wastes may be spilt and an appropriate number of site personnel will be trained in spill response techniques. • Waste treatment or disposal facilities used will be appropriately permitted, or if not available, based on the most suitable site in consultation with the relevant district councils (Haripur and Attock) and provincial Environmental Protection Agencies • Contaminated soils, if any, should be appropriately handled and disposed of in accordance with the relevant international (GIIP) and local requirements. Confirmation from the local environmental authorities should be sought to confirm the		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			acceptability of reuse of contaminated soils on site. Prior to reusing potentially contaminated soils as backfill. Appropriate risk mitigation measures shall be implemented to avoid environmental contamination and impacts on health. • The Contractor Site Manager will not release the waste if there is concern about the standard of transport or destination of the waste • NTDC should identify and take action to strengthen regional and/or local waste management capacity for example with regard to recycling (e.g. use of community-based recycling organisations within the Project AoI). • A detailed operational waste management procedure will be produced to embed best practice waste management in the operational philosophy of the Project. The waste management procedure will highlight the relevant policy and legislation of Pakistan and include a Site Waste Management Plan (SWMP). It will also include: – A waste management philosophy based on the waste hierarchy of prevention, reduction, reuse, recovery, recycling, removal and disposal of wastes – A map showing each temporary waste storage location for the Project – A description of each waste generated by the operation of the facility, the appropriate handling methodology, the correct approach for temporary storage and the correct route for removal/disposal off site – Staff training requirements with respect to waste handling procedures – Waste generation data collection for each waste stream by volume, according to the EWC. This should include the proportion of each waste stream going for reuse, recycling or disposal. Any unusual waste volumes should be investigated		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			– Any waste monitoring as deemed to be necessary – An audit schedule which details the frequency of waste management audits and those responsible for undertaking them – A section related to continuous improvement and corrective actions where audit findings can be recorded and incorporated into the waste management procedure. This will also highlight any new and feasible reuse or recycling opportunities which may arise over time – A mechanism by which to routinely track waste consignments from the originating location to the final waste treatment and disposal location – The correct procedure for reporting any environmental incidents related to waste – The specific regulatory reporting requirements as they relate to waste. – In addition, a valid copy of all waste carriers' licences will be kept on site. All transfer notes related to waste uplifts will be completed in full and contain an accurate description of the waste and be signed by the producer and carrier before waste leaves the site. • Specific issues to be covered in the OWMP include: – To minimise the effects of using the landfill areas at appropriate locations, as part of the development of its operational waste management plan NTDC should consider the potential to develop an international standard landfill site within its property and dispose all non-recyclable waste there according to international best practice. – NTDC should review existing practices for the treatment and disposal of sanitary and sewerage effluents and identify and implement a solution in accordance with GIIP. This may require the development of new or rehabilitation of existing waste water treatment plants on site in accordance		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			with GIIP. – If it is necessary to use Gas Insulated Switchgear, ensure management procedures are in place for installing, maintaining and operating the GIS and that the procedures are in line with GIIP. – Medical wastes will be stored and transported as follows: – Colour coded medical waste containers will be used. These will be puncture-proof (usually made of metal or high-density plastic) and fitted with covers – Bags and containers for infectious waste will be marked with the international infectious substance symbol – Wastes will be stored in a waste management area – Wastes will be transported to a medical facility with a licence for waste incineration		
Spoil Management Plan	• To define the requirements that should be implemented to manage and monitor any potential negative risk and impacts to the environment, workers or the community resulting from the excavation, blasting, handling, transportation and / or disposal of spoil.	• Dust as a result of excavation, blasting and transportation of earthen materials • Landslide from stockpiling, vegetation removal, excavation and blasting. • Erosion and sedimentation from the flow of rainwater into water bodies • Landscape and landuse changes	• Topsoil, overburden, and low-quality materials should be properly removed, stockpiled near the site, and preserved for rehabilitationThe Contractor will ensure that all temporary spoil waste disposal sites adjacent to excavation areas are engineered such that: – They allow for the sorting and grading of spoil, removal of excess waters through filtration where needed, and, if necessary, are covered to prevent dust emissions. • The Contractor will ensure that spoil wastes will not be mixed or contaminated with any other type of waste generated on site. • The Spoil Management Plan will include a description of the control measures at each spoil disposal site (such as spot checking of spoil loads) to ensure that only material excavated from each of the Project's components is deposited there. • The Contractor will develop specific method	• Prior to site any site preparation and construction	• Contractor

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			statement and risk assessment for each spoil waste disposal site. • Where practical, topsoil will be reused on site upon re-instatement and landscaping of cut / excavated areas.		
Noise and Vibration Control Plan	• To guide the means by which NTDC and the contractor will control noise and vibration caused by construction, traffic, operations, and other activities to ensure noise does not exceed applicable standards at the site boundary and beyond. • Single or separate Plans may be developed for construction, operation, or both.	• Noise impacts as a result of site preparation, excavation and foundations, construction and blasting • Vibration impacts as a result of blasting • Noise impacts (nuisance) as a result of site traffic movements to and from site, including abnormal loads	• Avoiding or minimising project transportation through community areas. • Unnecessary revving of engines will be avoided and equipment will be switched off when not in use • Timing of deliveries to avoid sensitive times of the day • Internal haul routes will be kept well maintained • Use of effective exhaust silence systems or acoustic engine covers as appropriate • Plant will always be used in accordance with manufacturers' instructions. Care will be taken to site equipment away from noise-sensitive areas. Where possible, loading and unloading will also be carried out away from such areas • Regular and effective maintenance by trained personnel will be undertaken to keep plant and equipment working to manufacturers specifications • Procedures for handling noise and vibration complaints • Blasting will be avoided where possible. Where unavoidable, blasting shall be in accordance with control techniques according to the Blasting Act in Pakistan. Contractor will prepare a Blast Management Plan.	• Prior to any site preparation and construction works	• Contractor
Air Quality Management Plan	• To define the minimum requirements that should be implemented to mitigate any potential negative risks to the environment, workers or the community resulting from air emissions that arise during the construction phase of the Project	• Deterioration of air quality as a result of – Site preparation; land clearing; excavation, quarrying; road construction; spoil deposition;	• Controlling dust emissions from excavation activities at the source (e.g., through water sprinkling) • Controlling dust emissions from processing equipment (e.g. crushers, grinders, screens, conveyors and bins) through dust collectors, wet processing, or water spraying. Dust control applications should consider the final use of	• Prior to any site preparation and construction works	• Contractor

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
		general construction activities – Traffic and vehicle movements on site roads – Transportation of spoil to disposal sites • Construction traffic and machinery	extracted material, for example, e.g. wet-processing stages are preferred when wet materials or high water contents would not negatively affect their final use • Implementing dust suppression techniques to minimize dust from vehicle movements and stockpiles. Techniques may include water spraying and surface treatment (e.g. hygroscopic media, such as calcium chloride, and soil natural–chemical binding agents) of roadways and exposed stockpiles using a sprinkler system or a ”water-mist cannon” • Where possible vehicles to use defined access roads/tracks. • Where travelling off road, keep vehicle movements to a minimum. • Managing emissions from mobile sources (on-site vehicles) by requiring contractors to use modern, well-maintained vehicles that comply with applicable emission limits • Avoiding open burning • Planning land clearing, removal of topsoil and excess materials, location of haul roads, tips and stockpiles, and blasting with due consideration to meteorological factors • Designing, installing and applying a simple, linear layout for materials-handling operations to reduce the need for multiple transfer points, • Preferring use of mobile and fixed-belt transport and conveyors over hauling the material by trucks through internal roads • Compacting and periodically grading and maintaining internal roads • Vegetating exposed surfaces of stockpiled materials • Generators used should be of a modern design and well-maintained to minimise air pollutant emissions. • Using personal protective equipment (PPE), such as dust masks, where dust levels are excessive		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			• Equipping excavators, dumpers, dozers, wagon-drills, and other automated equipment with air conditioned, dustproof, and soundproof cabs. • Particular measures for managing dust issues from blasting: – Alternatives to blasting, such as hydraulic hammers or other mechanical methods – If blasting is necessary, planning of the blasting (arrangement, diameter, and depth and direction of blast holes) will be implemented as per Blast Management Plan – Correct burning of explosive, typically composed of a mixture of ammonium nitrate and fuel oil, will be ensured by minimising the presence of excess water and avoiding incorrect or incomplete mixing of explosive ingredients • Particular measures for managing dust issues from the blending, packing, loading, unloading and use of bulk cement: – Containment of dusty processes: containment and arrestment is the preferred option for control of emissions to air from processes handling cement – Suppression of dust using water or proprietary suppressants. Where water is used for dust suppression, processes require an adequate supply of water. To demonstrate an adequate water supply on tanks that are not fed from the mains, a low level alarm will be fitted. It is noted that water-based suppression has caused issues with mud production on the T4HP site and therefore alternative chemical-based suppression options could be pursued in certain locations. – Protection of external sources, such as stockpiles and external conveyors, from wind whipping is necessary. There are various methods that may be used to this end. Crushed rock, sand or coarse aggregate, can be delivered, stored and handled so as to minimise dust emissions, for example by		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			dampening or covering		
Oil and Chemical Spill Response Plan	• To define the requirements and procedures to be followed during the handling and storage of chemicals, lubricants, solvents, oil and fuel throughout the project as well as the prevention and response to land-based spills.	• Pollution caused by improper materials handling and storage. • Contaminated material generated from fuel spills and leaks.	• Develop in accordance with local Emergency Response regulations, GIIP and IFC and HSE guidance. The following requirements will be included in the plan: • Undertake soil and groundwater quality baseline assessment for the Project area, including soil and groundwater contamination testing. • Establish baseline values for the site to compare with future monitoring and to identify conditions the site should be returned to in future when the power station has closed and is to be decommissioned. • Establish a complete inventory of hazardous materials (chemicals, oils and fuels) stored on-site so that in the event of a spill, information is available on volumes present • Maintain copies of Material Safety Data Sheets (MSDS) for all hazardous materials held on-site so that in the event of a spill information is available on potential risks, both to nearby receptors and the health and safety of construction workers • Ensure the appropriate storage and transfer requirements are in place at site • Undertake regular inspections of equipment and facilities to check for leaks or faulty equipment. This includes checking for dents and rust. • A single page quick guide spill response procedure will be included (based on the stop, contain notify system or similar) that will be reproduced and displayed at all locations on site where a spill is possible. If possible, the spill response procedure and ERP should be aligned. • All vehicles to carry fire extinguishers and spill kits.	• Prior to any site preparation and construction works • Prior to operation	• Contractor for construction (Approved by ESIC) • NTDC for operation
Sediment, Erosion and Landslip Control Plan	• To provide the basis for NTDC and the contractor to manage and control erosion caused by construction activities and to minimise impacts	• Vegetation loss and compaction, resulting in erosion of soils	**Sediment and Erosion Control measures** • Work sites and access roads will be carefully selected so that the risk of surface runoff entering the river is minimised. Measures such as rip rap and	• Prior to any site preparation and	• Contractor for construction (Approved by ESIC)

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
	on water quality and aquatic habitat erosion and sedimentation.	• Deposition of dust on surfaces where it may cause damage and/or lead to a need for increased cleaning or repair • Adverse health effects from excessive inhalation of fine particles • Complaints from the public relating to dust or emissions • Impacts on vegetation from dust deposition • Sedimentation of drainage systems resulting in impacts to water quality, ecology and /or drainage control • Sedimentation of water courses resulting in contamination and impacts on ecology and downstream water users. • Landslide.	slope protection will be adopted where appropriate. • Surface water runoff to be controlled by the construction of temporary drainage channels terminating in sediment traps/ soak away ponds. • Sedimentation ponds must be appropriately located and sized and well maintained. Any discharges from sedimentation ponds must meet surface water quality standards. • Slope breakers to be installed where the potential for rill erosion is identified/observed. • Top soil to be stripped and stockpiled where practical. • Temporary stockpiles to be protected from erosion. • If required, quarries and borrow pits following completion of works re-contoured and top soil reinstated and vegetation re-established through sewing of suitable grass seed if dormant seeds in top soil do not contain viable native seed stock. This is to be in accordance with the Habitat Reinstatement Plan • Plant new trees and vegetation in the areas subjected to erosion in accordance with the Habitat Reinstatement Plan • Other measures to be employed as needed including straw bales, silt fences, stilling ponds, erosion protection matting, bio-engineering. • Water turbidity will be monitored to assess the effectiveness of erosion control measures implemented. • All waste water requiring treatment will be processed in the dedicated wastewater treatment facility if it is operational or collected and treated off site, in accordance with the procedures in the Water Quality Management Plan. **Landslip management** • Slope supports or mitigation measures will be	construction works • Prior to construction	• NTDC for operation

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			employed to ensure that the slopes remain stable with design to appropriate standards. • Contractor will monitor engineering slopes and landslides near the powerhouse, including deformation, stress and strain, seismic response, blasting vibration. • Removal of the overburden deposits at the powerhouse site that are currently considered unstable • As a rule, cutting and removal of the soil/rock mass should be performed from upper to lower portion to maintain the slope stability. • After the excavation of slope, timely sealing and protective measures shall be adopted for soft rock slope surface • Geological work (assessing conditions encountered) will continue throughout construction • Temporary works shall be designed to be safe, reliable, and adequate for all loads and uses. • Blasting should be avoided where practicable. Contractor will prepare a Blast Management Plan. • Contractor responsible to undertake proper maintenance of all roads being used by the Contractor and Employer during the entire construction period including removal of slides, road surface repair and drainage system cleaning and upgrading. • ERP to include landslide risks.		
Chance Finds Procedure	• Project-specific procedure that outlines what will happen if previously unknown heritage resources, particularly archaeological resources, are encountered during project construction or operation.	• Damage to unrecorded archaeological and cultural heritage features.	• If any unexpected finds are encountered during earthworks or excavation works the following mitigation approaches will be employed by the Project: – Work will be immediately stopped in the area – The find(s) will be demarked and protected via fencing / blocking off and the site manager and Project Environmental Officer will be contacted – The cultural authority will be informed in order to	• Prior to any site preparation and construction works	• Contractor

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			seek guidance and specialist advice for management of the find(s) and how best to proceed, given its nature and extent – All finds will be recorded.		
Ecological Management Plan	• To detail the contractor's commitments to managing and monitoring impacts on flora and fauna. • The EMP will cover construction only. The objective is to protect biodiversity for the construction phase of the project in the project area.	**Construction** ***Terrestrial fauna:*** • Habitat loss/degradation • Disturbance (presence of people, artificial lighting and noise) • Injury or death owing to construction works (including trapping in deep excavations) and increased traffic • Temporary habitat fragmentation ***Aquatic habitats and species:*** Construction activities leading to: • Changes in water quality ***Aquatic habitats and species:*** Construction activities leading to: • Changes in water levels **Operation** ***Terrestrial habitats and flora:*** • Dust deposition and	**Generalmeasures** • The plan must include: • Survey of the area by qualified biologist(s) ahead of ROW clearing, as well as strict prohibition for the workforce on killing or capturing any of the species Details of the local NGO or consultancy, and the specialists that will undertake some of the activities that require specialist and local knowledge • Description of the biodiversity monitoring methods and sites to be used during construction. **Prevention of the introduction and spread of non-native and invasive species** • Contractor to monitor all known non-native and invasive plant species in the AoI during construction and will identify and report new invasive species establishing in the Project AoI during construction • Other species known to be invasive in Pakistan and globally will also be monitored if they are recorded on the construction sites. • A local botanist will be employed to undertake the monitoring or will be contacted to confirm the identification of invasive species. • Construction and operational activities will comply with international guidelines on the prevention and management of alien invasive species (AIS) (IPIECA & OGP (2010). Alien invasive species and the oil and gas industry. Guidance for prevention and management. OGP Report Number 436) • Preventative, control and monitoring measures will need to be implemented with regard to the following aspects of the Project. Not all measures will need to be implemented; a risk screening will be undertaken	• One month prior to any site preparation and construction works • Restoration should start at the end of construction and prior to operation	• Contractor for construction (Approved by ESIC) • NTDC for operation

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
		run off from increased vehicle movements • Permanent habitat fragmentation (low scale) ***Terrestrial and riparian fauna:*** • Permanent habitat fragmentation (low scale) • Increased disturbance, noise, dust • Increased risk of road kills ***Aquatic habitats and species:*** • Changes in water quality (sediments) • Changes in water quality (chemicals due to pollution events) • Changes to the water levels • Entrainment	by the contractor for each construction site and this will inform the implementation of the most appropriate prevention and control measures. The risk screening process will be included in the EMP: – Packaging and movement of materials: – Minimise traffic and the distance it has travelled – Source goods/materials locally where possible – Contain any AIS and report their presence. – Vehicles and plant: – 'As-new' wash-down is essential before entering non-infested areas and after working in infested areas – Train and raise awareness regarding AIS – Pressure wash vehicle tyres in a contained area – Contain and destroy residue – Record and report the presence of any AIS. – Soil and vegetation: – Minimise disturbance to, or movement of, soil and vegetation – Prevent soil damage and erosion – Ensure imported soil/other materials are safe and free of AIS (source from a reputable supplier, request information on the soil's origin and certification of AIS-free status if possible) – Prevent AIS establishment on exposed stored soil (do not store bare soil near known sources of AIS, consider using matting to cover exposed soil) – Ensure infested material is disposed of safely – Retain as much natural vegetation as possible. – Habitat reclamation: – Use native plants for reinstatement and landscaping – Assess any non-native species (to be used in landscaping) for AIS potential		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			– Consider that some AIS may be soil-based – Avoid altering soil and water body properties. – Linear elements (transmission lines, roads, waterway): – Plan the timing of activities to avoid impacts on AIS – Minimise spread width – Minimise vehicle-related impacts – Contain existing AIS – Minimise entry and exit points. • Measures to prevent or minimise the introduction/spread of invasive fish species, including the non-native carp species will be adopted, including awareness raising and education programmes for the local communities **Terrestrial and riparian animal species** • Noise reduction: – Avoidance of unnecessary revving of engines and switch off equipment when not in use – Vehicles and equipment will be properly maintained to meet the manufacturers' noise rating levels. Any silencers or bearings which become defective would be replaced as soon as possible – Using reverse warning systems incorporating broadband noise where practicable – Using enclosures for noisy plant such as pumps or generators – Minimising drop height of materials – Limiting the use of particularly noisy plant or vehicles where practicable – Plant and vehicles will be operated with noise control hoods closed. • Reduction and control of artificial lighting. Artificial lighting used on construction sites and camps at night will be shaded and directed downwards to avoid light spillage and disturbance to nocturnal		

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			birds, bats and other wildlife. • Ban on hunting and poaching: – All construction and operation staff will be required to follow company rules and code of conduct – Signage will be installed illustrating the hunting ban on any species throughout the Project areas – Measures will be implemented by both the Contractor and the client, who will employ suitable environmental staff to audit compliance • Mitigation for breeding, foraging and wintering birds: – Vegetation clearance outside the breeding period if possible. Where this is not possible, the areas to be cleared will be checked for breeding birds prior to the clearance and if nesting birds are found, appropriate mitigation measures will be implemented. This may involve avoiding construction within 50m of the active nest until the chicks have fledged. – Installation of bird diverters 7m to 10m spacing[46] on power lines **Aquatic habitats and species** • Management control measures to reduce, capture, and treat soil erosion. For example: – Exposed work areas near watercourses or in the riparian zones will be reinstated with suitable vegetation as soon as possible. Where possible, reinstatement will be undertaken using the same species present in the area before construction – During construction, riparian vegetation adjacent to the water courses will be retained where possible to act as buffer zones to assist in trapping sediments before reaching the water course.		

[46] Avian Power Line Interaction Committee (APLIC), (2012). Reducing Avian Collisions with Power Lines: The State of the Art in 2012. Edison Electric Institute and APLIC. Washington, D.C.

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			• No direct discharges of any pollutants to the river. There will be no direct discharges of any pollutants to the river, and the river should not be used to clean machinery or for any other purpose where pollutants may be released. Fuel storage, asphalt manufacturing, explosives and other potentially polluting activities must occur away from rivers and have adequate pollution control measures. • Awareness and education – Sponsor awareness raising programmes for the local communities to explain why and how invasive species of plants and animals (especially invasive fish) affect native biodiversity. Measures to reduce overgrazing and soil erosion will also be explained to the local communities. These programmes will be implemented by a local NGO to be employed by NTDC. **Other Mitigation Measures** • All pits, trenches and excavations will be covered overnight or fenced to avoid animals falling in. Pits and trenches will be checked prior to refilling. • Vegetation clearance will be carried out in a methodical manner so that any fauna present in these areas can disperse. Where clearance of dense scrub is required, it will be preceded by a hand search for mammal and/or reptile species which may be present in the sward. The dense vegetation will only be cleared once it has been established that any individuals present have fled. The incidental creation of pockets of habitat or islands will be avoided. Before and during vegetation clearance or tree felling, any animals found will be removed and released to safe refuge. • In sensitive areas, notices will be put up along the site roads to highlight the risk of collision with mammals and other animals		
Habitat Removal and Restoration	• To establish mitigation and good practice for terrestrial habitats and	**<u>Construction</u>** ***Terrestrial habitats***	A Habitat Removal and Restoration Plan (HRRP) will be produced by the Contractor and reviewed by a	• One month prior to any	• Contractor for construction

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
Plan (HRRP)	flora.	***and flora:*** • Loss and degradation of terrestrial and riparian habitat • Introduction or spread of non-native invasive species	qualified ecologist before start of construction. The HRRP will set out the minimum requirements in relation to the clearance and restoration of natural habitats, and the removal, storage and reinstatement of soil. The HRRP is likely to include the following practices: • Where practical, soil removed from construction sites will be stored and used in the restoration • Habitats affected temporarily during construction will be restored/reinstated on a 'like-for-like or better principle', using the species recorded during the baseline surveys (native species only) • Specifications for a tree inventory of all trees to be removed or affected by the works. The inventory will be undertaken pre construction and pre-vegetation clearance and will include an assessment of the tree species to be affected, their size and condition • All species used in the habitat restoration will be native. No introduction of non-native plant species will be allowed.	site preparation and construction works • Restoration should start at the end of construction and prior to operation	(Approved by ESIC) • NTDC for operation
Health and Safety					
Occupational Health and Safety Plan / Contractor ESHS Plan	• To implement a safe working environment, procedures and culture during the construction phase. Further policies / procedures to be developed if need identified through site audits. • Health and safety risks: – Risks or changes to community health (including through changes to local traffic conditions), safety and security including public health and access to health services • Risks associated with occupational health and safety (OHS)	• Occupational health and safety risks, including: – exposure to physical hazards from use of heavy equipment including cranes – trip and fall hazards – exposure to dust, noise and vibrations – falling objects – exposure to	• Proper use of personal protective equipment (PPE) by all workers, PPE use in workers' code of conduct • Contractor to have an appropriately equipped first aid room and staff to address workers' health and manage community health interactions • Reservoir use and safety awareness including barriers, signage and sensitisation, especially near the dam and where risk of slippage and drowning near the reservoir is high • Monitoring and reporting of accidents, injuries, lost-time incidents, near misses and community interactions on health issues • Worker accommodation monitoring • Tool box talks on hygiene and sanitation at least every six months	• System in place prior to construction, additional plans and policies developed as needed	• Contractor (ESHS Plan) • NTDC (OHS Plan)

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
		hazardous materials; and exposure to electrical hazards from the use of tools and machinery – working around large water bodies; – working at height, with live power equipment and lines • exposure to electro-magnetic fields (EMFs).	• Good housekeeping on site to prevent pooling of water • Control and quality assurance of drinking water • Pest and vector control activities • Information dissemination and sensitisation campaigns on venomous snakes directed to workers and provision of additional doses of snake and rabies serum to health facilities on site • Driver first aid kits in all vehicles.		
Emergency preparedness and response plan	• To manage potential emergencies during the construction, operation and decommissioning of the Project. The EPRP will form part of the wider suite of plans to be implemented by the N-ESMU and C-ESMU teams.	• Accidental and emergency situations	• A Project specific EPRP will be produced to cover the specific HSE risks associated with the Project construction activities. Plan to be prepared to follow international practice. • The project specific EPRP will: – Identify and evaluate emergencies – Determine preventative action – Highlight trigger events and measures to implement plan.	• Prior to any site preparation and construction works • Prior to operation	• Contractor for construction (Approved by ESIC) • NTDC for operation
Worker Accommodation Plan	• To ensure that all Project accommodation areas are designed, constructed and maintained as healthy, clean and pleasant locations for workers to live in.	Hygiene, safety and security risks	Prior to the construction works, NTDC and the Contractor(s) will commit to: • Meeting the requirements set out in the guidance note by IFC and EBRD on workers' accommodation: processes and standards (2009). • In particular, the provision of accommodation will meet international good practice in relation, but not restricted, to the following: – Practice for charging for accommodation – Provision of minimum amounts of space for each	• Prior to construction of the worker accommodatio n. • Maintained throughout the project lifecycle	• Contractor for construction (Approved by ESIC) • NTDC for operation

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			worker – Provision of sanitary, laundry and cooking facilities and potable water – Location of accommodation in relation to the workplace – Any health, fire, safety or other hazards or disturbances and local facilities – Provision of first aid and medical facilities – Heating and ventilation • Workers freedom of movement to and from the employer-provided accommodation will not be unduly restricted • Liability for security clearance for staff to enter site will be with the employer • A bill of quantities item shall be implemented in the contract to ensure the T4HP worker camp is refurbished if re-used. • It shall be ensured that food available is of a good standard.		
Social					
Stakeholder Engagement Plan (SEP)	• To maintain liaison with the communities and to avoid any conflicts	Broad community support	Describes the means by which the Project will ensure continuous engagement with affected people and other interested parties, especially with regards to disclosure of construction information and ongoing sustainability reporting to the wider public, key stakeholders and the public	• Prior to construction	• Community Liaison Officer (CLO) of NTDC or Contractor
Community grievance mechanism[47]	• Ensures the timely resolution of community grievances	• Broad community support	• Identifies structured process to review the validity, responsibility and response/action of community grievances	• Prior to construction	• CLO
Worker grievance mechanism	• Ensures the timely resolution of worker grievances to prevent lost time incidents	• Employment generation	• Identifies structured process to review the validity, responsibility and response/action of labour grievances	• Prior to construction	• Contractor Human Resource (HR) Manager

[47] Normally this mechanism is part of the stakeholder engagement plan however it can also be a stand alone document.

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
Gender Strategy	• Raise gender awareness of the different roles and responsibilities within the community, the economy and agricultural production • Implement a gender mainstreaming component in all Project related plans and programmes • Suggest practical and measurable gender actions and targets to be achieved as a result of the Project and related programmes	• Employment generation Broad community support	-	• Prior to construction	• CLO and Contractor HR Manager
Project Labour Statement Recruitment Policy Human Resources Policy Local Content Strategy	• Identifies that all project employers will meet national labour laws and uphold labour rights, especially in relation to having signed contracts, not using excessive overtime use • Commits to equity in local employment benefits and equal employment opportunities across ethnicities and women. • Prohibits the use of child and forced labour / promote non-discrimination and equal opportunities. • To help promote the participation of national companies, local businesses and local workers in the service and equipment procurement opportunities.	• Employment generation • Minimises social conflict • No preference for local labour • Labour issues regarding working hours, wage structure, holidays, over time and leave arrangements.	• Prevents workforce discontent and labour protests • A clearly defined Project Recruitment Policy shall be implemented • Contract clauses shall be put in place requiring the Contractor to hire people from Affected Communities • Regular bulletins shall detail descriptions of employment and supply chain opportunities to local people and businesses, including information about required skill levels, indicative timeframes for recruitment and likely duration of contracts. • Bulletins shall be distributed in nearby villages and printed in local newspapers and the Recruitment Policy is to be referred to in job adverts. • Individual contracts of employment shall be provided for all workers. These shall detail workers' rights and conditions related to hours of work, wages, overtime, compensation and benefits such as maternity or annual leave. Contracts shall be updated when material changes occur. • Monitoring of labor rights and workforce profile is required quarterly. • Toolbox talks shall be held frequently on safety and labor issues and a review of the labor grievance mechanism shall be undertaken twice a year during the construction phase.	• Prior to construction	• NTDC Contractor HR Manager

Plan / Policy	Objective	Impacts	Mitigation	Implementation	Responsibility
			• A supply chain review shall be undertaken quarterly to identify issues of child or forced labor and Occupational Health and Safety (OHS) risks.		
Workers' Code of Conduct	• Governs the behaviour of workers on site, in their accommodation and in the local communities	• Employment generation Minimises social conflict	-	• Prior to construction	• Contractor HR Manager

11.3.5 Operation: The NTDC Environmental & Social Impact Cell

NTDC has a designated Environment and Social Impact Cell (ESIC) which is responsible for environmental and social assessment and monitoring on behalf of the organization. The ESIC oversees preparation of impact statements, liaises with the relevant EPA's and manages NTDC's E&S legal compliance.

During the operation period, NTDC's ESIC will be solely responsible for the E&S performance of the operational power evacuation facilities (transmission lines and grid stations). ESIChas some capacity/resources and capability to deliver the commitments set out in this ESMP. The proposed organizational structure for the operational phase will be largely similar to that proposed for the construction phase. An operational phase ESMS will be developed in alignment with the principles of ISO14001.Communication

NTDC will establish and maintain procedures for the following levels of communication:

- Internal communication between the various levels and functions of the organisation and between NTDC, ESIC and ESMU (ESMU to be responsible for communication with consultants and contractors relating to environmental issues)
- Receiving, documenting and responding to relevant communication from external interested parties, in particular a procedure for managing environmental complaints that are received from the public or government organisations through a community grievance mechanism (discussed later in the Chapter)
- All complaints received by the General Plant Management should be handled in a responsive manner, through a labour grievance mechanism.

11.4 Environmental and Social Management and Monitoring

This section introduces the proposed activities for managing and monitoring the potential E&S effects associated with the Project. The impacts and mitigations identified for the decommissioning phase are considered to be sufficiently similar to the construction phase to conclude that a separate ESMP for the decommissioning phase is not required at this stage.

11.4.1 Environmental Code of Practices (ECPs)

The environmental codes of practice (ECPs) are generic, non-site-specific guidelines. The ECPs consist of environmental management guidelines and practices to be followed by the contractors for sustainable management of all environmental issues. The contractor will be required to follow them and also use them to prepare site-specific management plans (Construction Environmental and Social Management Plan, CEAP). In addition to the ESMP, the ECPs will also be attached to the construction contracts and will be monitored for compliance. The ECPs are listed below and given in **Annex 5**.

- ECP 1: Waste Management
- ECP 2: Fuels and Hazardous Substances Management
- ECP 3: Water Resources Management
- ECP 4: Drainage Management
- ECP 5: Soil Quality Management
- ECP 6: Erosion and Sediment Control

- ECP 7: Top Soil Management
- ECP 8: Topography and Landscaping
- ECP 9: Borrow Areas Management
- ECP 10: Air Quality Management
- ECP 11: Noise and Vibration Management
- ECP 12: Protection of Flora
- ECP 13: Protection of Fauna
- ECP 14: Protection of Fisheries
- ECP 15: Road Transport and Road Traffic Management
- ECP 16: Construction Camp Management
- ECP 17: Cultural and Religious Issues
- ECP 18: Workers Health and Safety.

11.4.2 Resettlement Action Plan

The Islamabad West Grid Station will require about 200 acres of land, affect a total of 150 households. The social impacts largely include loss of agricultural land with associated loss of income and livelihoods. To address and mitigate these relocation and resettlement impacts, the RAP has been prepared. The RAP is based on the findings of the inventory and census surveys as well as meetings and consultations with various project-affected persons. The RAP presents (a) type and extent of loss of assets including land, structures and trees; (b) principles and legal framework applicable for mitigation of these losses; (c) the entitlement matrix, (d) relocation strategies and plans, including provision for livelihoods; (e) resettlement and rehabilitation budget; and (f) institutional framework for the implementation of the plan, including monitoring and evaluation. It has been designed as a “development” plan, therefore the overall objective of the RAP is to restore and/or improve the living standards of the affected persons from pre-project level.Land requirements for the Transmission Line will be identified under a separate RAP which will be developed once the design consultants have identified the exact location of towers. Guided by the LARF, it will be prepared and approved by the Bank prior to any construction work.

Income and Livelihood Restoration Program

The RAP has developed income and livelihood restoration programs with the aim of improving or at the least restoring to the earlier level the livelihood of all affected households/persons. In preparing the program the impact of dislocation on livelihoods and adversely affected income was given due consideration. In addition to income restoration, capacity building and enhancing social capital of the affected communities are major objectives of this program.

11.4.3 ComplianceMonitoring

This Section describes the compliance monitoring activities of the Project parties. For construction, the monitoring and reporting regime is broadly summarised as follows:

- 1st party monitoring: undertaken by the Contractor (C-ESMU) of its own compliance and that of its sub-contractors and supply chains with results documented in monthly monitoring reports.
- 2nd party monitoring: undertaken by the Project Proponent (N-ESMU), with support from the Engineer (E-ESMU) in order to verify the C-ESMU monitoring findings.
- 3rd party independent monitoring: by the lenders and their consultants, to verify the findings of the above two layers and to assess overall compliance with lender requirements.

During the operations phase, ongoing monitoring requirements will need to be assumed primarily by NTDC.

The Contractor's Compliance Monitoring and Reports

The Contractor will undertake on a daily/weekly basis, compliance monitoring of the construction sub-contractors E&S activities as per the World Bank General EHS Guidelines (2007) and this ESMP.

The Contractor shall prepare monthly reports for issue to the Project Proponent. These reports will summarize the following:

- Progress in implementing the ESMP and other management plans
- Findings of the monitoring programmes, with emphasis on any breaches of the control standards, action levels or standards of general site management
- Outstanding Non-Compliance Reports (NCRs)
- Summary of any complaints by external bodies and actions taken/to be taken
- Relevant changes or possible changes in legislation, regulations and international practices.

Any breaches of the acceptable standards specified by law/construction permits and/or this ESMP should be reported to the Project Proponent, using a NCR Form.

The Contractor shall carry out internal audits of its own performance on a bi-monthly basis. Audit findings will be actioned and tracked to close out through a Corrective Action Plan.

Project Proponent's Monitoring of Construction Activities

The N-ESMU on behalf of Project Proponent (supported by the Engineer) will undertake compliance monitoring of the Contractor's E&S activities on a regular basis as per the World Bank General EHS Guidelines (2007) and this ESMP. Internal compliance audits (supported by the Engineer) will be undertaken within two months of commencement of construction and thereafter every three months focusing on the performance of the implementation of this ESMP. Audit findings will be actioned and tracked to close out through a Corrective Action Plan.

Any breaches of the acceptable standards specified by law/construction permits and/or this ESMP through the Project Proponent's monitoring of the Contractor and sub-contractor(s) should be reported using a NCR Form. A copy of each completed NCR (whether prepared by the Contractor or otherwise) should be held on file by the Project Proponent'sEHS department, to be replaced by the reply copy when it is received. A record of corrective actions should also be made and tracked to their completion.

Project Proponent's Monitoring of Operational Activities

The E&S impacts that will occur during the operation phase have been assessed through the present ESA. Impacts will be managed and monitored through the commitments outlined in this ESMP. The Project Proponent's EHS Director should prepare annual reports for issue to the lenders summarizing progress against implementation of the Project Proponent's ESMP obligations throughout the operational phase. This will include full reporting of monitoring results where relevant.

Project Proponent's External Reporting for Regulatory Compliance

A register of all necessary external stakeholder reporting requirements under Pakistan Legislation and for regulatory compliance purposes will be developed where appropriate. The frequency of reporting, the required reporting format and the person(s) responsible for producing the report (along with any necessary specialist service providers/constructors required to assist for data collection or interpretation purposes) is to be noted in the register.

The Project Proponent will need to ensure that all the necessary reports are produced and submitted in a timely fashion in order to achieve on-going regulatory compliance throughout the life of the Project. Meeting regulatory reporting requirements is to also form part of the scope for any internal audits and management reviews.

Project Proponent's Lenders Reporting Requirements

During the construction phase, the Project Proponent will undertake quarterly reporting, based on their monitoring results as a project requirement. Operational monitoring will be undertaken annually throughout the loan period.

External Audits (Third Party Validation)

As a minimum, on an annual basis throughout the first three years of the construction works and operation activities, arrangements should be made for the M&E consultants to carry out an independent audit of the existing practices against the requirements of the ESMP. The key objectives of the audit should be as follows:

- Report on the practical implementation of the ESMP and progress since the last visit
- Establish feasible improvement objectives for completion before the next visit.

The following aspects will be covered under the external audit:

- The ESMP is being adequately implemented
- Mitigation measures are being implemented and their effectiveness monitored
- The compliance and effects monitoring are being conducted
- Environmental and social trainings are being conducted
- Complete documentation is being maintained.

These audits should be used to re-examine the continued appropriateness of the ESMP and to provide advice on any up-dates required. Attention should be given to lessons learnt in the light of experience. In particular, consideration should be given to the monitoring programs in place to determine whether their purpose has been served and they can therefore be terminated or reduced in frequency

Monitoring of social issues will be important, especially with regards to worker management, workers' terms and conditions, occupational health and safety and grievances. External monitoring will need to verify that the Project commitments to worker's rights are implemented, in particular with regards to:

- Use of child labour
- Not employing forced labour
- Payment of minimum wages and overtime
- Not taking any action to prevent employees from exercising their right of association and their right to organise and bargain collectively
- Ensuring no workers are charged fees to gain employment on the Project
- Implementation of plans, procedures and training for occupational health and safety
- Non-discrimination and equal opportunity
- Meaningful use of the labour grievance mechanism
- The existence of human resource policies, job descriptions, written contracts
- Provision of information to labour force regarding rights and working conditions
- Employee training activities.

Annual monitoring reports of any independent advisor should be made available for public disclosure on the Project Proponents website and the World Bank's website.

11.4.4 Management Reviews

NTDC Management should review the results of internal and external audits and provide commitment and resources to tackling outstanding issues.

NTDC Management should support the proposed ESMU in mechanisms to manage financial payments to contractors based on performance against the items identified in the ESMP.

11.4.5 Monitoring Predicted Effects

The ESA predicts the impacts of the proposed project on the basis of information available at the time of conducting the assessment and the natural processes that link various environmental and social parameters. Based on this prediction, mitigation measures are introduced such that the predicted residual effects do not exceed acceptable levels. However, there can be an element of uncertainty in such predictions, for example, due to insufficient information on the processes, limitations in prediction techniques, or inadequate data on the environment. This is true for the physical, biological, as well as socioeconomic environment. Consequently, it is possible that even if the mitigation measures are implemented fully, the negative impacts of the Project could exceed predicted levels or acceptable limits.

In order to address the above concerns, effects monitoring will be undertaken during the Project activities, with the overall objective of proper management of environmental and social risks and uncertainties. Broadly, effects monitoring has the following objectives:

- To verify that the Contractor is implementing all of the management plans developed for the project
- To verify that the impacts of the proposed project are within acceptable limits, thus establishing credibility (public assurance)
- To immediately warn the Project proponents (and the regulatory agencies, if required) of unanticipated adverse impact or sudden changes in impact trends so that

corrective actions can be undertaken, which may include modifications in the proposed activities, or the inclusion of modified or additional mitigation measures

- To provide information to plan and control the timing, location, and level of certain project activities so that the effects are minimised
- To facilitate research and development by documenting the effects of the proposed project that can be used to validate impact-prediction techniques and provide a basis for more accurate predictions of future projects.

The effects monitoring plan is provided in **Table 11.6**. The detailed methodologies will be developed during the detailed design phase of the Project when the specific information on field activities will be known. The monitoring table below focuses primarily on the construction phase and monitoring responsibilities primarily attributable to the Contractor.

Table 11.6: Effects Monitoring Plan

Management Plan	Monitoring Parameter	Monitoring Locations	Frequency	Responsibility	Documentation
Construction Traffic Management Plan (TMP)	• Speed limits of vehicles, traffic congestion on main roads near project sites	• Working areas	• Daily	• C-ESMU	• Visual observations
	• Trucks conditions and maintenance	-	• Monthly	• C-ESMU	• Visual observations
	• Vehicular accident records	-	• Monthly	• C-ESMU	• Maintain accident / incident records
	• Vehicle safety signals (flares, warning lights, reflectors)	-	• Monthly	• C-ESMU	• Visual observations
	• Vehicle fuelling procedures	-	• Monthly	• C-ESMU	• Visual observations
	• Vehicle loading / off-loading procedures	-	• Monthly	• C-ESMU	• Visual observations
	• Vehicle daily checks	-	• Monthly	• C-ESMU	• Visual observations
Materials and Waste Management Plan (MWMP)	• Implementation of all mitigation	• Working areas and site compounds	• Daily • Weekly	• C-ESMU • E-ESMU	• Visual observation
	• Records of waste volumes generated by the site and indicate the final disposal option for each waste stream	• Grid station Site compound	• Monthly	• C-ESMU	• Waste volume record
	• Records of consignment and waste transfer notes	• Site compound	• Monthly	• C-ESMU	• consignment and waste transfer notes
	• Audit of waste management practices	• Working areas and site compounds	• Quarterly	• E-ESMU	•
Spoil Management Plan	• Site walkover	• Spoil disposal sites	• Daily	• C-ESMU	• Visual observation for erosions and landslides
	• Routine inspections	• Spoil disposal sites	• Fortnightly	• E-ESMU	• Visual observation
	• Record volumes of spoil generated for spoil production and stockpiling.	• Spoil disposal sites	• Observe daily and report monthly	• C-ESMU	• Spoil disposal material record
Noise and Vibration Control Plan	• Noise and vibration	• Near communities within AoI	• A baseline noise survey at the sensitive receptors immediately	• C-ESMU	• Maintain monitoring records.

Management Plan	Monitoring Parameter	Monitoring Locations	Frequency	Responsibility	Documentation
		• The labor camp • At locations representative of sensitive receptors in the vicinity •	prior to construction • At monthly intervals throughout construction, but not at pre-arranged times • As and when required, during critical phases of construction, i.e. when possible exceedance of the project noise and vibration criteria is anticipated • In response to reasonable noise complaints being received •	• E-ESMU	• Record and investigate complaints using sound level meter / PPV via the community grievance mechanism.
	• National Environmental Quality Standards[48] (NEQS) thresholds for noise and vibration	• Communities inside AoI • The labor camp	• Daily	• C-ESMU	• Using sound level meter at the nearest residential properties to construction activities and compare it with NEQS and record in a monitoring report.
	• Implementation of mitigation measures	•	• Daily • Weekly	• C-ESMU • E-ESMU	• Visual observations
Oil and Chemical Spill Response Plan	• Soil and groundwater quality baseline, including soil and groundwater contamination.	• At each temporary and permanent construction area	• Pre-construction	• C-ESMU	• Monitoring report
	• Check and approval of: • Inventory of hazardous materials (chemicals, oils and fuels) stored on-site so that in the event of a spill, information is available on volumes present • Material Safety Data Sheets (MSDS) for all hazardous materials held on-site	-	• Pre-construction and ongoing during construction as content is revised	• E-ESMU	• Review records

48 If monitoring demonstrates continued exceedences of NEQS, site practices and mitigation measures should be reviewed to reduce construction related impacts.

Management Plan	Monitoring Parameter	Monitoring Locations	Frequency	Responsibility	Documentation
	• A single page quick guide spill response procedure				
Air Quality Management Plan	• NEQS thresholds for ambient air quality	• Near communities along the AoI.	• Bi-annually	• C-ESMU	• Monitoring report
	• PM2.5 and PM10 levels	• Near communities along the AoI.	• Immediately prior to construction	• C-ESMU	• ESA baseline data to be corroborated through a monitoring survey as part of the construction monitoring programme
	• Implementation dust mitigation measures	-	• Daily • Weekly	• C-ESMU • E-ESMU	• Visual observations • Maintain a record of high dust incidents and record any violations were observed. • If high dust levels are as a result of poor site management contractor to impose disciplinary action on construction subcontractor.
	• Implementation of mitigation measures		• Daily • Weekly	• C-ESMU • E-ESMU	• Visual observations
Water Resources Management Plan	• NEQS thresholds for water supply - monitoring at the sites sampled for the Project baseline together with monitoring of wastewater discharges into the river.	• Haro river	• Bi-annually throughout construction	• C-ESMU	• Monitoring report
	• Implementation of mitigation measures		• Daily • Weekly	• C-ESMU • E-ESMU	• Visual observations

Management Plan	Monitoring Parameter	Monitoring Locations	Frequency	Responsibility	Documentation
Ecological Management Plan (including HRRP)	• Trees	• All trees to be removed or affected by the works	• Pre-construction and pre-vegetation clearance	• C-ESMU	• Tree inventory; including an assessment of the tree species to be affected, their size and condition.
	• Habitats	• All restored or created habitats	• Monitoring will start six months after the completion of habitat restoration or creation at each site and will continue every six months for five years	• C-ESMU	• Bi-annual monitoring reports
	• Birds, mammals and herpetofauna	• Undertake pre-construction surveys using transects and survey points in the footprint of the Project components which were not surveyed in 2015.	• Surveys for different species to be carried out at appropriate times of year in advance of construction at each location. Where there is no seasonal dependency, surveys to be completed at least one month prior to construction at each location to ensure mitigation can be included in Contractor method statements.	• N-ESMU	• Pre-construction monitoring reports, including any site specific mitigation.
	• Invasive plant species	• Working areas and site compounds	• Every three months	• C-ESMU	• Visual observations
	• Implementation of mitigation measures	•	• Daily • Weekly	• C-ESMU • E-ESMU	• Visual observations
OHS Plan / ESHS Plan	• Accidents, injuries, lost-time incidents, near misses and community interactions on health issues	• Working areas and site compounds • Project affected area	• Monthly	• C-ESMU	• Monitoring report
	• First aid room use	• Working areas and site compounds	• Monthly	• C-ESMU	• Monitoring statistics
	• OHS target accident rate of zero	• Working areas and site compounds	• Monthly	• C-ESMU	• Compile data from monitoring report and statistics

Management Plan	Monitoring Parameter	Monitoring Locations	Frequency	Responsibility	Documentation
	• Implementation of mitigation measures	•	• Daily • Weekly	• C-ESMU • E-ESMU	• Visual observations
Stakeholder engagement plan (SEP)	• Develop / disclose compliant plan to local communities • Appoint Community Liaison Officer (CLO) • Implement plan during construction	• Local government offices • Within local communities	• Prior to construction • Monthly • Update prior to operations and on an ongoing basis as new stakeholders are identified	• N-ESMU (plan development/ update) • C-ESMU (implementation) CLO	• SEP • CLO employment contract and job description • Minutes and photographs of meetings
Community grievance mechanism	• Grievance mechanism in SEP • Signage providing grievance contact details • Grievance logging	• Site perimeter • Grievance log in site office	• Prior to the start of construction • Monthly	• C-ESMU CLO	• SEP • Grievance logs and investigation reports
Worker grievance mechanism	• Signage providing grievance contact details • Grievance logging • Worker verification interviews	• Within site and worker accommodation • Grievance log in site office	• Prior to the start of construction • Monthly	• C-ESMU	• Grievance logs and investigation reports
Implement gender strategy	• Ration of female to male employees in semi-skilled or managerial positions in accordance with plan developed by N-ESMU • Measures to raise gender awareness • Economic empowerment measures for local women in the community	• Site office • Local communities	• Monthly	• N-ESMU (plan development) • C-ESMU (implementation)	• Workforce profile statistics • Write ups of consultation with local women
Project labour statement Recruitment policy Human resources policy Workers code of conduct	• Inclusion of policy details in employee contract documentation • Policies being accessible to staff via signage or in common areas	• Site offices and common area	• Prior to the start of construction • Monthly	• C-ESMU	• Timesheets (no excessive overtime) • Payslips (paid on time) • Labour grievance register

Management Plan	Monitoring Parameter	Monitoring Locations	Frequency	Responsibility	Documentation
Local content strategy	• Local advertisements for employment / procurement opportunities • Ratio of local to migrant workers • Ratio of local to migrant procurement contracts	• Site offices	• Prior to the start of construction • Monthly	• C-ESMU	• Advertisements • Workforce profile statistics • Procurement and supply chain profile statistics
Worker accommodation plan	• Sleeping space per worker • Number of ablution facilities per worker • No. ambulances and medical facilities per worker • Quality of food provision • Recreational facilities • Worker grievance logs	• Workers accommodation areas	• Prior to the start of construction • Weekly	• C-ESMU	• Statistics in relation to parameters and investigation reports • Grievance logs • Photographs

11.5 Trainings and Awareness Raising

11.5.1 Overview

In achieving the approach to environmental management described in previous sections, it is implicit that all staff (NTDC, Engineer and Contractor) receive the required training in both general and job-specific terms. This training should not be considered a stand-alone exercise, but must form an integral part of on-going training programs. Arrangements must also be provided for training of all new recruits and continual refresher courses for established staff put in place.

E&S training will help to ensure that the requirements of the ESA and ESMP are clearly understood and followed by all project personnel throughout the project period. E&S training programs will also ensure that all site personnel, as applicable to their job responsibilities fully understand:

- The environmental requirements of the Project and how they will be implemented and monitored on site
- The potential impacts of the Project, the mitigation measures that have been adopted to address those impacts and how and where to apply these measures
- Any environmentally or socially sensitive areas in the vicinity of the construction site
- The procedures for responding to the media, to unauthorised visitors to the site and enquiries from the public
- Any defined seasonal ecological sensitivities and restrictions (timing or methods) for construction activities
- Know how to deal with unforeseen environmental incidents
- Are aware of the roles of NTDC, the Engineer and the Contractor with respect to environmental issues.

The primary responsibility for providing training to all project personnel will be that of the ESMU. The E&S training program will be finalized before the commencement of the project, during the detailed design phase. Training will cover all staff levels, ranging from management and supervisory personnel to the skilled and unskilled workforce. Training details have been provided in the following section. The training requirements are summarized in **Table 11.7**.

Table 11.7: Training Requirements

Contents	**Participants**	**Responsibility**	**Schedule**
• General E&S awareness/toolbox talks • E&S sensitivity of the project area • Key findings of the ESA • Mitigation measures • ESMP • Social and cultural values of the area.	Design team; Selected NTDC management staff	ESMU (for N-ESMU staff, training in environmental and social management plans and OHS related issues must have been completed prior to carrying out training of others)	Prior to the start of the project activities. (To be repeated as needed.)
• General E&S awareness/toolbox talks	All site personnel	ESMU	Prior to the start of the field activities.

• E&S sensitivity of the project area • Mitigation measures • Community issues • Awareness of transmissible diseases • Social and cultural values.			(To be repeated as needed.)
• ESMP • Waste Disposal	Construction staff	Contractor	Prior to the start of the construction activities. (To be repeated as needed.)
• Road safety • Defensive driving • Waste disposal • Cultural values and social sensitivity.	All drivers	Contractor	Prior to and during the field operations. (To be repeated as needed.)
• Camp operation • Waste disposal • Natural resource conservation • Housekeeping	All site personnel	Contractor	Prior to and during the field operations. (To be repeated as needed.)
• Restoration requirements • Waste disposal	Contractor	Contractor	Prior to restoration activities.

11.5.2 General Awareness Training

All staff members will be required to attend an in-house training course on general environmental awareness (site induction training). This will be delivered in a consistent structure, irrespective of the staff designations attending. The main objective of this type of training is to provide:

- A general understanding of the environmental risk associated with the Plant
- Local, national and international actions which are required to combat these risks
- Clarification of the NTDC Environmental Policy and its practical implementation, stressing that it carries implications for the working methods and responsibilities for all employees.

Continual awareness of environment matters should be maintained. The Environmental Policy Statement should be on permanent display in prominent positions around the Project sites, such as the administration block, reception area, the control room, staff catering facilities and construction site offices.

The site induction training will be carried out by all staff before they commence work on site. As a minimum the training will include but will not be limited to:

- The purpose and objectives of the ESMP and sub-plans
- The reason why the requirements set out in the ESMP and sub-plans are important
- The requirements for due diligence and duty of care
- NTDC, Engineer and Contractor's environmental personnel and other key contacts

- Methods for implementing environmental controls included within the ESMP and sub-plans
- Procedure for reporting environmental incidents
- Procedures for responding to the media, to unauthorised visitors to the site, and enquiries from the public
- Details of site emergency and response plans where these apply to environmental emergencies (e.g. chemical / fuel spillage).

In addition to the site induction training personnel will not be allowed to perform hazardous operations before they have completed appropriate additional training in this regard.

Job Specific Trainings. In addition to the site induction training additional specific environmental and social training will be provided focused on small, discrete groups of employees who carry out the same, or similar, roles such as the Contractor(s) ESS supervisors.

Specialist environmental and social training will also be provided for construction workers as applicable to their job responsibilities. Selected workers will be responsible for emergency responses to major oil and chemical spills and will receive the appropriate training.

NTDC, the Engineer and the Contractor will maintain a training needs matrix and associated training program to identify which specific job roles for their respective organizations require such additional specialist training. Specialist training will either be performed by suitable qualified in-house personnel or by approved specialist external training providers.

11.5.3 Toolbox Talks

It is the responsibility of the C-ESMU to implement a program of toolbox talks for all construction personnel during the construction phase. This will be assisted by N-ESMU and E-ESMU personnel if necessary. At least fortnightly toolbox talks will be performed for all workers on-site; these will be done in groups with talks made relevant to their construction roles on site. NTDC, the Engineer or the Contractor’s senior management may call additional toolbox talks should the need arise to further discuss safety or environmental and social aspects.

The topics of the talks will cover all environmental, social and safety issues; they will be focused on issue relevant to forthcoming construction works or related to any non-compliance that have recently occurred. When performing the talks C-ESMU will ensure that they are kept interesting, less than fifteen minutes and relevant to the current on site construction activities.

11.6 Record Keeping

11.6.1 Monitoring Records

Proper arrangements are necessary for recording, disseminating and responding to information which emerges from the various E&S management and monitoring plans/programs. Records are also necessary for rendering the ESMS “auditable”. The primary focus must however remain the pragmatic control of pollution, not the creation of complex bureaucratic procedures.

Quantitative Physical Monitoring

The objective of quantitative physical monitoring is to ensure that the mitigation measures designed to prevent, reduce and where possible offset any significant adverse impacts on the environment are being implemented throughout the Project lifecycle. A database should be developed by ESMU, with involvement from ESIC, for storing the results of the quantitative monitoring. The facility should be capable of producing tabulated weekly and monthly reports that provide the following information:

- Sampling points
- Dates and times of sample collection
- Test results
- Control limits
- "Action limits" (circa 80% of the control limits) at which steps must be taken to prevent the impending breach of the control limit
- Any breaches of the control limits, including explanations if available.

The monitoring data should be continually processed as it is received, so as to avoid a build-up of data.

General Site Inspections and Monitoring

A Site Inspection Checklist for recording the findings of the general site condition surveys should be developed by the contractor and should be developed in line with the Environmental Management and Monitoring Plan described in **Section 11.4**. This should cover all the ESMP commitments as provided in this ESMP. The Site Inspection Checklist should be supported by maps/plans, as necessary.

11.6.2 Complaints Records

A tabulated standard form should be prepared for recording any environmental complaints that are received from the public or government organizations by whatever medium i.e. visits to the Project site, telephone calls or correspondence.

The form should concisely list the following information:

- Date of the complaint
- Name and contact address of the complainant
- Brief description of the complaint, with a file reference to any correspondence from the complainant
- Brief description of the action taken by the Plant Management to investigate the cause of the complaint and bring about corrective action, if justified
- Date of reply to the complainant, with a file reference to any correspondence.

All complaints received by the Plant Management should be handled in this way.

11.6.3 Information Sources

A complete and up-to-date file of all relevant sources of information should be maintained by the ESMU. This file should be readily accessible and include, as a minimum, copies of the following documents:

- Current environmental permits and consents
- All relevant Pakistan regulations, international guidelines and codes of practice

- Material safety data sheets (MSDS) for all hazardous substances used on the Project
- Manufacturers' operating manuals for all the environmental monitoring equipment
- Current calibration certificates for all the equipment that requires calibration by an external organisation
- The latest version of this ESMP.

11.6.4 Non-Compliance Report

Any breaches of the acceptable standards specified, should be reported to the ESMU / ESIC (dependent on project phase), using a standard form, i.e. a Non-Compliance Report (NCR).

A copy of each completed NCR should be held on file by the ESMU, to be replaced by the reply copy when it is received. A record of corrective actions should also be made and tracked to their completion.

11.6.5 Monthly and Quarterly Reports

The ESMU and N-ESMU team environmental engineer(s) should prepare a monthly and a quarterly report for issue to the Project General Manager. These reports should summarize the following:

- Progress in implementing this ESMP
- Findings of the monitoring programmes, with emphasis on any breaches of the control standards, action levels or standards of general site management
- Any emerging issues where information or data collected is substantially different from the baseline data reported in the ESA
- Outstanding NCRs
- Summary of any complaints by external bodies and actions taken / to be taken
- Relevant changes or possible changes in legislation, regulations and international practices.
- Any trainings conducted.

11.6.6 Training Records

Records of all training provided and the associated attendees should be maintained in line with the requirements of an ISO 14001 Environmental Management System.

Staff should complete and sign an attendance sheet for all courses attended, including the staff awareness training. It would also be prudent to ask staff to complete a course evaluation sheet at the end of each course in order to assess the effectiveness of the training delivered.

All records, including the course evaluation sheets and attendance sheets, should be held centrally, possibly by the Human Resources Team or the Environmental Officer.

11.7 Grievance Redress Mechanism

Grievance Redress Mechanism will be set up for the project to deal with both land acquisition and construction related grievances. Three level of grievance redress committees (GRC) will be established – at village level, project level, an independent headed by a retired judge. The aim of the Grievance Redress Mechanism and Committees is to provide the mechanism whereby any displaced persons who are dissatisfied with their entitlements can seek redress. However, with careful observance of the provisions of the RAP by all stakeholders involved, grievances should be avoided.

If necessary, the aggrieved displaced person will first approach the village level committee through ESMU, whose officers will strive for an informal settlement within 10 days of lodging of the complaint. If the complaint cannot be settled, the grievance will be referred to the Land Acquisition Collector (LAC member of the subproject level grievance committee for all land, trees and crops compensation related matters).

The LAC will have to address the complaint within 15 days. If the complaint still remains unresolved, it can be re-lodged by the displaced person within one month to the Program level GRC headed by the General Manager NTDC. If the grievance redress mechanism fails to satisfy the aggrieved displaced person, they can submit the case to the appropriate court of law as set out in Sections 18 to 22 of the LAA (1894).

The grievances will be attempted appropriate resolution in the following manner.

Table 11.8: Grievance resolution process[49]

Land/crops compensation issues	Project/other items compensation issues
1. First, complaints resolution will be attempted at village level through the involvement of the ESIC, NGO and informal mediators.	1. First, complaints resolution will be attempted at village level through the involvement of the ESIC, NGO and informal mediators.
2. If still unsettled, a grievance can then be lodged to the LAC who has 30 days to decide on the case.	2. If still unsettled, a grievance can be lodged to the PIU/ESIC, which will have 30 days to respond.
3. If no solution was reached a grievance can be lodged to the PMU. The AP must lodge the complaint within 1 month of lodging the original complaint with the LAC and must produce documents supporting his/her claim. The PMU will provide the decision within 21 days of registering the complaint. The PMU decision must be in compliance with this LARF provisions.	3. If no solution was reached a grievance can be lodged to the PMU. The AP must lodge the complaint within 1 month of lodging the original complaint with the LAC and must produce documents supporting his/her claim. The PMU will provide the decision within 21 days of registering the complaint. The PMU decision must be in compliance with this LARF provisions.
4. Should the grievance redress system fail to satisfy the AP, they can further submit their case to the appropriate court of law as per the process set out in Sections 18 to 22 of the LAA (1894).	4. Should the grievance redress system fail to satisfy the AP, they can further submit their case to the appropriate court of law as per the process set out in Sections 18 to 22 of the LAA (1894).

11.7.1 Confidentiality and Anonymity

The Project will aim to protect a person's confidentiality when requested and will guarantee anonymity in any public reporting. Individuals will be asked permission to disclose their identity. Investigations will be undertaken in a manner that is respectful of the aggrieved party and the principle of confidentiality. The aggrieved party will need to

[49] In case of subprojects in tribal areas the process will instead include: (stage 2) appeal to the deputy political agent; (stage 3) appeal to the Political agent through the Jirga, and (stage 4) appeal to the court.

recognize that there may be situations when disclosure of identity is required for processing claims and the Project will identify these situations to see whether the aggrieved party wishes to continue with the investigation and resolution activities.

11.7.2 Construction Related Grievance Reporting and Resolution

Grievances will be logged in a formal logging system. This will be the responsibility of a staff member with community liaison officer responsibility. People may register grievances by contacting the CLO or reporting to their village representative. Contact details for the CLO will be included in appropriate project communication materials. The CLO will classify grievances according to **Table 11.9.**

Table 11.9: Grievance Classification Criteria

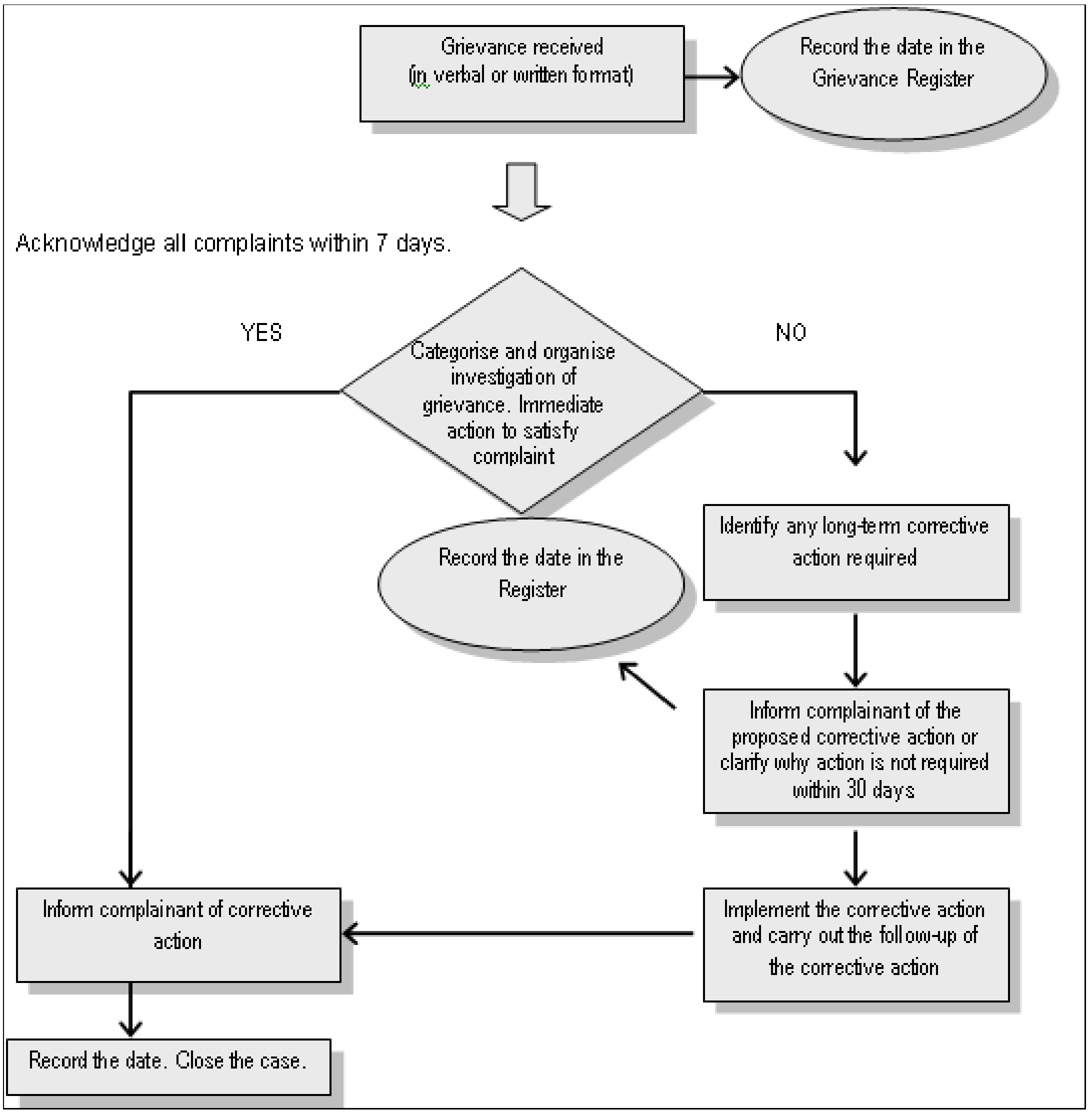
Classification	Risk Level	Response
Comment (not a grievance)	None or low	CLO to identify whether the comment can be answered or the request can be accommodated. If it can, an action plan to implement will be developed.
Low	None or low	CLO will conduct an investigation, document findings and provide a response.
Medium	Possible risk and likely a one off event	CLO and an appropriate investigation team will conduct an investigation. The Site Manager or Occupational Health and Safety Manager may decide to stop work during the investigation to allow the corrective preventive actions to be determined. The CLO will provide a response.
High	Probable risk and could reoccur	CLO will get the contractor to organise a Major Investigation Team for prompt investigation and resolution. Work may be stopped in the affected area. The CLO will provide a response.

Where investigations are required, project staff and outside authorities as appropriate, will assist with the process. The CLO will collaborate with its management to identify an appropriate investigation team with the correct skills to review the issue raised. Investigations will aim to identify whether the incident leading to the grievance is a singular occurrence or likely to reoccur. Identifying and implementing activities, procedures, equipment and training to address and prevent reoccurrence will be part of the investigation activities.

The CLO will explain in writing or orally in person (especially where literacy is an issue) to the complainant the review process, the results, and any changes to activities that will be undertaken to address the grievance and how the issue is being managed to meet appropriate environmental and social management standards. In some cases it will be appropriate for the CLO to follow up at a later date to see if the person or organization is satisfied with the resolution or remedial actions.

The CLO will summarize grievances weekly during construction. The procedure will be at no cost and without retribution to project affected persons and stakeholders. The procedure for processing grievances is depicted in **Figure 11.2**.

Figure 11.2: Grievance Process



11.8 ESMP Implementation Cost

11.8.1 Indicative Budget

The overall indicative total E&S budget for construction, assuming a construction period totals USD 4.7m. An E&S budget for a typical operational year has also been considered and is estimated at USD 0.8m. **Table 11.10** shows the budget distribution over the different areas covered in this ESMP. The total for construction will be required to be split appropriately into annual budgets. For both construction and operational budgets it is important to note that at the beginning of each phase a more significant proportion of that phases' budget will be required in order to cover the planning and set up costs.The tentative cost estimates for cost of land acquisition for grid station, transmission line andcommunity development activities to be USD 19 million (USD 14 million for grid station, USD 3 million for transmission line, and USD 2 million for community development programs),

Table 11.10: Indicative ESMP Budget (m USD)

ESMP Budget (million USD)	**Construction (Total)**	**Operation (annual Total)**
Implementing the suite of environmental and social management plans set out in **Table 1.4**	1.0	0.1
Environmental and social monitoring as set out in **Table 11.5**.	0.5	0.1
Environmental staff (N-ESMU, C-ESMU, E-ESMU, ESIC, External ESMU auditors)	1.0	0.1
Establishing and maintaining ESMU plans, procedures and management systems (including ESIC and N-ESMU team IT equipment)	0.2	0.1
Environmental and social enhancement measures*	0.5	0.1
E&S training and capacity building	0.5	0.1
Contingency	1.0	0.2
TOTAL	**4.7**	**0.8**

*Identification of environmental and social enhancement measures not part of present scope but allowance included

11.8.2 Reallocation of Funds / Update of Budgets

A number of costs have been estimated on the basis of the information available at the time of the preparation of the ESA documentation. It is expected that the cost associated with some measures may change. Although a provision was always made when the budget was prepared, it is possible that budgets allocated prove to be either under-estimated or over-estimated. NTDCwill propose twice per year an update of the overall environmental and social budget with suggestions on the way to reallocate funds. These suggestions will be presented to lenders for review.

12 Consultation and Disclosure

This Chapter explains the stakeholder engagement process followed throughout the ESA. Stakeholder engagement was carefully planned and based on the principles of respectful and meaningful dialogue. Stakeholder opinions were sought with regards to baseline information sources, assessment methods, impacts, mitigation and enhancement measures and the draft power generation ESA findings.

Stakeholder engagement activities have been undertaken in compliance with Pakistan environmental law and related requirements as well as applicable World Bank policies. The legal and regulatory framework makes adequate provisions for public consultation and disclosure. The legal requirements provide the entry points for effective stakeholder engagement throughout the ESA process and subsequent Project implementation.

12.1 Stakeholder Engagement Objectives

The Government of Pakistan (GoP) as well as international donors (e.g. the World Bank) place great importance on involving primary and secondary stakeholders for determining the environmental and social impacts associated with project implementation. In order to gather local knowledge for baseline, understand project affected person's perceptions regarding impact significance, and propose meaningful mitigation measures, participation of stakeholders has been part of the Project ESA process. An attempt has been made to consult with a full range of stakeholders to obtain their views on project interventions.

The logic behind stakeholder consultation is that a project proponent has shared with all stakeholders' relevant information on the project interventions including potential environmental and social, (positive and negative) impacts. The consultation process consists of initiating dialogues among all the stakeholders. The process, starting from awareness campaign to the identification, inclusion and participation of project affected persons (PAPs) has been able to build on the existence of the Tarbela Dam which is now a normal part of local communities' lives. PAPs and stakeholders are generally able to understand the implications of the Project activities.

The present ESA has been prepared afterconsulting with local communities, non-governmental organizations (NGOs) and concerned government departments/ organizations dealing particularly with related fields and to ensure that their views and concerns have been taken into account in the study.

The following objectives have served as the moving force for the design, implementation and fact findings for participation process:

- To provide key project information to, and create awareness among, various stakeholders about project interventions and the ESA process;
- Providing engagement opportunities to ensure that the benefits of the Project are maximized and that no major potential impacts have been overlooked;
- To begin establishing communication and an evolving mechanism for the resolution of social and environmental problems at local and project level;
- To have interaction for primary and secondary data collection with project affectees and other stakeholders;
- Obtaining local and traditional knowledge to inform the ESA process;
- Identifying issues of concern to stakeholders so these can be addressed appropriately within the ESA process;

- To receive feedback from stakeholders on mitigation and enhancement measures for environmental and social impacts and verifying their significance;
- Managing expectations and misconceptions regarding the Project.

12.2 Stakeholder Engagement Activities – Power Generation Component

At the start of the ESA, a stakeholder identification exercise was undertaken to identify key stakeholder groups, and organizations. Because the Project is already in existence, most stakeholders are well-known and the ESA consultations were able to build on existing stakeholder relationships. Stakeholders are considered to be individuals or organizations which have an interest in the Project or knowledge that would provide insight into Project issues or affect decision making related to the Project.

During scoping, meetings with a range of governmental, non-governmental organizations, and local community members were organized. Ten public consultation meetings were held in different villages located within the Project AoI (**Table 12.1**). The scoping public consultation meetings were attended by 117 people representing a range of interests.

Table 12.1: Summary of consultation meetings during scoping

Village	District	Date	Number of participants
Pontian	Swabi	December 2014	09
Ghazi Hamlet	Haripur	December 2014	13
Mohalla Zakoo – Topi	Swabi	December 2014	14
Pehure Hamlet	Swabi	December 2014	11
Dera Mohat	Haripur	December 2014	06
Galla Hamlet	Swabi	December 2014	17
Left Bank Colony	Swabi	December 2014	08
Right Bank Colony	Swabi	December 2014	20
Ghari Mera	Haripur	December 2014	13
Kukur Chawa	Haripur	December 2014	06
Total			117

During the detailed ESA, individual meetings with stakeholders were held and14 focus groups were organized. **Figure 12.1** shows the locations of the villages where consultation activities were organized. See **Table 12.2** for a summary of participation in the focus group meetings. Table 12.3provides details of the consultation results and topics covered.

Figure 12.1: Location of consultation meetings (Power Generation Components)

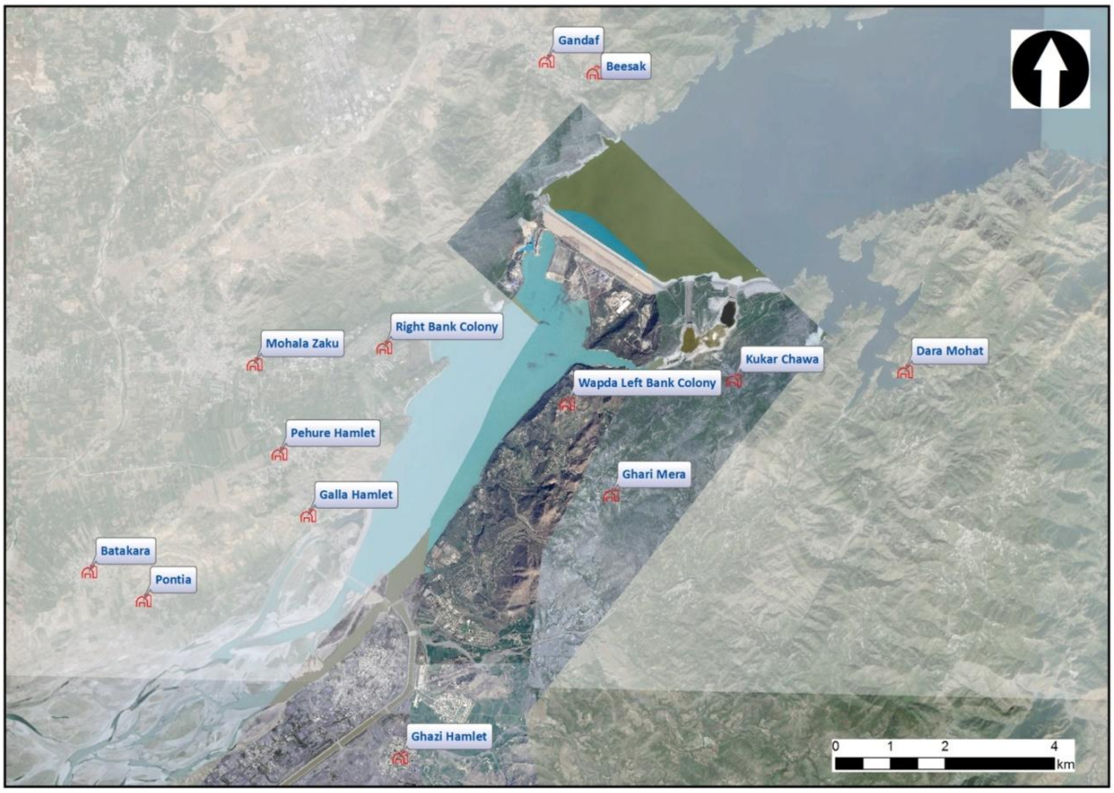


Table 12.2: Focus group meetings

Village	District	Date	Number of participants
Pontian	Swabi	January 2015	15
Ghazi Hamlet	Haripur	January 2015	54
Mohalla Zakoo – Topi	Swabi	January 2015	24
Pehure Hamlet	Swabi	January 2015	11
Dera Mohat	Haripur	January 2015	18
Galla Hamlet	Swabi	January 2015	16
Left Bank Colony	Swabi	January 2015	26
Gandaf	Swabi	January 2015	40
Beesak	Swabi	January 2015	23
Batakra	Swabi	January 2015	30
Right Bank Colony	Swabi	January 2015	21
Ghari Mera	Haripur	January 2015	35
Kukur Chawa	Haripur	January 2015	18
Khabble	Haripur	January 2015	04

Consultation with women during power generation ESA Stage			
Dera Mohat	Swabi	January 2015	06
Gandaf	Swabi	January 2015	11
Beesak	Swabi	January 2015	09
Batakra	Swabi	January 2015	13
Ghari Mera/ Kukur Chawa	Haripur	January 2015	13
TOTAL			387 (52 Females and 335 Males)

Table 12.3: Summary of stakeholders' consultation activities

Organisation or Stakeholder name and type of stakeholder	Issues discussed and information shared	Location and Date
Scoping Stage		
World Wide Fund for Nature (WWF) - NGO	• Consultants briefed the participants about the project • There is no protected area around the Tarbela Dam • There are some known important habitat sites in the route of transmission lines but WWF can confirm after the consultants provide us the exact coordinates of the route • WWF has no information on flora and fauna of the Project area for the powerhouse • WWF has never conducted detailed survey of the Project area for power house	Lahore, November 2014
Environment Protection Agency (EPA) Punjab - Government	• Consultants briefed the participants about the project • EPA explained that the consultants have to submit the ESIA to both EPAs Punjab & Khyber Pakhtunkhwa (KP) because the transmission line falls in both provinces. They have provided an NOC for a similar situation where the Project area was falling in more than one province • Punjab EPA does not have specific guidelines for transmission line but KP EPA has drafted EIA guidelines for transmission lines • There are no transmission line separation distances specified in the guidelines; however it was stated that NTDC uses 12-15m from centre line on either side.	Lahore, November 2014
Institute of Social and Cultural Studies, University of the Punjab, Lahore – Research Institute	• Consultants briefed the participants about the project • The Institute does not have any information about the Project but are informed about T4HP • The department is providing consultancy as a third party in resolving the resettlement legacy issues as proposed in legacy report of T4HP • The department is also providing feedback on occupational health and safety issues of labourers in T4HP. Their team has regular contact with labourers to check the compliance of labour laws in T4HP by the contractor • 41 of 228 resettlement issues have been resolved to date with out of court settlements	Lahore, November 2014

	• They received complaints about working on holidays and all the issues relating to it were investigated by their team and they found no evidence • They have not found any evidence of child labour at T4HP • Other labour issues at T4HP include: – Poor hygienic and ventilation conditions of the labour camp – No arrangements to kill mosquitoes in labour camp – Food quality – Insufficient medicines (quantity) provided by doctor.	
Environmental Social Team of T4CJV – Project	• Consultants briefed the participants about the project • Air, drinking water and surface water quality tests are conducted on biannual basis by the contractor using the services of SUPARCO • Noise monitoring is done on weekly basis using the portable meter • All parameters tested to date are well within the permissible limits of NEQS	Tarbela, December 2014
Environmental Social Team WAPDA – Project	• Consultants briefed the participants about the project • Stated that the village Gandaf should be consulted during ESIA • Stated that the condition of the T4HP labour camp is not good, so the consultants should propose construction of new labour camps in the T5HP Project ESA • No migratory birds have been seen to date	Tarbela, December 2014
Environmental Social Team Sino-Hydro (Contractor) - Project	• Consultants briefed the participants about the project • Health and Safety (H&S) awareness in local staff was raised as the main issue • Stated there is difficulty in finding safety conscious staff • Stated that no fish have been killed or trapped during the construction of the coffer dam both up and down stream of dam	Tarbela, December 2014
Child Protection Bureau (Swabi) - Government	• Consultants briefed the participants about the project • The Department ensures that the no child labour is working on any project within the district. • To date no visit has been conducted at the T4HP site to check any violation of the child labour laws. However, the department had planned a visit to the project and was waiting for approval.	Swabi, December 2014
Sungi Foundation (Swabi) - NGO	• Consultants briefed the participants about the project • Sungi foundation is working on a reforestation project near the Gandaf area about 7km upstream of the Project area • In the nearby District Topi the Sungi foundation is working on women's right to vote	Tarbela, December 2014
Fisheries Department Swabi KP - Government	• Consultants briefed the participants about the project • 5km upstream of dam at Jahangira village the reservoir is auctioned every year for fishing right for one season • Stated that fish found in the Project area include swati, china carp, mahseer, silver carp, brass, rahu and mari	Swabi, December 2014
Wildlife Department Topi KP - Government	• Consultants briefed the participants about the project • Stated there is no protected area within or in the immediate vicinity of the Project area • No migratory birds have been spotted in the Project area or its surroundings • No species of IUCN categorization is found in the Project area	Swabi, December 2014

Power generation ESA Stage		
Environmental Social Team of T4CJV - Project	• Stated that it should be ensured that ESMP is made part of the contract document • Stated that full time inputs of E&S staff of contractor and the engineer should be mentioned in the ESMP including the staff number in order to ensure proper implementation of the ESMP	Tarbela, January 2015
Environmental Social Team WAPDA - Government	• Training programs should be included in the ESMP • WAPDA team should receive training on ESMPs • It should be ensured that the ESMP is made part of the contract document	Tarbela, January 2015
Ghazi Brotha Tarqiati Idara (GBTI) - NGO	• Consultants briefed the participants about the project • GBTI is providing soft loans to women in the Attock district to buy sewing machines and goats in order to increase their income level • No project is currently being carried out in Tarbela area by GBTI	Hattian, January 2015
Social Welfare Department - Government	• Consultants briefed the department about the project • Stated that more projects should be built like this as projects such as T5HP create job opportunities in the area • The department does not interfere in WAPDA projects as it is a federal department. • To date no visit has been conducted by the department of Tarbela area or T4HP site as WAPDA is a federal department and the area is restricted • The department will conduct a site visit to T4HP or T5HP if any complaint is received and subject to authorization of the District Coordination Officer (DCO)	Swabi, January 2015
Directorate of Fisheries (WAPDA) - Government	• Consultants briefed the department about the project. • The official informed that fishing is not allowed in an area covering 5km upstream and 7km downstream of the Tarbela Dam • In some special cases a one day pass can be issued allowing five fish to be caught in the Ghazi barrage pond near the GM office. The person is not authorised to fish from any other sites. • WAPDA fisheries directorate is no longer owner of the fish as this has been transferred to provincial department. • Fish found in the Tarbela reservoir include china carp, silver carp and brass.	Tarbela, January 2015
Fisheries Department - Government	• Consultants briefed the participants about the project • The stretch of the Indus River from Tarbela dam to Ghazi Barrage is not controlled by fisheries department due to security reasons • Department boundary starts from 5km upstream of Tarbela dam • 5km upstream of dam at Jahangira village the reservoir is auctioned every year for fishing rights for one season • Stated that fish found in the Project area include swati, china carp, mahseer, silver carp, brass, rahu and mari	Haripur. January 2015
Wildlife Department - Government	• Consultants briefed the participants about the project • Confirmed that no protected area established by the wildlife department exists in Ghazi Tehsil • During March and April the migratory birds leave the country	Haripur, January 2015

	and return during September and October	
Forest Department - Government	• Consultants briefed the participants about the project • Confirmed that no protected area established by the wildlife department exists within Haripur District • The trees alongside the national & provincial highways and local roads are the property forest department only in the district • The department will be willing to cooperate where the exact locations of transmission line towers and corridor is provided officially to the divisional officer in Abbottabad • The department also helps to determine the schedules rates of government and public trees if requested • Every year new saplings are planted alongside roads and canals	Haripur, January 2015
Education Department - Government	• Consultants briefed the participants about the project • Stated that these types of project bring income into the area and benefit the whole community	Haripur, June 2015
Health Department - Government	• Consultants briefed the participants about the project. • In T4 the project has provided one Basic Health Unit (BHU) to the health department in Ghazi Mera which is a good initiative • T4HP and T5HP are in the same area and the closest villages are Ghazri Mera and Kukar Chawa and provision of BHU has really helped the local population as there was no dispensary in this area before • During T4HP no burden has been placed on the local hospital in Ghazi as the labour has been provided its own health facilities and the WAPDA hospital is used for serious cases	Haripur, June 2015
District Administration Haripur - Government	• Consultants briefed the participants about the project • The department is informed about the T5HP project as WAPDA has requested extra security for foreign employees • Stated that job preference should be given to local people	Haripur, June 2015
Local Government Haripur - Government	• Consultants briefed the participants about the project • Stated that job preference should be given to local people • Stated that a job quota should be fixed for the local population	Haripur, June 2015

12.3 Stakeholder Engagement Activities – Power Evacuation Component

12.3.1 Consultations with Primary Stakeholders

For the power evacuation component of the T5HP project, stakeholder engagement was achieved with the help of focused group discussions, informal meetings, and individual meetings with the primary stakeholders, and formal meetings with institutional stakeholders. **Figure 12.2**shows the location of the community consultation carried out for the power evacuation facilities of T5HP; details of these meetings and discussions are provided in **Table 12.4.**

Figure 12.2: Location of consultation meetings (Power Evacuation Components)

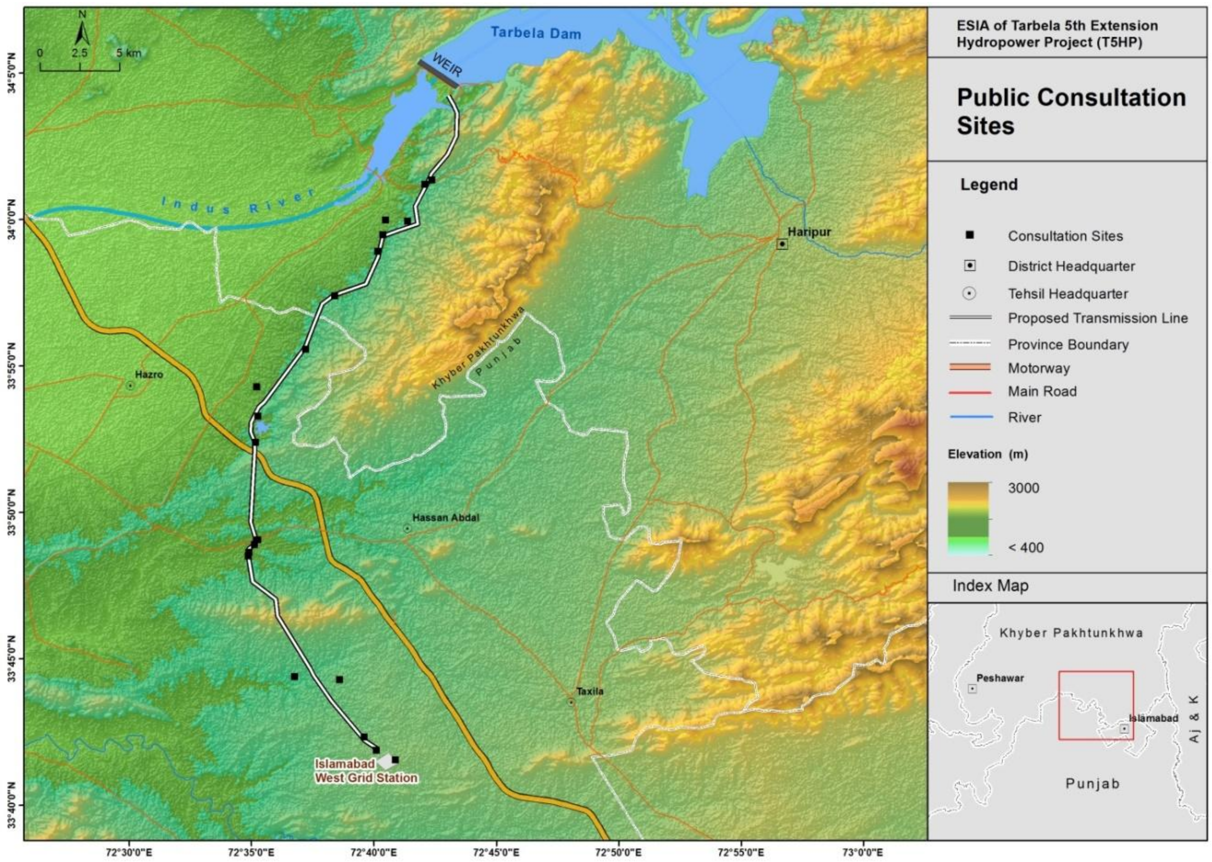


Table 12.4: Grassroot Consultations Conducted for Power Evacuation Facilities

Name Participants	Location	Main Concerns/Discussion Pints	Date
Mohammad Maqsood, Mohammad Akhtar Muhammad Shakeel Muhammad Ismail Khan Afsar Tariq Mahmood Allah Ditta Bahadur Khan Mohmand Khan	Kamalpur Manyan (grid station site), an FGD session has been conducted for assessing the proposed grid construction environmental impacts as whole and physical impacts in particular.	• Towers will occupy their agricultural land • Fears regarding electrocution risk especially during rain. • Need to avoid houses and not to pass by any residential area • Land compensations must be given • Working opportunities should be provided to the locals as laborers • Proper compensation must be given if trees are to be cleared • Natural drains system should not be disturbed, as this can cause a check dam like structure which could cause flooding to the agricultural fields • The grid station and transmission line construction activities should not disturb the land formation to avoid soil erosion and land cutting. • The grid station will damage the aesthetics of the area. • Land value will decrease. • Agriculture is the only source of livelihood for the local people. So, even if compensation is provided, it	12 November 2015

		would not suffice.	
Banaras Khan, Hukam Khan, Mohammad Yusuf	Bahtar Mera	• High winds in the season, damages crops and houses, may create problems for the transmission line as well. • A stream crosses the fields but remains dry most time of the year. • Compensation of the damage to the crops during construction activities should be given. • Compensation should be given to the land owners. • The generated power should also be distributed to the villages near the transmission line. • The already bad condition of the roads may get worse due to construction activities. • Transmission lines should not be near houses and buildings.	13 November 2015
Ghulam Qaisar	Pind Sahab Khan	• If the land is to be used for transmission lines then proper roads should be built for the village.	14 November 2015
Abdul Hakim Mehboob Ilahi Ghulam Qadir Noor Bakhs Khan Nawaz	Burhan (Burhan is a village along the transmission line ; GT road is crossing proposed transmission line in front of Burhan village)	• Generally the project is for national interest but locals are optimistic that this will be beneficial for them also. • The Transmission line should not be in close proximity of the houses. • Where passing near to the houses, proper height must be maintained • Electricity to the local villages should be given. • Land compensation should be given. • Working opportunities must be given to locals, if possible. • Trees compensation should be given if required by the proposed transmission line	14 November 2015
Manzoor Ahmad Zahor Ali Aksar Ahmad Raza Yaqoob Khan Sultan	Qibla Bandi (a village near transmission line, Qibla Bandi access roads will be crossed by the proposed transmission line)	• Transmission line should not pass through residential house • Geologically stable areas should be chosen for towers to avoid tilting/falling and avoid any mishap in the future • Tower locations should be planned to avoid disturbance to the agricultural land and movements of agricultural equipment. • Provide fencing around the towers to prevent any mishap. • Access roads should not be damaged. • Access ways/roads should be improved as a developmental incentive for the local areas • Locals should be preferred for employment during construction. • The water level may rise due to dam extension that may cause damage to	15 November 2015

		fields and the transmission line.	
Gul Muhammad Sabz Ali Khan Rahmatullah Mir Bacha Gulbacha Raj Muhammad	Anjar Sar (a small village), proposed transmission line will pass through/near the village	• Transmission line should be away from population to minimize damage. • Electricity should be given to the local residents because currently there is no electricity. • Schemes and plans for drinking water should be incorporated in the plan because of water scarcity in the area.	17 November 2015
Jamshed Khan Muhammad Javed Bilal Umar	Kutab Bandi/ Dhok Khazana (a small village with widespread land, the houses will not be affected)	• No accident has been reported associated with existing transmission line. • The construction workers should not unnecessarily damage the vegetation and crops. • Minimum crop damage should be done as agriculture is the only source of livelihood. • Cropping damages should be compensated to owners during construction phase • Local laborers should be given priority during construction work	17 November 2015
Safdar Muhammad Jahandad	Gwari- Pakki Ban/ Kotera (a small village with widespread land, the houses will not be affected)	• A drinking water source should be provided because there is scarcity of water in the area. • Recent earthquake damaged some houses so transmission line owners must be constructed by using good quality of civil work to avoid any mishap in future.	17 November 2015
Zeeshan Ali Adnan Majid Khan Faizan Ali	Ghaara (a small village with widespread land, the houses will not be affected)	• The transmission line would destroy the landscape of the area. • Construction activities may cause some nuisance issues if construction waste is not properly managed. • As it is a high power line, it may be dangerous in the rain as other people have already experienced such case of getting induced current shocks.	18 November 2015
Muhammad Yamin Tabarak Hussain shah Abdul Rahman	Village Kher Bara/ Mohalla Bhera (a small village with widespread land, the houses will not be affected)	• Drinking water supply scheme is the most important for this village • Access roads are the water ways only, needs road facility • Health facility should be provided • Land is mostly barren and locals are earning their livelihood from labor works in the cities, so if possible the unskilled labor work should be provided to locals	18 November 2015
Shafqat Ali Fazal Baig Muhammad Ahsan Muhammad Khurshid	Hamlet Colony (Densely populated town/colony near the proposed transmission line. The	• Locals are using Gravity Springs for drinking water which should be protected from the damage and contamination. • Land is very costly as it is near to town, the proposed transmission line will adversely affect the value of land. • transmission line should not pass over	18 November 2015

	transmission line is passing between open spaces of houses)	any house • Qualified and skilled local people should be considered in the project as per their education and experience	
Abdul Tahir Hasham Khan Abdul Nazeer	Omar Khana (Omer Khana is the nearest village of Tarbela Dam, there are several existing transmission lines of 500kV and 132kV and the proposed line will also passing from this village)	• Land will be affected and so far they have not compensated for the previous transmission line, now they demand for transmission line. • School, health care facilities are the basic needs and demands • Due to steep slope the roads and access ways are damaged by flash rains, so they demand for pavement of them. • There is no solid waste management system in the village, but community can voluntarily designate site if project provide them boundary wall and collection facility. • Land sliding should be kept in mind when choosing tower locations. • If possible the existing towers should be used for the proposed transmission line • Locals should be given job opportunity in the proposed project • drinking water supply schemes should be provided	20 November 2015
Shahzada Khan Sabir Ali Muhammad Aslam Khan Bahadar Kashif Ali Khan Muhammad Imran	Near Islamabad West grid station site and Tower 34 and 35	• People of the area demanded employment share in the project. • Project site has many small land holders who are not willing to give their land as farming on this land is their only livelihood. • Bahter Mehra village is deprived of basic needs like water, drainage system and Sui gas. • People are demanding that land for tower must be acquired permanently by the authority.	16 November 2015
Sarwar Rehman Haseeb Hassan Haji Nawaz Zarhad Khan Shafat Ali Saad Azim Hassan Rehman Gul Shair Muhammad Rehman Haq Nawaz	Gari Mehra	• People of the area showed concerns about the electric shock hazards during rainy season. • People demanded that the land occupied by the towers should also be acquired permanently. • They showed concerns about the reduced land rates due to passage of transmission line and placement of towers as any construction activity is not allowed in the area of 30 m around the tower.	20 November 2015
Abdul Waheed Abdul Nazeer Abdul Tahir Hashim Khan Bibi Ansia	Umer Khana	• People of Umer Khana village strongly opposed the proposed transmission line passing over the village as there are already four transmission lines passing through that village.	18 November 2015

Akbar shah Muhammad Rehan Ishaq Khan Akhtar Zaman Haq Nawaz Aslam Hayat Munraiz Khan Zahoor Shah Muhammad Khursheed Muhammad Jamshaid		• Most of the people of the village are already affectees of Tarbela Dam and, according to them; they were not compensated or provided with any incentive. • People face problems in movement due to security issues. • Access way problems.	
Zahoort Ali Faizan Ali Adnan Ali Majid Ali Abrar Hussain Ghulam Hussain Nazar Ali	Ghara	• Concern of people for electric shocks during rainy season. • Right Of Way (ROW) should not affect houses and other assets. • People demanded proper compensation and basic social amenities especially Sui Gas	18 November 2015
Nazakal Ali Adil Ahmad Aqeel Ahmad Naseer Ahmad Zubair Khan Dil Nawaz Aqib Nawaz Muhammad Jamil Muhammad Anwar Waris Ali	Hemlet	• People of the area had issues like: o Improper water supply o Lack of health facilities o Lack of access to higher education o Lack of Sui Gas. • They showed concerns about the reduction in land rates due to passage of transmission line and placement of towers as any construction activity is not allowed in the area of 30 m around the tower and RoW of transmission line. • They suggested that, NTDC should design an alternate route along-with Ghazi Brotha Canal instead of the proposed transmission line route.	18 November 2015
Matee-ur-Rehman Muhammad Naveed Gohar Rehman Tabarakh Hussain Muhammad Amin Abdur Rehman	Bera	• People demanded that the land occupied by the towers should also be acquired. • They argued that NTDC should acquire land permanently. • People demanded basic social amenities like water supply, health facilities, higher education, gas, etc. • They opposed the project.	18 November 2015
Mazhar Khan Haq Nawaz Zahid Khan Muhammad Khan Ajib Noor Qadar Zaman Sher Rehman Muhammad Nisaf Sardar Ahmad Amanat Ali	Dhamraee	• People of Dhamrai village had severe social and ethnic issues with Afghan Mohair people. They wanted to get them out from their village. • They also showed concerns about electrical shocks and other electrical hazards from extra high voltage transmission line as two or three electricity accidents had occurred there. • Village had no access road.	18.11.2015

Sajawal Khan Tqriq Khan Zulifqar Ali Aksar Hayat			
Attiq-ur-Rehman Manzoor Elahi Mumtaz Elahi Alam Zeb Muhammad Ahsan Yasir Nawaz Rayasat Shah Zeeshan Ali	Bharwasa	• People were not agreeing on the proposed transmission line route, as they were already planning to construct a housing society under the transmission line route.	20.11.2015
Muhammad Naeem Muhammad Ibrahim Imran Ali Muhammad Riaz Khan Muhammad Pervaiz Ali Abid Mehmood Haider Zaman	Pakki Bann	• Area from where the proposed Transmission line has to pass had small land owners whose livelihoods will be badly affected. • The land where tower has been placed will lose its market value and also production capacity. • The people of the area demanding basic necessities in the village like Hospitals, schools, and employment in the proposed project.	19.11.2015
Muhammad Nawaz Nazakat Ali Muhammad Ayaz Anser Khan Muhammad Aziz Liaquat Ali Muhammad Siddique Naeem Khan Muhammad Amin	Qutab Bandi	• Villagers of Qutab Bandi are conditionally agreed on the proposed project only if the development of the village will be given priority. • People were demanding basic amenities for the villages like educational and health. • People had issues on transmission line as there are some cases reported in that area of getting electric shock from the previous transmission line.	19.11.2015
Muhammad Rayyasat Amjad ali Muhammad Farooq Muhammad Arif Mubarakh Khan Muhammad Ishaq Sajid Ali	Dhok Garh (Gujran)	• People are willing for the proposed project if the proper compensation is being provided. • Up gradation of the village is also demanded.	19.11.2015
Zulifqar Bhutta Saif ur Rehman Aziz Khan Arshad Khan Muhammad Bashir Luqman Ali Fazal Haq Sajid Ali	Qibla Bandi	• Mostly people in the area had no major issue with the transmission line except protecting residential areas. • Facilities like Sui gas are not available in the village. • Village is deprived of the access road.	20.11.2015
Saleem Ahmad Khan Muhammad Muhammad Sabbir Sohail Mahmood	Noorabad	• People showed concerns over electric shock due to high voltage transmission line. • Villagers were demanding employment opportunities for the	20.11.2015

Abdur Reham Matloob Ali Sadaquat Ali Muhammad Ayaz Muhammad Zaheer		locals as there was a lot of unemployment in that village. • Primary schools were there in the village but there is strong need for the high schools for both Boys and Girls. • There was also issue of access road to the village.	
Zubair Ali Muhammad Arif Karim Elahi Sabir Khan Pervaiz Khan Abrar Khan Muhammad Aslam Malik Sadaqat	Burhan	• Villagers were opposing the project because the land from where the transmission line is planned was proposed commercial land as it was on the edge of the main GT road. • Some housing societies were also planned on the proposed land and transmission line will create problem for them. • The village has small land owners whose livelihood will be badly affected by the proposed project.	20.11.2015
Ameer Afzal Tanveer Ali Naveed Ahmad Muhammad Mumtaz Khan Dil Nawaz Rizwan Ali Muhammad Shahzad Basharat Ali Mehmoob Ali Rehmat Ali Zaheer Ali Shahzeb Khan	Dhok Khaliq Dad	• Provide and upgrade the basic necessities like sewerage system, electricity, Sui gas, employment opportunities, schools and health facilities.	20.11.2015
Iftikhar Ali Muhammad Safoor Doctor Zubair Azim Kham Muhammad Nawaz Khan	Kamal Pur Maiyan	• The land is agricultural and productive and only source of income for the mostly villagers. • Mostly small land owners are involved; whose only source of livelihood is agriculture/ farming. • A large portion of the land to be acquired is disputed. • Most of the people disagreed to sell the land.	21.11.2015

12.3.2 Consultations with Institutional Stakeholders

Details of consultations carried out with key departments are presented in Table 12.5below.

Table 12.5: Institutional Consultations Conducted for Power Evacuation Facilities

Department	Contact person Details	Comments	Date
Federal EPA	Muhammad Ahsan Rafi Kiani- Deputy Director (EIA/Mont)	• In case of transmission line the EPA Khyber Pakhtunkhwa (KPK) should also be consulted, as major part of transmission line will occupy the KPK province territory • Impacts on migratory birds should	28-11-2015

		not be overlooked. • Buffer zone must be present to avoid EMF. • As the Project area falls into two of the provinces, EPA's of respective provinces should be involved. • Game reserves or national parks should be protected. • Costing of mitigation measures should be employed in the report. • EMP monitoring team must be prepared. • The area affected by the project must be given some benefits, e.g. water schemes and provision of small health centres.	
National Highway Authority (NHA)	Fareeha Mumtaz Malik-Director (Environment)	• The transmission line should be at a proper height from the road. • Safe overhead distance must be provided. • Eucalyptus trees are abundant near Burhan area of the GT road, which will need cutting. So, 10 trees should be planted for every single tree that needs to be cut down. • EMF effects should be kept in mind. • The premises of motorways should be maintained clean and there should be a proper plan for Solid Waste management. • Should have proper management plan for any liquid spills from the construction work of transmission line. • The crossing point at motorway is of hilly topography so the slope should not be disturbed to avoid landslides creations near the motorway. • Tower points should not hinder the drains constructed by NHA and also the natural drainage should also be kept reserved.	1-12-2015
National Highway Authority	Atta-ul-Mohsin	• The towers should be located away from right of way (ROW) both at Motorway and GT road crossing points to avoid problems to the future expansion planning. • Maximum height should be maintained to avoid electric currents to tall vehicles on motorway in rains • All sites should be cleared once the construction work is complete for transmission line in the vicinity of motorway • Precipitation factor should be kept in mind while deciding the overhead safety distance.	

12.4 Public Consultations

Two public consultations were organized by WAPDA and NTDC at Ghazi. Details of these consultations are given in **Table 12.6**. Information regarding the public consultations was published in the daily newspapers both in Urdu and English languages. Findings of ESA reports are disclosed in these consultation meetings. List of participants of these meetings are given **in Annex 6**.

Table 12.6: Details of Public Consultations

Date	Location	Number of Participants
December 31, 2015	Ghazi (near Tarbela)	152
January 1, 2016	Kamalpur Maiyan (near grid station site)	57

Figure 12.3: Photographs from the public consultation meetins

12.5 Summary of Issues Raised

The issues raised in the public meetings and focus groups are identified in **Table 12.6**.

Table 12.7: Summary of Key issues raised during the consultations and plans to address these issues

Issues raised	Main comments	Stakeholders who raised comments	How they have been addressed in the power generation ESA
Job preference to local people	Job preference shall be given to local people. Hiring process shall be open and transparent and hiring committee shall include participants from every village nearby.	People of Kukar Chawa, Ghari Mera, Ghazi Hamlet, Gala Hamlet, Pontian, Batakra and WAPDA Left, Right Bank Colonies, Kamal Pur Mayian, Bahtar Mehra, Pakki Ban, Noorabad and, Dhoke Khaliq Dad.	This recommendation is included in the ESMP. The contractor will be contractually bound to disclose the "Recruitment Policy" that specifically includes a requirement to prioritise local employment for unskilled and semi-skilled positions that become available.
Lack of health and educational facilities in the area	WAPDA should help in the up gradation of educational and health facilities in nearby villages.	People of Kukar Chawa, Ghari Mera Ghazi, Dhoke Khaliq Dad, Qutab Bandi Kamal Pur Mayian and, Bahtar Mehra,	T4HP is currently implementing a community development programme focusing on health and education. Similar programs will be continued in T5HP.
Polluted drinking water	WAPDA should arrange clean drinking water in nearby villages.	People of Kukar Chawa, Ghari Mera and Ghazi.	The T4 community development programme includes installing drinking water schemes (filtration plants) at Darra Mohat, Kukar Chawa, Ghazi Hamlet and Topi Area. It also is installing sewage equipment at Ghazi, Pehure, and Topi. Similar programs will be carried out under T5HP.
Risk of traffic accidents during construction phase of the project	WAPDA should rehabilitate the old roads to be used during construction phase to avoid traffic hazards to local community	People of Ghazi Hamlet.	Traffic management plan will be implemented during construction. The access roads damaged by the construction activities will be restored.
Access to Villages	WAPDA should allow easy access	People of Kukar Chawa, Ghari Mera,	Tarbela is not able to change access issues because of

Issues raised	Main comments	Stakeholders who raised comments	How they have been addressed in the power generation ESA
	to villagers living in Kukur Chawa and Ghari Mera by providing them the security passes. Especially relaxation should be given in case of emergency.	Minar Kot and Ghazi.	security reasons.
Payment of land compensation	Compensation should be provided for the affected land of both grid station and transmission line	People of Kamalpur Manyan, Burhan, Qila Bandi, Dhoke Khaliq,Umer Khana, and Bharwasa	Compensation will be paid for all the affected land
Transmission line should avoid settlements	The design of transmission line should be such that the houses and settlement should not be affected	People of Kamal Pur Burhan, Qila Bandi, Hamlet Colony	The transmission line alignment will be designed to avoid settlements to the maximum extent possible (2016-2017).
Electrocution concerns	People were concerned regarding electric shocks especially during rainy season.	People of Kamal pur Manyan, Burhan, Ghaara, hamlet Colony, Piplian, Umar Khana, Noorabad	The height of the transmission lines will have a clearance of 9.0m when passing over any structure in order to avoid potential damage from electric fields.
Grid Station site should be changed	There are many other sites available for grid station	People of Kamalpur Manyan	The grid station site has been selected after evaluation of three potential options
Existing transmission line should be used	At present there are existing four transmission lines which could be used for electricity evacuation without having to construct a new one.	People of Kamal pur Manyan, Burhan, Ghaara, hamlet Colony, Umar Khana, Noorabad	The option of using existing transmission lines were also studied, but this option is selected based on technical feasibility and also considering the overall power sector development in the country (development of a new grid station at Islamabad for Dasu and other hydropower projects).
Impacts from	Agricultural lands were affected by	Public consultation	ESA has recommended further studies to understand

Issues raised	**Main comments**	**Stakeholders who raised comments**	**How they have been addressed in the power generation ESA**
Tarbela and Ghazi Barotha projects	Ghazi Barotha canal. On the left bank water logging is the problem, and on the right bank there is water scarcity. Sewerages from WAPDA colonies are polluting the river water		the impacts of downstream impacts of Tarbela and Ghazi Barotha, and to develop appropriate mitigation plans (2016-2017).
Support for development of local area	Roads, drinking water and sewerage facilities, hospitals, parks, access to Sui gas facility, schools, job opportunities, training and skill development,	Public consultations	Social development activities will be continued under T5HP (2016-2020).
Pending Claims	Many cases of compensation are still remaining unresolved. The land acquired originally for Tarbela for borrow areas are no longer in use and should be returned to affectees	Public consultations	Resettlement Claims Committee will be re-established under T5HP (2016-2017).
Compensation for land acquisition	Adequate compensation should be paid to local people to re-establish their livelihoods. Compensation should also be paid to the transmission line towers.	Public consultations	Adequate compensation will be paid covering all the losses (2016-2019)

12.6 Disclosure

The ESA, LARF and RAP reports will be disclosed in WAPDA's and NTDC websites and will also be sent to World Bank InfoShop. The executive summary of the ESA will be translated in to Urdu and will be disclosed in WAPDA's and NTDC websites. Public consultation meetings were held on 31st December 2015 at Tarbela and on 1st January 2016 at grid station site to disclose the ESA findings. The ESA reports will also be submitted for KP and Punjab EPAs for their clearance. The EPAs will also arrange public hearing meetings in the project area as part of their review process. The periodic progress on project implementation will also be disclosed in World Bank InfoShop.

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ANNEXES

Annex 1 Terms of Reference for ESA Study of T5HP

A- Background

The Tarbela Dam Project (TDP) was developed during the seventies of the last century as part of the framework of the Indus Basin Water Master Plan. Initially the main purpose of TDP was to supply irrigation water to the densely populated agricultural areas in Punjab and Sindh. The reservoir behind the dam is almost 100 km long and measures 260 km^2 when completely filled. The live storage capacity of the reservoir was initially 11.9 billion m^3, but this has been reduced due to siltation during 35 years of operation to 6.8 billion m^3. The Tarbela Dam is 2,743 m long, 143 m high above the river bed and has two spillways cutting through the left bank and discharging into a side valley. At the right bank there are four tunnels, each of about 900 m length as bypass for irrigation releases and/or power generation. Tunnel 5 used for irrigation releases is situated at the left bank.

Starting in the mid-eighties power generation capacity was added in three subsequent hydro-electrical project extensions, installing a total of 3,478 mega-watts (MW) generating capacity on respectively Tunnel 1 (four turbines), Tunnel 2 (six turbines) and Tunnel 3 (four turbines).

During 2011, Tarbela 4th Extension Hydropower Project (T4HP) was designed with the aim to increase the power generation from the water releases through Tunnel 4. Environment and Social Assessment of the project was carried out and subsequently reviewed and approved by the World Bank. The World Bank approved the financing of this project and it is currently under implementation. T5HP now aims to further increase the power generation from the water releases through Tunnel 5.

The Government of Pakistan has now initiated design of theT5HP. The present TOR has been prepared for the ESA study for this project.

B- Project Overview

The Pakistan Water and Power Development Authority (WAPDA) with funding from the World Bank (WB), is developing an extension to the power generating capacity of the Tarbela Dam. The additional capacity will be achieved by converting the fifth irrigation tunnel (T5) of the Tarbela Dam for hydropower generation.

The Project would add an indicative 1,446 MW (3x482 MW) to the 3,478 MW already installed at Tarbela Dam and 1,410 MW from the Tarbela 4th extension hydropower project (T4HP) which is currently under construction (the World Bank is financing the Tarbela 4th Extension). The Project will thus increase the overall generation capacity of the Tarbela Dam to approximately 6,334 MW. The main objective of the Project is to use the existing irrigation tunnel 5 (T5) for power generation.

The primary components of the T5HP Project are[50]:

- Raised Intake for T5
- Powerhouse for T5HP

[50] All other facilities already exist including the reservoir, dam, spillways, tunnels, and associated ancillaries.

- Tailrace channel for T5
- Switchyard
- 500kV transmission line for power evacuation from T5 power house.

Power Generation Facilities

The Project consists of retrofitting a hydropower plant with a capacity of 1,410MW onto the tunnel five (T5) irrigation release of Tarbela Dam. The scheme aims to maximize the hydropower potential of this significant multipurpose storage reservoir scheme and provide WAPDA with greater flexibility with regard to power generation and irrigation supply to meet critical power shortages in Pakistan. The Project will not result in any additional inundation or land take associated with the reservoir.

The Project involves modifying T5 so that the majority of irrigation releases can be used for electrical generation. The Project also aims to utilise flows that would otherwise have been passed through the spillway and instead divert these through T5 for power generation. The Project powerhouse will connect to the downstream end of T5. The existing low level outlet (LLO) structure which releases water at the end of the waterway will be connected to a new penstock to maintain water release capacity in situations when power cannot be generated. A new raised intake within the reservoir will also be provided and this will connect to the existing tunnel just upstream of the main gates. A tailrace culvert and tailrace canal will carry the water from the powerhouse to a lower discharge level in the Dal Dara channel below the Dal Dara Weir. A new switchyard will be constructed on the opposite bank of the Dal Dara channel to the Powerhouse and an overhead connection made to the Powerhouse. The Project is split between the hydropower generation plant and the power evacuation facilities which include the switchyard and transmission lines.

There is no land acquisition foreseen for the Project as all construction activities will take place on the existing Tarbela site owned by WAPDA. Buildings to support permanent operations are already established within a reasonable distance of the powerhouse. These include facilities such as offices, workers' accommodation (if using the existing workers accommodation standards will need to be improved) and a maintenance workshop.

Transmission Line for Power Evacuation

The T5 transmission line will have a total length of about 50 km and will have about 35 Angle Towers. The total number of towers is expected to be about 150. The location of the Angle Towers has been determined whereas the location of suspension towers will be determined during the construction phase. The transmission line will pass through mostly plain area with some low hills.

The T5 transmission line will be constructed in accordance with typical NTDC specifications. Towers generally have a construction footprint of 200m^2 and range in height from 46m for normal towers to 56m for special towers. Foundations are expected to have been excavated to a depth of 2-3m with tower footings extending a further 1m above ground level as a general rule. The typical span between towers is 300m, although this distance increases or decreases depending upon the topography and geography of the location. In hilly areas the length decreases while in populated areas it is generally greater. The height of each tower varies following similar criteria e.g., for river crossings a 56m high special tower is normally required. Generally, every tenth tower is assigned as a "dead tower" for the purposes of maintenance and repairs. Dead towers are designed to withstand increased structural loading caused by events such as earthquakes that have been experienced in the region and also the failure of one or more conductors. They can accept unbalanced loading and mitigate the potential for cascading tower failure along the length of the transmission line.

NTDC policy is to maintain a 60m (30m either side of the center line) Right of Way (RoW) that would be clear of development as far as possible. Ground clearances adopted by NTDC are in accordance with the National Electrical Safety Code (ANSI C2) currently applicable in the United States. Conductor to ground clearances currently applicable (at a maximum temperature of 65.5^0C) are also specified in the ANSI C2 code.

C- Potential Environmental and Social Issues

The Project site works will create some localized disturbances related to construction activities that produce noise, movement or vibration, traffic, hindrance of movement, and dust. The nuisance and disturbance related to construction activities will be most felt by TDP workers. Because of the distance from the work site to Kukur Chawa (a village near the T5 HP site) it is anticipated that movement and vibration, dust and noise from construction will mildly affect community member's daily activities.

Blasting activities can affect workers', animals and to a lesser extent communities. Blasting may be an exception and it will certainly affect workers at the power plant and animals in the area. Kukur Chawa is much higher and set back from the construction site so there is a natural noise shield. Nonetheless blasting procedures will take into account the village as a sensitive receptor. Traffic constraints have the highest potential to create nuisance for community members. However, because of T4HP construction activities, community members are likely to have acclimatized to the changed traffic patterns.

Site preparation, construction and O&M activities and the use of workers'/staff accommodation pose potential risks to the health, safety, security and therefore wellbeing of construction workers. Potential issues with the use of temporary accommodation include sanitation, disease, fire, cultural alienation, sleeping space, quality and quantity of food, personal safety and security, temperature control and recreation, amongst others.

For transmission line, occupational health and safety (OHS) risks likely to arise during construction and O&M include exposure to physical hazards, trip and fall hazards, exposure to dust, noise and vibrations, falling objects, exposure to hazardous materials, exposure to electrical hazards, exposure to extreme heat, working around large water bodies, working at height, electro-magnetic fields (EMF), working live power equipment and lines, and impacts of access roads/routes. In addition damage to crops, buildings and other structures, and physical infrastructure can also take place. In the mountainous areas, soil erosion and land sliding can also be caused by the construction activities. Vegetation clearing and tree cutting may also be needed for the construction and O&M of the transmission line.

D- ESA Study

Through the proposed study, WAPDA desires to ensure safeguards analysis of the T5HP Project, including its pre-construction, construction, operation and maintenance, and de-commissioning phases, and to assess environmental and social consequences in line with the World Bank's Operational Policy (OP 4.01) as well as compliance with the national, provincial regulations on environment and social aspects. The proposed study is aimed at screening and assessing the proposed project interventions against adverse environmental and social impacts and recommending, where necessary, appropriate mitigation and enhancement measures, and course of action for implementation.

The ESA will need to comply with the WB safeguards requirements given in the below listed operational policies (OPs) for '**Category A**' projects.

OP / BP 4.01	Environmental Assessment
OP / BP 4.04	Natural Habitats
OP 4.09	Pest Management
OP 4.11	Physical Cultural Resources
OP / BP 4.12	Involuntary Resettlement
OP 4.10	Indigenous Peoples
OP / BP 4.36	Forests
OP / BP 4.37	Safety of Dams
OP / BP 7.50	Projects on International Waterways
OP / BP 7.60	Projects in Disputed Areas
BP 17.50	Disclosure of Operational Information

The consultants will also make use of the WBG Environmental, Health, and Safety Guidelines.

The ESA will also comply with the national environmental requirements defined through Pakistan Environmental Protection Act of 1997 and subsequent provincial acts, regulations, and guidelines.

The ESA will take into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, indigenous peoples, and physical cultural resources); transboundary and global environmental aspects including climate change and its implications, and also induced impacts as well as the cumulative impacts of other development projects in the area. The ESA will consider natural and social aspects in an integrated way. It will also take into account the variations in project and country conditions; the findings of country environmental studies; national environmental action plans; the country's overall policy framework, national legislation, and institutional capabilities related to the environment and social aspects; and obligations of the country, pertaining to project activities, under relevant international environmental treaties and agreements.

E- Specific Tasks for the Consultant

To achieve the broad aim of ensuring safeguards' analysis, the consultant will:

1. Review the Project details

Review the proposed project and its geographic, ecological, social, and temporal context, including any offsite investments that may be required. Identify the need for any resettlement plan or indigenous people development plan.

Define **Area of Influence** on the basis of the project scope and extent.

2. Review of the Legislative and Regulatory Framework

Review the policy, legal, and administrative framework within which the ESA is carried out. Review the national environmental requirements and those of any co-financier. Identify relevant international environmental agreements to which the country is a party. Also review the WB OPs and their triggering status for the Project. Also state the actions taken/planned in response to each OP triggered.

3. Scoping

Scoping is among the first steps of the EA and is essentially the process of identifying the significant issues relating to the proposed action and of determining the scope of the issues to be addressed in the EA. The key tasks include: i) carry out reconnaissance field visit(s); ii) hold initial stakeholder consultations; iii) identify the key aspects to be studied during the detailed ESA, iv) finalize ESA ToRs in consultation with the stakeholders; v) prepare work plan for the subsequent ESA tasks; and vi) prepare the Scoping Statement compiling the process and outcome of the scoping tasks described above.

Review the definition of **Area of Influence** and revise if necessary.

4. Analysis of Alternatives

Systematically compare feasible alternatives to the proposed project site, technology, design, and operation--including the "without project" situation--in terms of their potential environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements. For each of the alternatives, quantify the environmental impacts to the extent possible, and attaches economic values where feasible. State the basis for selecting the particular project design proposed and justifies recommended emission levels and approaches to pollution prevention and abatement.

5. Detailed Baselines Studies and Analysis

Assess the dimensions of the study area and review relevant physical, biological, and socioeconomic conditions, including any changes anticipated before the project commences. Also study current and proposed development activities within the project area but not directly connected to the project. Also analyze the trends in the key environmental and social parameters of the area. Data should be relevant to decisions about project location, design, operation, or mitigatory measures.

Collect secondary and primary data on the following aspects:

Physical Environment (physiography, climate, geology and seismology, soils, hydrology, groundwater, flooding, sedimentation, water quality, air quality, noise, and others).

Biological Environment (natural vegetation - trees, shrubs, herbs, scrub, grasses, medicinal plants, others; fauna - mammals, birds including migratory birds, reptiles, amphibians, insects, fish and red listed species; biodiversity including carrying capacity; protected and non-protected areas including hunting, poaching, illegal fishing; wetlands; fish; benthic flora and fauna; and others).

Social Environment (population and demography; land use and natural resources including agriculture, livestock, grazing, forestry; other economic activities e.g. quarrying, tourism, fishing, trade, services; social infrastructure and services including education, health, communications, others; vehicular traffic; access and security; community organizations; vulnerable groups and poverty situation; gender aspects; recreation areas/potential; cultural heritage; archaeology; objects of special interest, e.g. graveyards and monuments; and others).

6. Stakeholder Consultations

Hold two rounds of consultations: 1) During ESA study, conduct interagency and consultation meetings, including consultations for obtaining the informed views of the affected people and local nongovernmental organizations (NGOs). Hold consultative workshops at the site, in Islamabad, and Peshawar.

2. Hold consultations after preparing draft ESA report (during Public Hearing) – with grass-root as well as institutional stakeholders.

7. Impact Assessment

Predict and assess the project's likely positive and negative impacts on people and environment, in quantitative terms to the extent possible, associated with Project site, design, technology, construction, and operation. Assess potential environmental impacts such as air quality deterioration, noise, soil erosion and contamination, water consumption and contamination, damage to natural habitat, loss of natural vegetation, and threat to wildlife, and EMF effects. Also assess the climate change implications for the project. Assess impacts associated with all permanent as well as temporary facilities of the project during construction as well as O&M phase including access routes/roads if any, construction camps, offices, workshops, and others.

Also assess potential social and socioeconomic impacts including loss of land and property, damage to crops, effects on local access routes, damage to local infrastructure and amenities, local conflicts, cultural issues, damage to sites of religious, cultural, or historical significance, impacts on vulnerable groups, safety hazards for local population and workforce, privacy/encroachment, and gender aspects.

Determine various characteristics of the potential impacts including spatial extent (local, regional, global), nature (direct/indirect), temporal extent (temporary, permanent), reversibility, severity, and sensitivity of receptors. Based on this, characterize the significance of each impact.

Assess the Project with reference to the national regulatory requirements (eg, NEQS) and WB OPs (forestry, natural habitat, safety of dam, involuntary resettlement, indigenous people, projects on international waters, physical cultural resources, and others - see list of OPs at the end of this document).

Identify mitigation measures and any residual negative impacts that cannot be mitigated, and also the significance of the residual impacts. The mitigation measures should be project- and site-specific, cost-effective, practical, and socially acceptable.

Explore opportunities for environmental enhancement as well as socioeconomic development. Identify and estimate the extent and quality of available data, key data gaps, and uncertainties associated with predictions, and specify topics that do not require further attention.

The impact assessment and mitigation measures should address the requirements detailed in WB OPs listed in Section D.

8. Cumulative and Induced Impacts

Consider and assess the cumulative impacts of other development projects in the area (on-going and planned) (including Tarbela 4th Extension). In particular, review the projects envisaged under WAPDA Vision 2030 and consider and assess any potential interaction of impacts of those projects with those of the T5 HP Project.

Also assess the induced impacts of the Project on upstream and downstream areas.

9. Environmental and Social Management Plan (ESMP)

Prepare ESMP complete with mitigation plan, compliance monitoring plan, effects monitoring plan, institutional arrangements, training needs, documentation and communication protocol, grievance redressal mechanism, cost of implementing ESMP, and mechanism to integrate ESMP with the Project (eg, through contractual clauses). The ESMP should follow the WBG EHS Guidelines.

As part of the ESMP, environmental and social management capacity within NTDC will be evaluated and appropriate institutional strengthening as well as capacity building arrangements will be proposed.

F- List of Deliverables

The consultants will be required to prepare and submit the following reports:

- Environmental and social assessment (ESA) for the entire project including ESMP.
- Land Acquisition and Resettlement Framework (LARF) for transmission line.

G- Proposed/Indicative Structure of ESA Report

The suggested and indicative contents of the ESA report:

Executive Summary

Concisely discusses significant findings and recommended actions.

1. Introduction

1.1 Overview

1.2 Background of the project

1.3 Objective of ESA

1.4 Approach to work

1.5 Area/Corridor of Impact

1.6 Composition study team

2. Legal and administrative framework

2.1 GoP requirements (legislation; guidelines and rules; policies; international treaties signed by Pakistan; national and provincial authorities; environmental procedures), their applicability, and compliance status for the Project.

2.2 World Bank requirements (operational Policies and safeguard requirements; and WBG Environmental Health guidelines) and their triggering and compliance status for the Project.

3. Project description

3.1 Need and purpose of project

3.2 Project location

3.3 Salient features

3.4 Description of project components (intake structures; tunnels and penstock arrangements; powerhouse; tailrace; switchyard and transmission lines; slope stability and realignment road; permanent facilities; temporary facilities -location ,size, type, etc.; others)

3.5 Construction activities

3.6 Construction machinery, materials and other supplies (including estimated numbers/quantities)

3.7 Waste generation and disposal (including estimated quantities)

3.8 Manpower requirements

3.8 Operation and maintenance (supplies; waste generation and management; manpower requirements; others).

4. Baseline description/analysis

4.1 Study area

4.2 Physical environment (physiography; climate; geology and seismology; soils; hydrology; groundwater; flooding; sedimentation; water quality; air quality; noise; others).

4.3 Biological environment (flora including natural vegetation, planted trees, medicinal plants, different habitat types, red list species; fauna including mammals, birds including migratory birds, reptiles, amphibians, fish and red listed species; biodiversity including carrying capacity; protected and non-protected areas including hunting, poaching, illegal fishing; wetlands; and fisheries).

4.4 Social and economic environment (population and demography; land use and natural resources including agriculture, livestock, grazing, and forestry; other economic activities e.g. quarrying, tourism, fishing, trade, services; social infrastructure and services including education, health, communications; access and security; community organizations; vulnerable groups and poverty situation; gender aspects; recreation areas/potential).

4.5 Cultural aspects (cultural heritage; archaeology; and other objects of special interest, e.g. graveyards, monuments).

5. Project alternatives

5.1 Without project alternative

5.2 Site selection

5.3 Intake options

5.4 Tunnel construction

5.5 Powerhouse

5.6 transmission line routes

5.7 Other temporary and permanent facilities

6. Other relevant issues

6.1 Risk of earthquakes

6.2 Risk of flooding

6.3 Climate change

7. Public Consultation and Information Disclosure

7.1 Scoping sessions

7.2 Focused group discussions

7.3 Public consultations

7.4 Information disclosure

8. Potential environmental impacts and their mitigations

8.1 Impact assessment, prediction, and characterization method.

8.2 Impacts during construction phase (including but not limited to irrigation releases; bird and bird migration; fish and other aquatic fauna; terrestrial fauna; vegetation; borrow and disposal areas; air quality; water quality (surface and groundwater); vehicular traffic; noise levels for residential areas and wildlife; soil erosion and slope stability; safety hazards; public health; cultural heritage; occupational hazards; waste disposal; damage to infrastructure; and others).

8.3 Impacts during operational phase (including but not limited to irrigation releases; sedimentation; fisheries; birds and bird migration; terrestrial fauna; dam safety; waste disposal; and others).

7.4 Impacts during decommissioning phase.

9. Potential social impacts and their mitigations

9.1 Resettlement and compensation

9.2 Impacts and their mitigations during construction phase (land requirement for temporary and permanent facilities; noise; increased traffic: pressure on local infrastructure and services; influx of labor; employment opportunities; social and cultural issues; privacy of local population; gender issues; others).

9.4 Impacts and their mitigations during operational phase (including but not limited to employment opportunities; additional pressure on local resources and services; damage to infrastructure; and others).

10. Cumulative and Induced Impacts

10.1 Cumulative impacts of on-going and planned projects in the area and on Indus River

10.2 Induced impacts of the Project upstream and downstream of the dam.

11. Environmental and social management plan (ESMP)

11.1 Types of impacts and their mitigations

11.2 Mitigation measures

11.3 Environmental Code of Practices (to be attached to bidding documents)

11.4 Monitoring Plan

11.6 Communication and documentation

11.7 Cost of ESMP

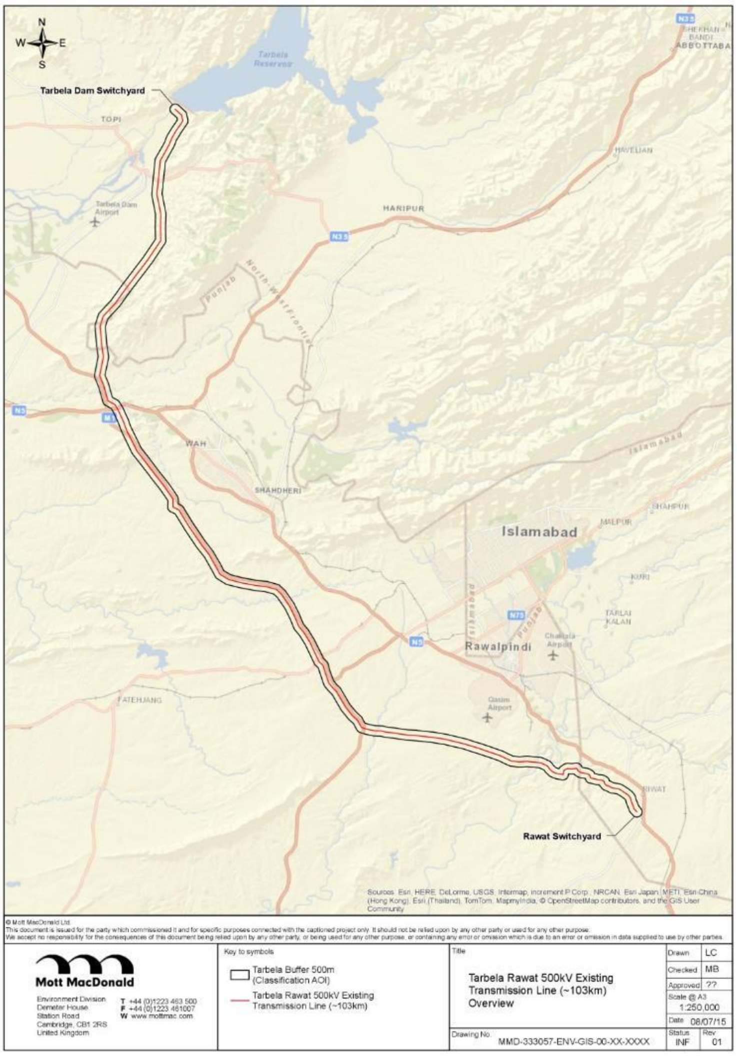
Annex 2 Environmental and Social Baseline Information on Existing 500 kV Tarbela – Rewat Transmission Line

Citation in Section 4.5

Location

The Tarbela – Rewat line starts at the existing Tarbela 500kV switchyard (just below the dam) and terminates at Rewat grid station. The length is approximately 110km with a total of 310 towers. The line passes through three districts of two provinces. The first stretch of line from tower number 1 to 82 lies within Haripur District of Khyber Pakhtunkhwa (KP) Province. After this the line enters Punjab Province with towers 83 to 125 situated in Attock District. The last stretch of the Tarbela – Rewat line, from tower number 126 to 310, lies within Rawalpindi District. The route of the Tarbela – Rewat line is illustrated in**Figure A2.1.**

Figure A2.1: Tarbela – Rewat Transmission Line Mpa



Land use

The land use of the proposed project could be defined in reference to the proposed tower/pylon locations of the entire project area. Land use baseline is given in the **Table A2.1**

Table A2.1 Land use details of the Transmission Line and Grid Station

Tower Number	**Description of the Environment**
310	Grid Station Rewat
309-258	Agriculture Land (scattered houses all along but not under the 80m wide line corridor)
258-257	Sawan Nullah
256-253	Agriculture Land
253-252	Chakri Road Crossing
251-225	Agriculture Land
225-224	Adiala Road Crossing
223-210	Barren Land
210-208	Foreign Employees Cooperative Housing Society
208-202	Barren Land
201	Village Noon (Near Bahria Town)
200-194	Agriculture Land
195-194	Property of Mobilink Pakistan (Barren Land)
194-193	Motorway Crossing near Islamabad Toll Plaza
193-186	Agriculture Land
186-185	Motorway Crossing near Tarnol Toll Plaza
184-183	Gulshan-e-Sehat Housing Society
182	Barren Land
181A-181B	Motorway Crossing
180-172	Agriculture Land
172-171	Army Welfare Housing Society
170	WAPDA Employees Housing Society Islamabad
169-158	Agriculture Land
157-156	Motorway Crossing
155-146	Margala Hills (Barren Hills) Stone Crushers nearby. Tower # 152 very near to stone crusher.
145-131	New Wah City Housing Society
131-130	Exit road to Motorway near Brahma Bahtar Exist
130-125	Agriculture Land
125-124	Motorway Crossing

124-115	Agriculture Land
114-108	Property of Pakistan Atomic Energy Commission (Barren Land)
107-96	Agriculture Land
96-95	Crosses Link Road to Motorway Near Burhan Interchange & Railway line from Rawalpindi to Attock
94-90	Barren Land
90-89	Harro Nala
88-84	Agriculture Land
84-83	Motorway Crossing near Ghazi Interchange
82-76	Agriculture Land
76-75	Village road crossing near Qibla Bandi
75-58	Agriculture Land
58-57	Near Ghor Ghashti Police Station
56-40	Sand mines
39-34	Agriculture Land
33-32	On top of Government Degree College Ghazi
32-22	Agriculture Land with scattered small houses nearby.
22-21	Sirikot Road Crossing
21-20	Agriculture Land
20-1	WAPDA Property. (Tarbela Dam Area)
11-10	WAPDA Road Crossing Inside Tarbela
8-7	Dall Dara Channel Crossing

Geology

The geological formations along the transmission line corridor in Haripur district consists of four prominent formations, namely the Dakhner, Samana Suck, Lockhart and Patala. Brief descriptions of these formations are given below:

Dakhner: This formation consists of argillite, sandstone and subordinate limestone. The sandstone and subordinate limestone are dark grey to greenish grey. Its upper contact with the Samana Suck formation is un-confirmable.

Samana Suck: This formation exhibits limestone and calcareous sandstone. The limestone is yellowish grey to dark grey, medium to thick bedded, partly argillaceous and formed locally. The sandstone is brownish grey, medium to coarse grained glance and is resistant. Both the upper and lower contacts with the Lockhart and Dakhner formations are un-confirmable respectively.

Lockhart: The limestone is light to dark grey, medium to thick bedded, massive, nodular and resistant having dark grey, thinly laminated shale intercalations. The upper contact with the Patala formations is confirmable.

Patala: This consists of inter-bedded shale and limestone with subordinate sandstone. The shale is dark greenish grey, thin bedded and fossiliferous. The sandstone is brownish grey, thin bedded and displays weak bedding whereas the limestone is white to light grey and nodular.

Quaternary: The recent to sub-recent deposits forming the land (cultivated and uncultivated) comprises loess and flood plain deposits.

Attock district for the most part lies in the 'Pothwar Plateau'. The rocks that underlie the 'Pothwar' are the soft grey sand-stones and orange to bright red shale of the Siwalik system. The district is a renowned collecting ground for the animal fossils so characteristics of this rock group.

Further north, between Fateh Jang and Attock cities there are several similar lime stone ridges which together form the Kala Chitta hills.

The high ground in the extreme north of the district, near Attock and north of Lawrence Pur is formed buy a much older rock series-known as the Attock slates.

The general trend of these hill ranges is from east to west, parallel with the general trend of the Himalayan ranges further north of which they form the foothills and outer ramparts. Based on the field visits finding and secondary data, the soils are mainly silty and sandy loamy clay with organic particles.

Hydrology

The Tarbela - Rewat line crosses the Haro River between tower numbers 89 and 90. The Haro River rises near Donga Gali in Abbottabad district, passing through Haripur district and enters Rawalpindi district near the village of Bhallar-top. It cuts across a small portion of Rawalpindi tehsil and then enters Attock tehsil. It is a seasonal river with typically low water levels in May and June and high flows in July, August and September. This indicates that the river is primarily fed from rainwater and groundwater seepage rather than glacial or snowmelt. The Haro River includes several small islands.

The Tarbela – Rewat line also crosses one major Nullah (the Swan Nullah) between tower numbers 257 and 258 and several small drainage channels. In addition, the small Qibla Bandi reservoir is located approximately 1km away from tower 76 in Attock district

. Hydrology of Haripur district is characterized as a network of river system.Siran, Daur and Haro are the well-known rives of the district. River Indus enters the district at Durband in the north- west, flowing along the western boundary of Haripur, feeds Turbela reservoir, and exits the district at Ghazi. Siranriver enters Haripur at Bir and falls into Turbela Lake near Bir. The Daur River has less water and comparatively shorter course than Siran. It has its catchment area at DaungaGali of district Abbottabad in the east and flows through the plains of the district towards west, joining Siran near Gandger range eight km above Turbela. The Haro River with adequate water originates from the southern end of DaungaGali range where it has two tributaries, the eastern known as Dhund and the western is called KarralHaro. The two streams join at the head of Khanpur tract that ultimately falls into Khanpur dam. The hydrology of Haripur district can be best seen from the blow given map.

District Attock is the rain fed district and agriculture is mainly relaying on the rain. The area in district Attock has gentle to steep topography with deep water table (15 m) in north east (Tehsil Hazro) to very deep (120 m) in south west (Tehsils Jand and PindiGheb).

The major source for the irrigation to crops is rain. Both surface water and underground is used for irrigation system. There are several perennial streams and nullahs (Haro, Soan, Sill, Naindna, Dotal, Raisi, Ghambir, Namal, Soka, Gandakas, Saghar, Ghanir, Jhablat and Kala Pani), mini dams, water ponds and lift systems for both drinking and irrigation. Besides these, river Indus and river Soan also pass along the boundaries of district Attock

Traffic and Transport

It is expected that some roads within the Haripur district will be utilized for the Project. A description of existing roads in the Haripur district is as follows; note that road references are annotated in**Figure A2.2**

- M1 / Qibla Bandi is an asphalted road which begins in Islamabad and terminates at Peshawar City, with a total length of 155 km and six lanes in some sections. Nearer to the Project site (Ghazi Barrage), the road is comprised of a single carriageway with one lane for each direction of traffic. This road crosses Ghazi Barrage and moves toward Topi City and up to Swabi City.
- Roads A, C, E and F are all approximately 20m wide, asphalted roads that are owned by the National Highway Authority. All roads are in a good condition with the exception of a 2km section near Ghazi Market
- Road B is an asphalted road which is approximately 17m wide and has recently been repaired and considered to be in good condition
- Road D is an asphalted road which is approximately 20m wide, until the road passes the Right Bank Colony at which point the width of the road reduces to approximately 17m. This road is owned by the local government of Topi and is considered to be in good condition.

The roads in the area are currently used by commercial and private users including trucks, buses and mini-buses, rickshaw drivers, animal drawn carts and pedestrians.

Traffic Numbers

A traffic survey was conducted at six observation points where up to six people observed and recorded the vehicle traffic flowing in both directions at the observation points from the hours of 7 am to 7 pm. The survey was undertaken on 8 June 2015 (roads A, B, C) and on 10 June 2015 (roads D, E, F).

During the traffic survey vehicle types (bicycle, tricycle, animal drawn vehicle, motorcycle, car, van, bus, truck) were recorded. The survey was scheduled at a time that would be indicative of average typical traffic flow and high traffic flow (e.g. avoidance of public holidays). The results of the data collected during the June 2015 traffic survey have been provided as a daily average in **Table A2.2**

Table A2.2 Average daily traffic volumes in the project area by road

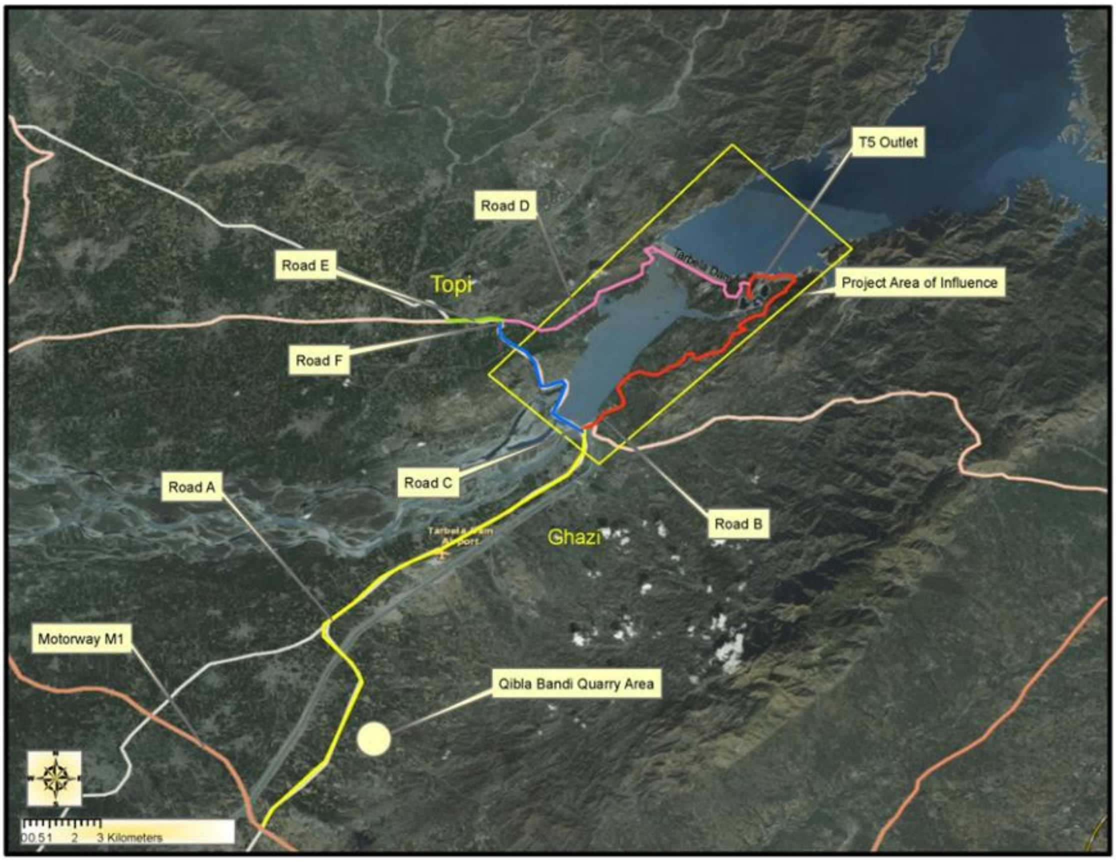
Traffic Mode	A	B	C	D	E	F
Animal Drawn	47	1	6	7	41	9
Motor Cycle / Rikshaws	3757	2048	1170	2124	1496	476
Cars / Pickups / Taxi	3128	2316	1320	710	600	404

Mini Buses / Bus/ Wagon	1316	304	343	75	56	66
Trucks / Tractor-Trolley	135	17	51	24	41	46
Average Daily Traffic (ADT)	**8383**	**4686**	**2890**	**2940**	**2234**	**1001**

Road A = M1/ Qibla Bandi to Ghazi; Road B = Ghazi and Topi to Left Bank Colony; Road C = Topi to Ghazi (Left Bank), Road D Topi to Right Bank Colony; Road E = Topi to Ghazi (Right Bank); Road F = Ghazi to Right Bank Colony.

The data provided in **Table A2.2** indicates that the roads with the highest volumes of traffic are road A (M1 / Qibla Bandi to Ghazi Road) and road B (Ghazi and Topi to Left Bank Colony Road). The traffic survey also found that peak times for traffic were 07:00 hrs to 10:00 hrs and 17:00 hrs to 19:00 hrs.

Figure A2.2 Roads in the Haripur District



Source: Feasibility Study of T5HP

Socioeconomic Baseline

This section presents the baseline characterization of the socio-economic context prior to implementation of the Power Evacuation Facilities to enable comparison of the current situation with changes anticipated as a result of the Power Evacuation Facilities. The following aspects are discussed in this section:

- Demography and population
- Economic context

- Health
- Education
- Land use.

Populationand Demography

In July 2014, the estimate for Pakistan's population was 196,174,380. The median ages for males and femaleswere similar and the population was relatively young. The 2014 estimated growth rate was 1.49% and life expectancy was higher for females (69 years) than males (65.2 years).

The AoI falls within the administrative district of Haripur in KP Province, and the districts of Attock and Rawalpindi in Punjab Province. Pakistan has a multi-tiered administrative system with districts forming the top level of a three-tier system of local government[51].**Table A2.3**presents district data.

Table A2.3: District demography

District	Area km^2	Population 1998	Growth Rate	Family Size	Projected Population 2018
Haripur	1,725	692,228	2.2	6.6	1,069,713
Attock	6,857	1,274,935	2.2	6.1	1,970,180
Rawalpindi	5,286	3,363,911	2.7	6.4	5,731,303

Source: District Population Census Reports 1998. Population Census Organization, Statistics Division, Government of Pakistan (1999)

The majority of people in the three districts are Pathan or Awan. Other main kinship lineages include Khattar, Gheba, Jodhra in Attock; Gujar, Syed, Tareen in Haripur; and Dilazak, Tarkheli, Mishwani in Rawalpindi. Urdu is the national language and widely understood by many people in the AoI however the main languages in the districts are Punjabi (various dialects) and Pashtu. About 98% of the population of all three districts are Muslim, with a small number of Christians, Hindus and other religions.

Local Economic conditions

Agriculture is the main occupation and source of income for people living in the AoI. Agriculture is mostly undertaken on a subsistence basis, with families farming small plots of land. Agricultural land is predominately "barani" or rain fed (97%) with only around 0.3% of land irrigated. Farmers in the AoI face food shortage challenges due to such factors as lack of rain, poor farming methods, prolonged droughts, pests and diseases. Besides agriculture, people also work as labourers in nearby citiessuch as Gadoon industrial estate in Swabi District, Karachi and abroad. People living closer to the dam also have small businesses, or get income from shop keeping, private or government services[52].

The barani land crops include wheat, oil seeds, and fodder during winter and maize, and millets, pulses and fodder during summer. The major crops however are wheat and maize, which occupy about 92% and 45% of the area used for barani crops, respectively. The crop yields are generally very low. On average, wheat yields about 2,000kg per

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[51] Pakistan is divided in four provinces, the federal capital territory, two autonomous and disputed territories and a number of federally administered tribal areas. Below these administrative units sit three local government tiers: districts, tehsils and union councils.

[52]Ibid

hectare (100 kg per kanal) and maize about 1,100 kg per hectare (60 kg per kanal). Irrigated land is mostly used for wheat and vegetables[53].

There are no industries of major importance in the AoI, although the three districts have a number of mineral deposits. In Rawalpindi District major minerals include limestone, marble, fire clay, ordinary sand and stones. In Haripur District major minerals include sandstone, limestone and dolomite. In Attock District, there is fireclay, gypsum, silica sand, marble, iron ore, coal, bentonite and line stone[54].In Haripur District, Hattian Industrial Estate established in 1985 has contributed to a large number of chemical businesses, cotton, fibre, textiles, telephone companies, and brick plants.

Livestock is a symbol of prestige and an important additional source of income for farming community besides providing milk, ghee and meat. The T5HP Power Generation SIA survey found that buffalo, goats and poultry were the most common animals kept in the Haripur District. Donkeys are mostly usedfor transportation and loading.

Credit plays a role in the lives of poor and lower middle class families in the local area. There are two major source of credit, institutional and non-institutional. The availability of institutional credit is very limited mainly due to lack of knowledge but also high interest rates charged on loans. The main sources of non-institutional credit are shop keepers, relatives and well-off families in the communities. These loans are mainly used for domestic and social needs such as marriages, birth ceremony, deaths, health and education.Banking services are available in Tarbela Dam colonies on the left bank for WAPDA employees.

Land Use and Infrastructure in the ADI

The AoI for the Tarbela - Rewat line is rural with some proximity to settlements. The AoI along the Tarbela - Rewat line includes the established RoW. Farming is permitted outside the RoWand there are towers along the route where agricultural land was identified. In the ADI, agricultural land was recorded around 178 of the existing 310 towers (57%) in 16 areas. The largest area of towers with agricultural land is near the Rewat Grid Station. See details in **Table A2.4** and illustrations in **Figure A2.3**. The remaining land uses within the AoI include barren land, transportation and some limited residential land connected to nearby houses.

Table A2.4 Detail of towers crossing through agriculture land

Tower Number	Description of the Environment
309-258	Agriculture Land
256-253	Agriculture Land
251-225	Agriculture Land
200-194	Agriculture Land
193-186	Agriculture Land
180-172	Agriculture Land

[53]EIA and Resettlement Action Plan Phase II, of 500kV transmission lines system of Ghazi Barotha Hydropower Project, May 2000.

[54]District Census Report of Rawalpindi, 1998; District Census Report of Haripur, 1998 and District Census Report of Attock, 1998, Population Census Organization, Statistics Division, Government of Pakistan; June 1999.

169-158	Agriculture Land
130-125	Agriculture Land
124-115	Agriculture Land
107-96	Agriculture Land
88-84	Agriculture Land
82-76	Agriculture Land
75-58	Agriculture Land
39-34	Agriculture Land
32-22	Agriculture Land
21-20	Agriculture Land

The Tarbela - Rewat line does cross over a limited number of housing compounds, isolated houses located within the AoI of the Tarbela - Rewat line in Ghazi Hamlet, Haripur District and Qibla Bandi, Attock District district, two educational institutes and several road and rail routes (see**Figure A2.3**).

The Tarbela - Rewat line passes two 11kV distribution lines at Ghazi Hamlet in Haripur District and at Burhan in Attock District.

Thirteen times the Tarbela - Rewat line crosses over a number of roads including the M1 and local roads, as well as the railway line. Details of infrastructure in the ADI are presented in**Table A2.5**.

Table A2.5: Tarbela – Rewat line road and rail crossings

Tower Number	Description of the Environment
253-252	Chakri Road Crossing
225-224	Adiala Road Crossing
194-193	Motorway Crossing
186-185	Motorway Crossing near Tarnol Toll Plaza
181A-181B	Motorway Crossing
157-156	Motorway Crossing
131-130	Exit toad of Motorway near Brahma Bahtar Exist
125-124	Motorway Crossing
96-95	Crosses Link Road to Motorway near Burhan Interchange & railway line from Rawalpindi to Attock
84-83	Motorway Crossing near Ghazi Interchange
76-75	Village road crossing near Qibla Bandi
22-21	Sirikot Road Crossing
11-10	WAPDA Road Crossing Inside Tarbela

Figure A2.3: Photographs along the Tarbela – Rewat Transmission Line

Cultivated land underneath the Tarbela – Rewat line

Government degree college underneath the Tarbela – Rewat line neat tower # 33

House underneath Tarbela – Rewat line tower # 32

Primary School underneath Tarbela – Rewat line tower # 95

Houses underneath Tarbela – Rewat line

11kV distribution lines crossing underneath the Tarbela – Rewat line

Tarbela – Rewat line crossing over railway line		**Tarbela – Rewat line crossing over motorway**
		

Annex 3 List of Flora and Fauna Species in the Project Area

Citation in Section 5.3

Exhibit A.1: List of Plant Species reported from the Project Area

S. no	Class	Family	Genus	Species
1	Dicotyledonae	Ranunculaceae	*Ranunculus*	*Ranunculus arvensis*
2	Dicotyledonae	Ranunculaceae	*Ranunculus*	*Ranunculus muricatus*
3	Dicotyledonae	Ranunculaceae	*Delphinium*	*Delphinium saniculaefolium*
4	Dicotyledonae	Fumariaceae	*Fumaria*	*Fumaria indica*
5	Dicotyledonae	Brassicaceae	*Brassica*	*Brassica campestris*
6	Dicotyledonae	Capparidaceae	*Capparis*	*Capparis decidua*
7	Dicotyledonae	Caryophyllaceae	*Stellaria*	*Stellaria media*
8	Dicotyledonae	Portulacaceae	*Portulaca*	*Portulaca quadrifida*
9	Dicotyledonae	Tamaricaceae	*Tamarix*	*Tamarix articulata*
10	Dicotyledonae	Malvaceae	*Malva*	*Malva neglecta*
11	Dicotyledonae	Malvaceae	*Malvastrum*	*Malvastrum coromandelianum*
12	Dicotyledonae	Malvaceae	*Sida*	*Sida cordata*
13	Dicotyledonae	Bombacaceae	*Salmalia*	*Salmalia malabarica*
14	Dicotyledonae	Tiliaceae	*Grewia*	*Grewia optiva*
15	Dicotyledonae	Tiliaceae	*Grewia*	*Grewia tenax*
16	Dicotyledonae	Tiliaceae	*Grewia*	*Grewia villosa*
17	Dicotyledonae	Zygophyllaceae	*Fagonia*	*Fagonia cretica*
18	Dicotyledonae	Geraniaceae	*Geranium*	*Geranium rotundifolium*
19	Dicotyledonae	Oxalidaceae	*Oxalis*	*Oxalis corniculata*
20	Dicotyledonae	Oxalidaceae	*Oxalis*	*Oxalis latifolia*
21	Dicotyledonae	Meliaceae	*Melia*	*Melia azedarach*
22	Dicotyledonae	Simarubaceae	*Ailanthus*	*Ailanthus altissima*
23	Dicotyledonae	Celastraceae	*Gymnosporia*	*Gymnosporia royleana*
24	Dicotyledonae	Rhamnaceae	*Ziziphus*	*Ziziphus mauritiana*
25	Dicotyledonae	Rhamnaceae	*Ziziphus*	*Ziziphus nummularia*
26	Dicotyledonae	Rhamnaceae	*Sageretia*	*Sageretia brandrethiana*
27	Dicotyledonae	Sapindaceae	*Dodonaea*	*Dodonaea viscosa*
28	Dicotyledonae	Leguminosae	*Medicago*	*Medicago lupulina*
29	Dicotyledonae	Leguminosae	*Medicago*	*Medicago minima*
30	Dicotyledonae	Leguminosae	*Indigofera*	*Indigofera linifolia*
31	Dicotyledonae	Leguminosae	*Astragalus*	*Astragalus psilocentros*
32	Dicotyledonae	Leguminosae	*Arachis*	*Arachis hypogoea*
33	Dicotyledonae	Leguminosae	*Lathyrus*	*Lathyrus aphaca*
34	Dicotyledonae	Leguminosae	*Butea*	*Butea monosperma*
35	Dicotyledonae	Leguminosae	*Atylosia*	*Atylosia mollis*

36	Dicotyledonae	Leguminosae	*Rhynchosia*	*Rhynchosia minima*
37	Dicotyledonae	Leguminosae	*Dalbergia*	*Dalbergia sissoo*
38	Dicotyledonae	Leguminosae	*Cassia*	*Cassia obtusifolia*
39	Dicotyledonae	Leguminosae	*Acacia*	*Acacia nilotica*
40	Dicotyledonae	Leguminosae	*Acacia*	*Acacia modesta*
41	Dicotyledonae	Leguminosae	*Mimosa*	*Mimosa himalayana*
42	Dicotyledonae	Leguminosae	*Prosopis*	*Prosopis spicigera*
43	Dicotyledonae	Leguminosae	*Albizzia*	*Albizzia procera*
44	Dicotyledonae	Myrtaceae	*Eucalyptus*	*Eucalyptus camaldulensis*
45	Dicotyledonae	Cactaceae	*Opuntia*	*Opuntia dellenii*
46	Dicotyledonae	Apiaceae	*Torilis*	*Torilis leptophylla*
47	Dicotyledonae	Asteraceae	*Conyza*	*Conyza canadensis*
48	Dicotyledonae	Asteraceae	*Conyza*	*Conyza japonica*
49	Dicotyledonae	Asteraceae	*Filago*	*Filago spathulata*
50	Dicotyledonae	Asteraceae	*Xanthium*	*Xanthium strumarium*
51	Dicotyledonae	Asteraceae	*Eclipta*	*Eclipta alba*
52	Dicotyledonae	Asteraceae	*Artemisia*	*Artemisia scoparia*
53	Dicotyledonae	Asteraceae	*Silybum*	*Silybum marianum*
54	Dicotyledonae	Asteraceae	*Taraxacum*	*Taraxacum officinale*
55	Dicotyledonae	Apocynaceae	*Thevetia*	*Thevetia peruviana*
56	Dicotyledonae	Apocynaceae	*Nerium*	*Nerium indicum*
57	Dicotyledonae	Oleaceae	*Olea*	*Olea cuspidata*
58	Dicotyledonae	Asclepiadaceae	*Periploca*	*Periploca aphylla*
59	Dicotyledonae	Asclepiadaceae	*Calatropis*	*Calatropis procera*
60	Dicotyledonae	Boraginaceae	*Ehretia*	*Ehretia laevis*
61	Dicotyledonae	Boraginaceae	*Heliotropium*	*Heliotropium europaeum*
62	Dicotyledonae	Boraginaceae	*Heliotropium*	*Heliotropium undulatum*
63	Dicotyledonae	Boraginaceae	*Cynoglossum*	*Cynoglossum lanceolatum*
64	Dicotyledonae	Boraginaceae	*Lithospermum*	*Lithospermum arvense*
65	Dicotyledonae	Boraginaceae	*Arnebia*	*Arnebia hispidissima*
66	Dicotyledonae	Convolvulaceae	*Convolvulus*	*Convolvulus arvensis*
67	Dicotyledonae	Convolvulaceae	*Cuscuta*	*Cuscuta reflexa*
68	Dicotyledonae	Convolvulaceae	*Ipomoea*	*Ipomoea carnea*
69	Dicotyledonae	Solanaceae	*Solanum*	*Solanum nigrum*
70	Dicotyledonae	Solanaceae	*Solanum*	*Solanum incanum*
71	Dicotyledonae	Solanaceae	*Solanum*	*Solanum surattense*
72	Dicotyledonae	Solanaceae	*Withania*	*Withania somnifera*
73	Dicotyledonae	Solanaceae	*Datura*	*Datura stramonium*
74	Dicotyledonae	Scrophulariaceae	*Verbascum*	*Verbascum thapsus*
75	Dicotyledonae	Scrophulariaceae	*Kickxia*	*Kickxia incana*
76	Dicotyledonae	Scrophulariaceae	*Mazus*	*Mazus delavayi*
77	Dicotyledonae	Acanthaceae	*Barleria*	*Barleria cristata*
78	Dicotyledonae	Acanthaceae	*Adhatoda*	*Adhatoda vasica*

79	Dicotyledonae	Acanthaceae	*Dicliptera*	*Dicliptera bupleuroides*
80	Dicotyledonae	Verbenaceae	*Verbena*	*Verbena officinalis*
81	Dicotyledonae	Verbenaceae	*Vitex*	*Vitex negundo*
82	Dicotyledonae	Verbenaceae	*Lantana*	*Lantana indica*
83	Dicotyledonae	Verbenaceae	*Lantana*	*Lantana camara*
84	Dicotyledonae	Lamiaceae	*Colebrookia*	*Colebrookia oppositifolia*
85	Dicotyledonae	Lamiaceae	*Micromeria*	*Micromeria biflora*
86	Dicotyledonae	Lamiaceae	*Salvia*	*Salvia moorcroftiana*
87	Dicotyledonae	Lamiaceae	*Salvia*	*Salvia aegyptiaca*
88	Dicotyledonae	Lamiaceae	*Leucas*	*Leucas nutans*
89	Dicotyledonae	Lamiaceae	*Otostegia*	*Otostegia limbata*
90	Dicotyledonae	Lamiaceae	*Ajuga*	*Ajuga bracteosa*
91	Dicotyledonae	Lamiaceae	*Ajuga*	*Ajuga parviflora*
92	Dicotyledonae	Nyctaginaceae	*Boerhaavia*	*Boerhaavia diffusa*
93	Dicotyledonae	Amaranthaceae	*Amaranthus*	*Amaranthus spinosus*
94	Dicotyledonae	Amaranthaceae	*Amaranthus*	*Amaranthus viridis*
95	Dicotyledonae	Amaranthaceae	*Pupalia*	*Pupalia lappacea*
96	Dicotyledonae	Amaranthaceae	*Aerua*	*Aerua persica*
97	Dicotyledonae	Amaranthaceae	*Achyranthes*	*Achyranthes aspera*
98	Dicotyledonae	Amaranthaceae	*Alternanthera*	*Alternanthera sessilis*
99	Dicotyledonae	Chenopodiaceae	*Chenopodium*	*Chenopodium album*
100	Dicotyledonae	Chenopodiaceae	*Chenopodium*	*Chenopodium botrys*
101	Dicotyledonae	Polygonaceae	*Polygonum*	*Polygonum aviculare*
102	Dicotyledonae	Polygonaceae	*Rumex*	*Rumex dentatus*
103	Dicotyledonae	Euphorbiaceae	*Euphorbia*	*Euphorbia parviflora*
104	Dicotyledonae	Euphorbiaceae	*Euphorbia*	*Euphorbia hirta*
105	Dicotyledonae	Euphorbiaceae	*Euphorbia*	*Euphorbia thymifolia*
106	Dicotyledonae	Euphorbiaceae	*Euphorbia*	*Euphorbia helioscopia*
107	Dicotyledonae	Euphorbiaceae	*Chrosophora*	*Chrosophora tinctoria*
108	Dicotyledonae	Euphorbiaceae	*Croton*	*Croton sparsiflorus*
109	Dicotyledonae	Euphorbiaceae	*Ricinus*	*Ricinus communis*
110	Dicotyledonae	Cannabiaceae	*Cannabis*	*Cannabis sativa*
111	Dicotyledonae	Moraceae	*Broussonnetia*	*Broussonnetia papyrifera*
112	Dicotyledonae	Moraceae	*Morus*	*Morus alba*
113	Dicotyledonae	Moraceae	*Ficus*	*Ficus glomerata*
114	Dicotyledonae	Moraceae	*Ficus*	*Ficus religiosa*
115	Dicotyledonae	Salicaceae	*Populus*	*Populus ciliata*
116	Monocotyledonae	Agavaceae	*Agave*	*Agave americana*
117	Monocotyledonae	Asparagaceae	*Asparagus*	*Asparagus gracilis*
118	Monocotyledonae	Juncaceae	*Juncus*	*Juncus bufonius*
119	Monocotyledonae	Lemnaceae	*Lemna*	*Lemna polyrhiza*
120	Monocotyledonae	Cyperaceae	*Fimbristylis*	*Fimbristylis ferruginea*
121	Monocotyledonae	Cyperaceae	*Carex*	*Carex wallichiana*

122	Monocotyledonae	Poaceae	*Poa*	*Poa annua*
123	Monocotyledonae	Poaceae	*Eragrostis*	*Eragrostis poaeoides*
124	Monocotyledonae	Poaceae	*Desmostachya*	*Desmostachya bipinnata*
125	Monocotyledonae	Poaceae	*Arundo*	*Arundo donax*
126	Monocotyledonae	Poaceae	*Hordeum*	*Hordeum murinim*
127	Monocotyledonae	Poaceae	*Agrostis*	*Agrostis munroana*
128	Monocotyledonae	Poaceae	*Sporobolus*	*Sporobolus marginatus*
129	Monocotyledonae	Poaceae	*Oryzopsis*	*Oryzopsis lateralis*
130	Monocotyledonae	Poaceae	*Aristida*	*Aristida depressa*
131	Monocotyledonae	Poaceae	*Dactyloctaenium*	*Dactyloctaenium aegyptium*
132	Monocotyledonae	Poaceae	*Cynodon*	*Cynodon dactylon*
133	Monocotyledonae	Poaceae	*Brachiaria*	*Brachiaria ramosa*
134	Monocotyledonae	Poaceae	*Echinochloa*	*Echinochloa colonum*
135	Monocotyledonae	Poaceae	*Setaria*	*Setaria glauca*
136	Monocotyledonae	Poaceae	*Cenchrus*	*Cenchrus pennisetiformis*
137	Monocotyledonae	Poaceae	*Imperata*	*Imperata cylinderica*
138	Monocotyledonae	Poaceae	*Saccharum*	*Saccharum bengalense*
139	Monocotyledonae	Poaceae	*Eulaliopsis*	*Eulaliopsis binata*
140	Monocotyledonae	Poaceae	*Apluda*	*Apluda mutica*
141	Monocotyledonae	Poaceae	*Themeda*	*Themeda anathera*
142	Monocotyledonae	Poaceae	*Dichanthium*	*Dichanthium annulatum*
143	Monocotyledonae	Poaceae	*Cymbopogon*	*Cymbopogon jwarancusa*
144	Monocotyledonae	Poaceae	*Sorghum*	*Sorghum halepense*
145	Monocotyledonae	Poaceae	*Chrysopogon*	*Chrysopogon montanus*
146	Monocotyledonae	Poaceae	*Heteropogon*	*Heteropogon contortus*
147	Pteridophyta	Dryopteridaceae	*Cetarch*	*Cetarch dalhousiae*
148	Pteridophyta	Dryopteridaceae	*Cheilanthes*	*Cheilanthes persica*
149	Pteridophyta	Adiantaceae	*Adiantum*	*Adiantum incisum*
150	Pteridophyta	Adiantaceae	*Adiantum*	*Adiantum capillus-veneris*
151	Pteridophyta	Pteridaceae	*Pteris*	*Pteris vitata*

Exhibit A.2: Association of vascular plant species reported from the project area with various habitat types. (See Table A.1 for plant species names)

Species[55]	AQ	CB	CC	CK	CP	FBL	FBO	FBR	FBS	OR	OS	OT	RS	RSR	SI	SL	SO	UG	UT	UW
Ran.arv	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ran.mur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Del.san	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fum.ind	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bra.cam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cap.dec	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ste.med	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
Por.qua	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-
Tam.art	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mal.neg	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-
Mal.cor	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Sid.cor	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Sal.mal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gre.opt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gre.ten	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gre.vil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fag.cre	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+
Ger.rot	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Oxa.cor	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	+	-	-
Oxa.lat	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mel.aze	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ail.alt	-	-	-	-	-	-	+	-	-	-	+	+	+	-	-	-	-	-	-	-
Gym.roy	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-

[55] The name code of species include first three words from specific epithet, dot (.) and then first three of genera name

Species[55]	AQ	CB	CC	CK	CP	FBL	FBO	FBR	FBS	OR	OS	OT	RS	RSR	SI	SL	SO	UG	UT	UW
Ziz.mau	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ziz.num	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sag.bra	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Dod.vis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Med.lup	-	+	-	-	-	-	-	-	-	+	-	+	+	+	-	-	-	-	-	-
Med.min	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
Ind.lin	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ast.psi	-	+	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
Ara.hyp	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Lat.aph	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
But.mon	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Aty.mol	-	+	-	-	-	-	+	-	-	-	+	+	-	-	-	-	-	-	-	+
Rhy.min	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Dal.sis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cas.obt	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aca.nil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aca.mod	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-
Mim.him	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+
Pro.spi	-	+	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-
Alb.pro	-	-	-	-	-	-	+	-	-	+	+	-	-	-	-	-	-	-	-	-
Euc.cam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Opu.del	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+
Tor.lep	-	-	-	+	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-
Con.can	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Con.jap	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fil.spa	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Species[55]	AQ	CB	CC	CK	CP	FBL	FBO	FBR	FBS	OR	OS	OT	RS	RSR	SI	SL	SO	UG	UT	UW
Xan.str	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ecl.alb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Art.sco	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sil.mar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tar.off	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+
The.per	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	-	-
Ner.ind	-	+	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-
Ole.cus	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Per.aph	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	+	-
Cal.pro	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
Ehr.lae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
Hel.eur	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+
Hel.und	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+
Cyn.lan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lit.arv	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	+
Arn.his	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Con.arv	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+
Cus.ref	-	+	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-
Ipo.car	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sol.nig	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sol.inc	-	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-	+	-	-	-
Sol.sur	-	-	-	-	+	-	-	-	-	-	+	-	-	-	-	-	+	-	-	+
Wit.som	-	+	-	-	-	-	-	-	+	-	+	-	+	-	-	-	-	-	-	-
Dat.str	-	+	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	+
Ver.tha	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Kic.inc	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+

Species[55]	AQ	CB	CC	CK	CP	FBL	FBO	FBR	FBS	OR	OS	OT	RS	RSR	SI	SL	SO	UG	UT	UW
Maz.del	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bar.cri	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Adh.vas	-	-	-	-	-	-	-	-	-	+	+	-	+	-	-	-	-	-	-	-
Dic.bup	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-
Ver.off	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vit.neg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lan.ind	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lan.cam	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Col.opp	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Mic.bif	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Sal.moo	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Sal.aeg	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Leu.nut	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oto.lim	-	+	-	-	-	-	-	-	-	+	+	-	+	-	-	-	+	-	-	+
Aju.bra	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aju.par	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boe.dif	-	+	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	+
Ama.spi	-	+	+	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	+
Ama.vir	-	+	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pup.lap	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+
Aer.per	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+
Ach.asp	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Alt.ses	-	+	-	-	-	-	-	-	-	+	+	-	+	-	-	-	-	-	-	-
Che.alb	-	+	-	+	-	-	+	-	-	+	+	-	-	+	-	-	-	-	+	+
Che.bot	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Pol.avi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Species[55]	AQ	CB	CC	CK	CP	FBL	FBO	FBR	FBS	OR	OS	OT	RS	RSR	SI	SL	SO	UG	UT	UW
Rum.den	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eup.par	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+
Eup.hir	-	+	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+
Eup.thy	-	+	+	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	+
Eup.hel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chr.tin	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Cro.spa	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ric.com	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
Can.sat	-	-	-	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Bro.pap	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mor.alb	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fic.glo	-	-	-	-	-	-	-	-	+	-	-	-	+	-	+	-	-	-	-	-
Fic.rel	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Pop.cil	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Aga.ame	-	+	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Asp.gra	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jun.buf	-	-	-	-	-	-	-	-	+	-	-	+	+	-	-	-	-	-	-	-
Lem.pol	-	-	-	-	-	-	+	-	-	+	+	-	-	-	-	-	-	-	-	-
Fim.fer	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	-
Car.wal	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Poa.ann	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Era.poa	-	+	-	+	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-
Des.bip	-	+	-	+	-	-	-	-	-	-	+	+	-	-	-	-	-	+	-	-
Aru.don	-	+	-	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
Hor.mur	-	+	-	+	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-
Agr.mun	-	+	-	+	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-

Species[55]	AQ	CB	CC	CK	CP	FBL	FBO	FBR	FBS	OR	OS	OT	RS	RSR	SI	SL	SO	UG	UT	UW
Spo.mar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ory.lat	-	+	-	+	-	-	-	-	+	-	+	+	-	-	-	-	-	+	-	-
Ari.dep	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dac.aeg	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-
Cyn.dac	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bra.ram	-	+	-	-	-	-	+	-	+	-	+	+	-	-	-	-	-	-	-	-
Ech.col	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Set.gla	-	+	-	+	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-
Cen.pen	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
Imp.cyl	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sac.ben	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-
Eul.bin	-	-	-	+	-	-	+	-	-	+	+	-	+	-	-	-	-	-	-	-

Exhibit A.3: List of mammals species reported from the Project Area

Sr. No	Scientific name	Common name	Family	Order	IUCN Status (2015)	CITES (2015)
1.	*Hemiechinus collaris*	Long-eared Desert Hedgehog	Erinaceidae	Eulipothyphla	LC*	N.A
2.	*Suncus etruscus*	Savi's Pygmy Shrew	Sorcidae	Eulipothyphla	LC	N.A
3.	*Suncus murinus*	House Shrew or Musk Shrew	Sorcidae	Eulipothyphla	LC	N.A
4.	*Pipistrellus tenuis mimus*	Least Pipistrelle	Vespertilionidae	Chiroptera	LC	N.A
5.	*Scotophilus heathii*	Common Yellow Bat	Vespertilionidae	Chiroptera	LC	N.A
6.	*Scotophilus kuhlii*	Lesser Asiatic Yellow House Bat	Vespertilionidae	Chiroptera	LC	N.A
7.	*Rhinopoma microphyllum*	Greater Mousetailed -Bat	Rhinopomatidae	Chiroptera	LC	N.A
8.	*Rousettus leschenaultii*	Fulvous Fruit Bat	Pteropodidae	Chiroptera	LC	N.A
9.	*Pteropus giganteus*	Indian Flying Fox	Pteropodidae	Chiroptera	LC	II
10.	*Manis crassicaudata*	Thick-tailed Pangulin	Manidae	Pholidota	NT	II
11.	*Canis aureus*	Asiatic Jackal	Canidae	Carnivora	LC	III
12.	*Canis lupus*	Wolf	Canidae	Carnivora	LC	I
13.	*Vulpes vulpes*	Common Red Fox	Canidae	Carnivora	LC	III
14.	*Felis chaus*	Jungle Cat	Felidae	Carnivora	LC	N.A
15.	*Herpestes edwardsii*	India Grey Mongoose	Herpestidae	Carnivora	LC	III
16.	*Herpestes javanicus*	Small Asian Mongoose	Herpestidae	Carnivora	LC	III
17.	*Martes flavigula*	Yellow throated Marten	Mustelidae	Carnivora	LC	III
18.	*Lutra lutra*	Eurasian Otter	Mustelidae	Carnivora	NT	I
19.	*Viverricula indica*	Small Indian Civet	Viverridae	Carnivora	LC	III
20.	*Paguma larvata*	Masked Palm Civet	Viverridae	Carnivora	LC	III
21.	*Sus scrofa*	Wild Pig or Indian Wild Boar	Suidae	Artiodactyla	LC	N.A
22.	*Lepus nigricollis*	Indian Hare or Black-naped Hare	Leporidae	Lagomorpha	LC	N.A
23.	*Funambulus pennantii*	Northern Palm Squirrel	Sciuridae	Rodentia	LC	N.A
24.	*Hystrix indica*	Indian Crested Porcupine	Hystricidae	Rodentia	LC	N.A
25.	*Mus musculus*	House Mouse	Muridae	Rodentia	LC	N.A
26.	*Bandicota bengalensis*	Lesser Bandicoot Rat	Muridae	Rodentia	LC	N.A
27.	*Rattus rattus*	Roof Rat or House Rat	Muridae	Rodentia	LC	N.A
28.	*Rattus turkestanicus*	Turkestan Rat	Muridae	Rodentia	LC	N.A
29.	*Tatera indica*	Indian Gerbil or Antelope Rat	Muridae	Rodentia	LC	N.A

Exhibit A.4: List of reptile and amphibian species along with conservation status reported from the proposed transmission line project

Sr. No.	Zoological Name	Common Name	Family	Order	Direct Obs.	Public interviews	Literature	IUCN Red List 2015	CITES Appendix
1	*Bufo stomaticus*	Indus valley toad	Bufonidae	Anura	√	X	X	LC	N.A
2	*Duttaphrynus melanostictus*	Black-spectacled Toad	Bufonidae	Anura	X	X	√	LC	N.A
3	*Bufo pseudoraddei pseudoraddei*	Sawat Green Toad	Bufonidae	Anura	√	X	√	LC	N.A
4	*Microhyla ornata*	Ornamented Pygmy Frog	Microhylidae	Anura	X	X	√	LC	N.A
5	*Uperodon systoma*	Marbeled Balloon Frog	Microhylidae	Anura	X	X	√	LC	N.A
6	*Euphlyctis cyanophlyctis*	Skittering frog	Dicroglossidae	Anura	√	X	√	LC	N.A
7	*Hoplobatrachus tigerinus*	Indian Bullfrog or Tiger Frog	Dicroglossidae	Anura	X	X	√	LC	II
8	*Fejevarya limnocharis*	Indian cricket frog	Dicroglossidae	Anura	√	X	√	LC	N.A
9	*Paa hazarensis*	Hazara Frog	Dicroglossidae	Anura	X	X	√	LC	N.A
10	*Calotes versicolor*	Garden lizard	Agamidae	Squamata	X	√	√	NE	N.A
11	*Laudakia agrorensis*	Agror valley rock agama	Agamidae	Squamata	X	√	√	NE	N.A
12	*Laudakia melanura*	Black Agama	Agamidae	Squamata	X	√	√	NE	N.A
13	*Saara hardwickii*	Indus Valley Spiny Tailed Lizard	Agamidae	Squamata	X	X	√	NE	II
14	*Crytopodian potoharensis*	Potohar Gecko	Geckonidae	Squamata	X	X	√	LC	N.A
15	*Hemidactylus flaviviridis*	Yellow bellied house gecko	Geckonidae	Squamata	X	X	√	NE	N.A
16	*Hemidactylus brookii*	Brook's house gecko	Geckonidae	Squamata	X	X	√	NE	N.A

17	*Ophisops jerdonii*	Jerdon's snake eye	Lacertidae	Squamata	X	X	√	LC	N.A
18	*Acanthodactylus cantoris*	Arabian Fringe-fingered Lizard	Lacertidae	Squamata	X	X	√	LC	N.A
19	*Eutropis dissimilis*	Striped grass skink	Scinidae	Squamata	√	X	√	NE	N.A
20	*Asymblepharus himalayanus*	Himalayan Ground Skink	Scincidae	Squamata	X	X	√	NE	N.A
21	*Eurylepis taeniolatus*	Yellow-bellied Mole Skink	Scincidae	Squamata	X	X	√	NE	N.A
22	*Varanus bengalensis*	Common Indian Monitor	Varanidae	Squamata	√	√	√	LC	I
23	*Eryx johnii*	Common sand boa	Boidae	Squamata	X	√	√	NE	N.A
24	*Amphisema stolatum*	Buff stripped Keelback	Colubridae	Squamata	X	√	√	NE	N.A
25	*Lycodon aulicus*	Wolf snake	Colubridae	Squamata	X	X	√	NE	N.A
26	*Ptyas mucosus*	Dhaman	Colubridae	Squamata	X	X	√	NE	II
27	*Platyceps rhodorachis*	Braid Snake	Colubridae	Squamata	X	X	√	NE	N.A
28	*Xenochrophis piscator*	Checkered Keel back	Colubridae	Squamata	X	X	√	NE	III
29	*Spalerosophis atriceps*	Diadem Snake	Colubridae	Squamata	X	X	√	NE	N.A
30	*Duboia russelii*	Eastern Russel Viper	Viperidae	Squamata	X	√	√	NE	N.A
31	*Echis carinatus*	Saw-scaled Viper	Viperidae	Squamata	X	X	√	NE	N.A
32	*Bungarus caeruleus*	Common / Indian krait	Elapidae	Squamata	X	√	√	NE	N.A
33	*Naja naja*	Black Cobra	Elapidae	Squamata	X	√	√	LC	II
34	*Naja oxiana*	Central Asian Cobra	Elapidae	Squamata	X	X	√	DD	II
35	*Python molurus*	Asiatic Rock Python	Pythonidae	Squamata	X	X	√	NE	I

Annex 4 List of Birds in the Project Area and their Eco-linkages

Citation in Section 5.3.7

TableA4.1: The Birds in the dam area and their ecolinkages with the dam water

No.	Name	Status	Ecological linkages	Cate-gory
1	**Little Grebe or Dabchick** *Tachybaptus ruficollis*	Resident	Feels safe in open water; dives for submerged vegetation & tiny fish. Droppings enrich fertility of the aquatic habitat.	a).
2	**Great crested Grebe***Podiceps cristatus*	Winter visitor	Feels safe in open water; dives for submerged vegetation & tiny fish. Droppings enrich fertility of the aquatic habitat.	a).
3.	**Great or Eurasian Cormorant***Phalacrocorax carbo*	on transit migration along Indus	Short stay on transit migration replenishes energy for long journey. Droppings enrich fertility of the aquatic habitat.	a).
4.	**Black Stork** Ci*conia nigra*	Passage migrant	Flies over the Indus river and the dam water reservoir on its annual two-way voyage between Siberia and Pakistan in autumn & back in spring	b).
5.	**Black Stork** Ci*conia nigra*	Passage migrant	Flies over the Indus river and the dam water reservoir on its annual two-way voyage between Siberia and Pakistan in autumn & back in spring	b).
6.	**Indian Pond Heron or Paddy bird***Ardeola grayii*	Resident	Found in the shallow edges of the bay reservoir. Consumes small amphibian, fish and macroinvertebrates. Increases fertility of the stagnant water through its droppings at the edge water.	b).
7.	**Cattle egret***Bubulcus ibis*	Resident	Found in the moist grassy land near the bay reservoir, among the grazing cattle to consume grasshoppers dislodged by the hooves of the livestock.	b).
8.	**Little Egret** *Egretta garzetta*	Resident	At the bay reservoir. Consumes small amphibian, fish and macroinvertebrates. Increases fertility of the stagnant water through its droppings at the edge water.	b).
9.	**Intermediate Egret** *Egretta intermedia*	Irregular year round visitor	At the bay reservoir. Consumes small amphibian, fish and macroinvertebrates. Increases fertility of the stagnant water through its droppings at the edge water.	b).
10.	**Large Egret** *Egretta alba*	Irregular year round visitor	At the bay reservoir. Consumes small amphibian, fish and macroinvertebrates. Increases fertility of the stagnant water through its droppings at the edge water.	b).
11.	**Grey Heron** *Ardea cinerea*	Resident	At the bay reservoir. Consumes small amphibian, fish and macroinvertebrates. Increases fertility of the stagnant water through its droppings at the edge water.	b).
12.	**Glossy Ibis** *Plegadis falcinellus*	Winter visitor	Found at the bay reservoir. It probes the mud in shallow water for molluscs and worms. Increases fertility of the stagnant water through	b).

			its droppings at the edge water.	
13.	**Greylag Goose** *Anser anser*	Passage migrant	Flies over the Indus river and the dam water reservoir on its annual two-way voyage in autumn & back in spring. Often stages in the bay reservoir for food and recouping its energy for further journey. Increases fertility of the stagnant water through its droppings in the water. At night these feed in nearby wheat fields	a).
14	**Bar-headed Goose** *Anser indicus*	Passage migrant	Flies over the Indus river and the dam water reservoir on its annual two-way voyage in autumn & back in spring. Often stages in the bay reservoir for food and recouping its energy for further journey. Increases fertility of the stagnant water through its droppings in the water. At night these feed in nearby wheat fields.	a).
15.	**Ruddy Shelduck** *Tadorna ferruginea*	Passage migrant	Flies over the Indus river and the dam water reservoir on its annual two-way voyage in autumn & back in spring. Often stages in the bay reservoir for food and recouping its energy for further journey. Increases fertility of the stagnant water through its droppings in the water. At night these feed in nearby wheat fields.	a).
16.	**Common Shelduck** *Tadorna tadorna*	Passage migrant	Flies over the Indus river and the dam water reservoir on its annual two-way voyage in autumn & back in spring. Often stages in the bay reservoir for food and recouping its energy for further journey. Increases fertility of the stagnant water through its droppings in the water. At night these feed in nearby wheat fields.	a).
17.	**Wigeon** *Anas penelope*	Passage migrant	Flies over the Indus river and the dam water reservoir on its annual two-way voyage in autumn & back in spring. Often stages in the bay reservoir for food and recouping its energy for further journey. Increases fertility of the stagnant water through its droppings in the water. At night these feed in nearby wheat fields.	a).
18.	**Gadwall** *Anas strepera*	Common Passage migrant & winter visitor	Flies over the Indus river and the dam water reservoir on its annual two-way voyage in autumn & back in spring. Often stages in the bay reservoir for food and recouping its energy for further journey. Increases fertility of the stagnant water through its droppings in the water. At night these feed in nearby wheat fields.	a).
19.	**Common Teal** *Anas crecca*	Abundant passage migrant	Flies over the Indus river and the dam water reservoir on its annual two-way voyage in autumn & back in spring. Often stages in the bay reservoir for food and recouping its energy for further journey. Increases fertility of the stagnant water through its droppings in the water.	a).

20.	**Mallard** *Anas platyrhynchos*	Common passage migrant	Flies over the Indus river and the dam water reservoir on its annual two-way voyage in autumn & back in spring. Often stages in the bay reservoir for food and recouping its energy for further journey. Increases fertility of the stagnant water through its droppings in the water. At night these feed in nearby wheat fields.	a).
21.	**Pintail Duck** *Anas acuta*	Common passage migrant	Flies over the Indus river and the dam water reservoir on its annual two-way voyage in autumn & back in spring. Often stages in the bay reservoir for food and recouping its energy for further journey. Increases fertility of the stagnant water through its droppings in the water. At night these feed in nearby wheat fields.	a).
22.	**Garganey** *Anas querquedula*	Uncommon passage migrant	Flies over the Indus river and the dam water reservoir on its annual two-way voyage in autumn & back in spring. Often stages in the bay reservoir for food and recouping its energy for further journey. Increases fertility of the stagnant water through its droppings in the water. At night these feed in nearby wheat fields.	a).
23.	**Shoveler** *Anas clypeata*	Common passage migrant	Flies over the Indus river and the dam water reservoir on its annual two-way voyage in autumn & back in spring. Often stages in the bay reservoir for food and recouping its energy for further journey. Increases fertility of the stagnant water through its droppings in the water.	a).
24.	**Red-crested Pochard** *Netta rufina*	Common passage migrant	Flies over the Indus river and the dam water reservoir on its annual two-way voyage in autumn & back in spring. Often stages in the bay reservoir for food and recouping its energy for further journey. Increases fertility of the stagnant water through its droppings in the water.	a).
25.	**Common Pochard** *Aythya ferina*	Passage migrant	Flies over the Indus river and the dam water reservoir on its annual two-way voyage in autumn & back in spring. Often stages in the bay reservoir for food and recouping its energy for further journey. Increases fertility of the stagnant water through its droppings in the water.	a).
26.	**Tufted duck** *Aythya fuligula*	Passage migrant	Flies over the Indus river and the dam water reservoir on its annual two-way voyage in autumn & back in spring. Often stages in the bay reservoir for food and recouping its energy for further journey. Increases fertility of the stagnant water through its droppings in the water.	a).
27.	**Water Rail** *Rallus aquaticus*	Rare passage migrant	Flies over the Indus river and the dam water reservoir on its annual two-way voyage in autumn & back in spring.	b).

28.	**Spotted Crake** *Porzana porzana*	Rare passage migrant	Flies over the Indus river and the dam water reservoir on its annual two-way voyage in autumn & back in spring.	b).
29.	**Little Crake** *Porzana parva*	Rare passage migrant	Flies over the Indus river and the dam water reservoir on its annual two-way voyage in autumn & back in spring.	b).
30.	**Ballion's Crake** *Porzana pusilla*	Rare passage migrant	Flies over the Indus river and the dam water reservoir on its annual two-way voyage in autumn & back in spring.	b).
31.	**Brown Crake** *Amaurornis akool*	Rare passage migrant	Flies over the Indus river an b). d the dam water reservoir on its annual two-way voyage in autumn & back in spring.	b).
32.	**Coot** *Fulica atra*	Common passage migrant	Flies over the Indus river and the dam water reservoir in large flocks, on its annual two-way voyage in autumn & back in spring. However huge flocks can be seen in the water reservoir throughout the winter. Increases fertility of the stagnant water through its droppings in the water.	a).
33.	**Common Crane** *Grus grus*	passage migrant	Flies over the Indus river and the dam water reservoir in large flocks, on its annual two-way voyage in autumn & back in spring.	b).
34.	**Demoiselle Crane** *Anthropoides virgo*	passage migrant	Flies over the Indus river and the dam water reservoir in large flocks, on its annual two-way voyage in autumn & back in spring.	b).
35.	**Black-winged Stilt***Himantopus himantopus*	Summer rainy season visitor	Visits reservoir bay shallow edges. Feeds on macroinvertebrates from water edges. Increases fertility of the stagnant water through its droppings in the water.	b).
36.	**Red-wattled Lapwing** *Hoplopterus indicus*	Resident	Found at the edges of the reservoir bay.	b).
37.	**Sociable Plover** *Chettusia gregaria*	passage migrant	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring. It may short stage on the edge of the reservoir bay.	b).
38.	**White-tailed Lapwing** *Chettusia leucura*	passage migrant	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring. It may short stage on the edge of the reservoir bay.	b).
39.	**Green Plover or Lapwing or Peewit** *Vanellus vanellus*	passage migrant	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring. It may short stage on the edge of the reservoir bay.	b).
40.	**Dunlin** *Calidris alpina*	passage migrant	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring.	b).
41.	**Little Stint** *Calidris minuta*	passage migrant	Flies over the Indus river and the dam water reservoir in large flocks, on its annual two-way voyage in autumn & back in spring. It may short stage on the edge of the reservoir bay.	b).
42.	**Timminck's Stint** *Calidris temminckii*	passage migrant	Flies over the Indus river and the dam water reservoir in large flocks, on its annual two-way voyage in autumn & back in spring. It may short stage on the edge of the reservoir bay.	b).
43.	**Sharp-tailed Sandpiper**	passage	Flies over the Indus river and the dam water	b).

	Calidris acuminata	migrant	reservoir in small flocks, on its annual two-way voyage in autumn & back in spring. It may short stage on the edge of the reservoir bay.	
44.	**Curlew Sandpiper** or **Curlew Stint** *Calidris ferruginea*	passage migrant	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring. It may short stage on the edge of the reservoir bay.	b).
45.	**Ruff (& Reeve)***Philomachus pugnax*	passage migrant	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring. It may short stage on the edge of the reservoir bay.	b).
46.	**Common Snipe** *Gallinago gallinago*	passage migrant	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring. It may short stage on the grassy edge of the reservoir bay.	b).
47.	**Painted Snipe** *Gallinago stenura*	passage migrant	Flies over the Indus river and the dam water reservoir in very small flocks, on its annual two-way voyage in autumn & back in spring. It may short stage on the edge of the reservoir bay.	b).
48.	**Solitary Snipe** *Gallinago solitaria*	passage migrant	Flies over the Indus river and the dam water reservoir in very small flocks, on its annual two-way voyage in autumn & back in spring. It may short stage on the edge of the reservoir bay.	b).
49..	**Spotted or Dusky Redshank** *Tringa erythropus*	passage migrant	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring. It may short stage on the edge of the reservoir bay.	b).
50.	**Redshank** *Tringa totanus*	passage migrant	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring. It may short stage on the edge of the reservoir bay.	b).
51.	**Greenshank** *Tringa nebularia*	passage migrant	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring. It may short stage on the edge of the reservoir bay.	b).
52.	**Marsh Sandpiper** *Tringa stagnatilis*	passage migrant	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring. It may short stage on the edge of the reservoir bay.	b).
53.	**Green Sandpiper** *Tringa ochropus*	passage migrant	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring. It may short stage on the edge of the reservoir bay.	b).
54.	**Wood Sandpiper** *Tringa glareola*	passage migrant	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring. It may short stage on of the reservoir bay.	b).
55.	**Terek Sandpiper** *Xenus cinereus*	passage migrant	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring. It may short stage on the edge of the reservoir bay.	b).
56.	**Common Sandpiper** Actitis *hypoleucos*	passage migrant	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring. It may short stage on the edge of the reservoir bay.	b).

57.	**Common Gull** *Larus canus*	passage migrant	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring.	c).
58.	**Herring Gull** *Larus argentatus*	passage migrant	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring. It may also be seen in winter.	c).
59.	**Lesser Black-backed Gull** *Larus fuscus*	passage migrant	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring.	c).
60.	**Gull-billed Tern** *Gelochelidon nilotica*	passage migrant & wintering	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring.	c).
61.	**Caspian Tern** *Sterna caspica*	passage migrant & wintering	Flies over the Indus river and the dam water reservoir in small flocks, on its annual two-way voyage in autumn & back in spring.	c).
62.	**Swift Tern or Great Crested Tern** *Sterna bergii*	irregular year round visitor	Seen mostly over the reservoir bay feeding on surfacing small fish.	c).
63.	**Indian River Tern** *Sterna aurantia*	irregular year round visitor	Seen mostly over the reservoir bay feeding on surfacing small fish.	c).
64.	**Caspian Tern** *Sterna caspica*	irregular year round visitor	Seen mostly over the reservoir bay feeding on surfacing small fish.	c).
65.	**Indian River Tern** *Sterna aurantia*	irregular year round visitor	Seen mostly over the reservoir bay feeding on surfacing small fish.	c).
66.	**Common Tern or Tibetan Common Tern** *Sterna hirundo*	irregular year round visitor	Seen mostly over the reservoir bay feeding on surfacing small fish.	c).
67.	**Greater Coucal or Common Crow-pheasant** *Centropus sinensis*	Resident	Seen at grassy edge of the reservoir bay. It is omnivorous. Its droppings in water promote aquatic food chain. It moves on floating vegetation and lives reed growth.	-
68.	**White-breasted Kingfisher** *Halcyon smyrnensis*	Resident	At the reservoir bay it hunt small fish and amphibians. Its role is to thin the surfacing fish fry population. That helps in growth of the healthy fish.	c).
69.	**Eurasian Common Kingfisher** *Alcedo atthis*	Resident	At the reservoir bay it hunt small fish and amphibians. Its role is to thin the surfacing fish fry population. That helps in growth of the healthy fish.	c).
70.	**Pied Kingfisher** *Ceryle rudis*	Resident	At the reservoir bay it hunt small fish and amphibians. Its role is to thin the surfacing fish fry population. That helps in growth of the healthy fish.	c).
71.	**Collard Sand Martin** *Riparia riparia*	Passage migrant	In autumn & Spring huge number are seen swarming close to water level to hunt small flying insects. These help in controlling flying aquatic insect populations	e).
72.	**Crag Martin** *Ptyonoprogne rupestris*	Summer breeder	Huge numbers are seen swarming close to water level to hunt small flying insects. These help in controlling flying aquatic insect populations	e).
73.	**Barn or Common Swallow** *Hirundo rustica*	Summer visitor & passage migrant	Huge numbers are seen swarming close to water level to hunt small flying insects. These help in controlling flying aquatic insect populations	e).
74.	**Red-rumped Swallow**	Double	Huge numbers are seen swarming close to water	e).

	Hirundo daurica	passage migrant	level to hunt small flying insects. These help in controlling flying aquatic insect populations	
75.	**Richard's Pipit** *Anthus novaeseelandiae*	Yearlong visitor	At water edges, feeds on small insects from moist soil.	b).
76.	**Tawny Pipit** *Anthus campestris*	resident	At water edges, feeds on small insects from moist soil.	b).
77.	**Brown Rock Pipitor Persian Rock Pipit or Long-billed Pipit** *Anthus similis*	Winter visitor	At water edges, feeds on small insects from moist soil.	b).
78.	**Red-throated Pipit** *Anthus cervinus*	Doubble passage migrant	Stages for a short time. At water edges, feeds on small insects from moist soil.	b).
79.	**Rosy Pipit** *Anthus roseatus*	Doubble passage migrant	Stages for a short time. At water edges, feeds on small insects from moist soil.	b).
80.	**Water Pipit** *Anthus spinoletta*	Doubble passage migrant	Stages for a short time. At water edges, feeds on small insects from moist soil.	b).
81.	**Red-throated Pipit** *Anthus cervinus*	Doubble passage migrant	Stages for a short time. At water edges, feeds on small insects from moist soil.	b).
82.	**Rosy Pipit** *Anthus roseatus*	Doubble passage migrant	Stages for a short time. At water edges, feeds on small insects from moist soil.	b).
83.	**Water Pipit** *Anthus spinoletta*	Doubble passage migrant	Stages for a short time. At water edges, feeds on small insects from moist soil.	b).
84.	**Blue-headed Yellow Wagtail** *Motacilla flava beema*	Doubble passage migrant	Stages for a short time. At water edges, feeds on small insects from moist soil.	b).
85.	**Grey-headed Yellow Wagtail** *Motacilla flava thunbergi*	Doubble passage migrant	Stages for a short time. At water edges, feeds on small insects from moist soil.	b).
86.	**Black-headed Yellow Wagtail** *Motacilla flava melanogrisea*	Doubble passage migrant	Stages for a short time. At water edges, feeds on small insects from moist soil.	b).
81.	**White-headed Yellow Wagtail** *Motacilla flava leucocephala*	Doubble passage migrant	Stages for a short time. At water edges, feeds on small insects from moist soil.	b).
82.	**Yellow-headed black-collared Wagtail** *Motacilla citreola citreola*	Doubble passage migrant	Stages for a short time. At water edges, feeds on small insects from moist soil.	b).
83.	**Yellow-headed black-backed Wagtail** *Motacilla citreola calcarata*	Doubble passage migrant	Stages for a short time. At water edges, feeds on small insects from moist soil.	b).
84.	**Yellow-headed Grey-backed Wagtail** *Motacilla citreola werae*	Doubble passage migrant	Stages for a short time. At water edges, feeds on small insects from moist soil.	b).
85.	**Grey Wagtail** *Motacilla cinerea*	Doubble passage migrant	Stages for a short time. At water edges, feeds on small insects from moist soil.	b).
86.	**SiberianPied Wagtail** *Motacilla alba dukhunensis*	Doubble passage migrant	Stages for a short time. At water edges, feeds on small insects from moist soil.	b).

87.	**Hodgeson's Pied Wagtail** *Motacilla a. alboides*	Doubble passage migrant	Stages for a short time. At water edges, feeds on small insects from moist soil.	b).
88.	**Masked Wagtail** *Motacilla alba personata*	Doubble passage migrant	Stages for a short time. At water edges, feeds on small insects from moist soil.	b).
89.	**Large Pied Wagtail** *Monticilla maderaspatensis*	Resident	Occurs at water edges, as well as in agricultural areas.	b).

Table A4.2: Birds of the spill water flow, in the river bed downstream and their ecological linkages with the habitats.

No.	Name	Status	Ecological linkages	Cate-gory
1.	**Little Grebe or Dabchick** *Tachybaptus ruficollis*	Resident	During no flow or least flow of water several temporary patches of stagnant water are formed in the river bed close to the dam. Some of the patches attract this bird for food. aquatic habitat.	a).
2.	**Indian Pond Heron or Paddy bird***Ardeola grayii*	Resident	Consume small fish and macroinvertebrates from the patches of the stagnant water	b).
3.	**Little Egret** *Egretta garzetta*	Resident	Consume small fish and macroinvertebrates from the patches of the stagnant water	b).
4.	**Intermediate Egret** *Egretta intermedia*	Irregular year round visitor	Consume small fish and macroinvertebrates from the patches of the stagnant water	b).
5.	**Little Stint** *Calidris minuta*	passage migrant	Feed on small molluscs & worms from the moist soil and from the patches of shallow stagnant water edges.	b).
6.	**Timminck's Stint** *Calidris temminckii*	passage migrant	Feed on small molluscs & worms from the moist soil and from the patches of shallow stagnant water edges.	b).
7.	**Sharp-tailed Sandpiper** *Calidris acuminata*	passage migrant	Feed on small molluscs & worms from the moist soil and from the patches of shallow stagnant water edges.	b).
8.	**Curlew Sandpiper** or **Curlew Stint** *Calidris ferruginea*	passage migrant	Feed on small molluscs & worms from the moist soil and from the patches of shallow stagnant water edges.	b).
9.	**Little Stint** *Calidris minuta*	passage migrant	Feed on small molluscs & worms from the moist soil and from the patches of shallow stagnant water edges.	b).
10.	**Timminck's Stint** *Calidris temminckii*	passage migrant	Feed on small molluscs & worms from the moist soil and from the patches of shallow stagnant water edges.	b).
11.	**Sharp-tailed Sandpiper** *Calidris acuminata*	passage migrant	Feed on small molluscs & worms from the moist soil and from the patches of shallow stagnant water edges.	b).
12.	**Spotted or Dusky Redshank** *Tringa erythropus*	passage migrant	Feed on small molluscs & worms from the moist soil and from the patches of shallow stagnant water edges.	b).
13.	**Redshank** *Tringa totanus*	passage migrant	Feed on small molluscs & worms from the moist soil and from the patches of shallow stagnant water edges.	b).
14.	**Greenshank** *Tringa nebularia*	passage migrant	Feed on small molluscs & worms from the moist soil and from the patches of shallow stagnant water edges.	b).
15.	**Marsh Sandpiper** *Tringa stagnatilis*	passage migrant	Feed on small molluscs & worms from the moist soil and from the patches of shallow stagnant water edges.	b).
16.	**Green Sandpiper** *Tringa ochropus*	passage migrant	Feed on small molluscs & worms from the moist soil and from the patches of shallow stagnant water edges.	b).
17.	**Wood Sandpiper** *Tringa glareola*	passage migrant	Feed on small molluscs & worms from the moist soil and from the patches of shallow stagnant water edges.	b).

18.	**Terek Sandpiper** *Xenus cinereus*	passage migrant	Feed on small molluscs & worms from the moist soil and from the patches of shallow stagnant water edges.	b).
19.	**Common Sandpiper** Actitis *hypoleucos*	passage migrant	Feed on small molluscs & worms from the moist soil and from the patches of shallow stagnant water edges.	b).
20.	**Common Gull** *Larus canus*	passage migrant	When the flow of water in the river bed is very low and patches of stagnant water are formed, these birds hunt small surfacing fish, as the suffocating gases at the bottom of water are generate due to the fermentation of organic debris. The fish population is thinned, which is good for the growth of surviving fish.	c).
21	**Herring Gull** *Larus argentatus*	passage migrant	Same as above	c).
22.	**Lesser Black-backed Gull** *Larus fuscus*	passage migrant	Same as above	c).
23.	**Gull-billed Tern** *Gelochelidon nilotica*	passage migrant & wintering	Same as above	c).
24.	**Caspian Tern** *Sterna caspica*	passage migrant & wintering	Same as above	c).
25.	**Swift Tern or Great Crested Tern** *Sterna bergii*	irregular year round visitor	Same as above	c).
26.	**Indian River Tern** *Sterna aurantia*	irregular year round visitor	Same as above	c).
27.	**Caspian Tern** *Sterna caspica*	irregular year round visitor	Same as above	c).
28.	**Indian River Tern** *Sterna aurantia*	irregular year round visitor	Same as above	c).
29.	**Common Tern or Tibetan Common Tern** *Sterna hirundo*	irregular year round visitor	Same as above	c).
30.	**White-breasted Kingfisher** *Halcyon smyrnensis*	Resident	These hunt surfacing fish in stagnant water patches of the river bed.	c).
31.	**Eurasian Common Kingfisher** *Alcedo atthis*	Resident	Same as above	c).
32.	**Pied Kingfisher** *Ceryle rudis*	Resident	Same as above	c).
33.	**All pipit & Wagtails that visit Tarbela water edges**	Passage migrants	Feed on small molluscs & worms from the moist soil and from the patches of shallow stagnant water edges	b).
34.	**Pariah Kite** *Milvus migrance*	Resident	These birds are scavengers and look for dead fish and eatables from garbage thrown in the river bed.	c)
35.	**House crow** *Corvus splendence*	Resident	Same as above.	Feeding from shore

Table A4.3: Birds along the Ghazi-Barotha canal and their ecological linkages with the habitats

No.	Name	Status	Ecological linkages

1.	**Indian Sand Martin** *Riparia paludicola*	Resident	Control swarming insects close to the water surface.
2.	**Collard Sand Martin** *Riparia riparia*	Resident	Same as above.
3.	**Crag Martin** *Ptyonoprogne rupestris*	Resident	Same as above.

Table A4.5: BIRDS OF EAST MARGINAL HILL, from Tarbela reservoir 72.76^0 E- 34.1^o n and to its south-western end at Jhamra village 72.64^o E –33.88^0 N. (Roughly between Surveyed Sites 1 and 6 as shown in **Figure 5.50**).

No.	Name	Status	Ecological linkages
1.	**Pariah Kite** *Milvus migrans*	Resident	Mainly scavenger.
2.	**Goshawk** *Accipiter gentilis*	Passage migrant along the Indus valley side-mountains	Predator of small & medium size birds. Day time and night roosting is in thick trees.
3.	**Eurasian Sparrow Hawk** *Accipiter nisus*	Winter visitor	Predator of small & medium size birds. Day time and night roosting is in thick trees.
4.	**Long-legged Buzzard** *Buteo rufinis*	Winter visitor	Predator of small mammals and reptiles.
5.	**Tawny Eagle** *Aquila rapax vindhiana*	Passage migrant along the Indus valley mountains	Predator of small mammals, but mainly scavenger.
6.	**Northern Hobby** *Falco subbuteo*	Two way passage migrant and rare winter visitor	Predator of small & medium size birds. Day time and night roosting is in thick trees.
7.	**Grey Partridge** *Francolinus pondicerianus*	Resident	Grains and insects eater in dry bushy areas. Night roosting is in thick trees.
8.	**Indian Ring Dove** *Streptopelia decaocto*	Resident	Eats grains and seeds. Night roosting is in trees.
9.	**Oriental Turtle Dove** *Streptopelia orientalis*	Winter visitor from temperate ecozones in mountains	Eats grains and seeds. Night roosting is in trees.
10.	**Little Brown Dove** *Streptopelia senegalensis*	Resident	Eats grains and seeds. Night roosting is in trees.
11.	**Spotted Dove or Chinese Dove** *Streptopelia chinensis*	Two way passage mibrant from Chir Pine ecozone	Eats grains and seeds. Night roosting is in trees.
12.	**Rose-ringed Parakeet** *Psittacula krameri*	Resident	Eats fruits, figs, maize, chillies, seeds of shisham tree.
13.	**Pied Crested Cuckoo** *Clamator jacobinus*	Summer breeder	It is a brood parasitic bird, which arrives in early summer from eastern subcontinent and migrates back after the summer monsoons. It is omnivorous, but eats mainly the insects. In day time it is often seen sitting on electric wires.
12.	**Common Hawk Cuckoo** *Hierococcyx varius*	Summer breeder	It is a brood parasitic bird, which arrives in early summer.
13.	**Plaintive Cuckoo** *Cacomantis passerinus*	Summer breeder	It is a brood parasitic bird, which arrives in early summer.

14.	**Eurasian Cuckoo** *Cuculus canorus*	Summer breeder	It is a brood parasitic bird, which arrives in early summer.
15.	**Koel** *Euedynamys scolopaceus*	Summer breeder	It is a brood parasitic bird, which arrives in early summer.
16.	**Collared Pygmy Owlet** *Glaucidium brodiei*	Resident	Nocturnal hunter of small rodents and large size insects.
17.	**West Himalayan Barred Owlet** *Glaucidium cuculoides*	Resident	Nocturnal hunter of small rodents and large size insects.
18.	**Spotted Owlet** *Athene brama*	Resident	Nocturnal hunter of small rodents and large size insects.
19.	**Savanna or Allied Nightjar***Caprimulgus affinis*	Summer visitor	Hunts flying insects at dusk and dawn.
20.	**Kashmir Roller** *Coracias garrulous*	Two way passage migrant	Hunts insects in the air as well as on ground.
21.	**Hoopoe** *Upupa epops*	Two way passage migrant	Digs ground worms and grubs.
22.	**Wryneck** *Jynx torquilla*	Two way passage migrant	Eats insects from the bark of trees.
23.	**Golden-backed Woodpecker** *Dinopium benghalensis*	Summer visitor	Eats insects from the bark of trees.
24.	**Sindh Pied Woodpecker***Dendrocopos assimilis*	Summer visitor	Eats insects from the bark of trees.
25.	**Brown-fronted Woodpecker** *Dendrocopos auriceps*	Two way passage migrant	Eats insects from the bark of trees.
26.	**Long-tailed Minivet** *Pericrocotus ethologus*	Winter visitor	Small flocks pick insects from trees.
27.	**White-cheeked Bulbul** *Pycnonotus leucogenys*	Resident	Omnivorous, but prefers insects.
28.	**Red-vented Bulbul** *Pycnonotus cafer*	Resident	Omnivorous, but prefers insects.
29.	**Black Redstart** *Phoenicurus ochruros*	Two way passage migrant	Insect eater from ground.
30.	**Stonechat or Collard Indian Bush-Chat** *Saxicola torquata*	resident	Eats low flying and ground insects.
31.	**Pied Bush-Chat** *Saxicola caprata*	resident	Eats low flying and ground insects.
32.	**Eastern Pied Wheatear** *Oenanthe picata*	Winter visitor	Eats low flying and ground insects.
33.	**Blue Whistling Thrush** *Myiophoneus caeruleus*	Winter visitor	Eats insects from moist soil and small stream edges.
34.	**Dark-throated Thrush or Black-throated Thrush** *Turdus ruficollis atrogularis*	Two way passage migrant	Insect eater from ground.
35.	**Pale Strong-footed Bush-Warbler** *Cettia fortipes*	Winter visitor	Eats tiny insects from branches.
36.	**Brown Hill Warbler** *Prinia criniger*	Winter visitor	Eats tiny insects from branches.
37.	**Booted Warbler** *Hippolais caligata*	Winter visitor	Eats tiny insects from branches.
38.	**Desert Warbler** *Sylvia nana*	Winter visitor	Eats tiny insects from branches.
39.	**Grey-headed Flycatcher Warbler** *Seicercus xanthoschistos*	Winter visitor	Eats tiny insects from branches.
40.	**Large Crowned Leaf Warbler** *Phylloscopus occipitalis*	Winter visitor	Eats tiny insects from branches.
41.	**Greenish Warbler or Dull Green Leaf Warbler**	Winter visitor	Eats tiny insects from branches.

	Phylloscopus torchiloides		
42.	**Brook's Leaf Warbler** *Phylloscopus subviridis*	Winter visitor from higher altitudes	Eats tiny insects from branches.
43.	**Yellow-browed or Hume's Leaf Warbler** *Phyllosopus inornatus*	Two way passage migrant	Eats tiny insects from branches.
44.	**Sulpher-bellied Warbler** *Phylloscopus griseolus*	Winter visitor	Eats tiny insects from branches
45.	**Chinese Leaf Warbler** *Phylloscopu affinis*	Winter visitor	Eats tiny insects from branches
46.	**Eurasian Chiffchaff orBrown Chiffchaff** *Pylloscopus collybita*	Winter visitor	Eats tiny insects from branches
47.	**Rufous-tailed Flycatcher** *Muscicapa ruficauda*	Winter visitor	As above
48.	**Spotted Flycatcher** *Muscicapa striata*	Winter and transit migrant from high altitudes	As above
49.	**Asian Paradise Flycatcher** *Terpsiphone paradisi*	Spring breeder	Eats flying insects.
50.	**Common Babbler** *Turdoides caudatus*	Resident	Ground insect feeder.
51.	**Jungle Babbler** *Turdoides striatus*	Resident	Ground insect feeder.
52.	**Black-crested Tit or Simla Tit** *Parus rufonuchalis*	Winter visitor	Eats tiny insects and soft buds.
53.	**Crested Black Tit** *Parus melanolophus*	Winter visitor	Eats tiny insects and soft buds.
54.	**Great Tit** *Parus major*	Winter visitor	Eats tiny insects and soft buds.
55.	**Oriental White-eye** *Zosterops palpebrosa*	Resident	Eats tiny insects and soft buds.
56.	**Golden Oriole** *Oriolus oriolus*	Passage migrant	Eats insects and soft buds.
57.	**3ay-backed Shrike** *Lanius vittatus*	Summer visitor	Insectivore.
58.	**Rufous-backed Shrike** *Lanius schach*	Resident	Eats flying insects
59.	**Great Grey Shrike** *Lanius excubitor*	Resident	Eats flying insects
60.	**Black Drongo** *Dicrurus macrocercus*	Residen	Eats flying insects
61.	**Indian Tree Pie** *Dendrocitta vagabunda*	Resident	Omnivorous
62.	**House Crow***Corvus splendens*	Resident	Omnivorous and scavenger
63.	**Common Starling** *Sturnus vulgaris*	Winter visitor	Insectivorous
64.	**Common Myna** *Acredotheres tristis*	Resident	Omnivorous
65.	**Bank Myana** *Acridotheres ginginianus*	Resident	Insectivorous
66.	**House Sparrow** *Passer domesticus*	Resident	Grainivorous and omnivorous.
67.	**Goldfinch** *Carduelis carduelis*	Winter visiotor	Eats seed & soft vegetation.
68.	**Red-mantled Rosefinch** *Caprodacus grandis*	Winter visiotor	Eats seed & soft vegetation.
69.	**Rock Bunting***Emberiza cia*	Passage migrant	Eats seeds

Table A4.5: The birds of the urban habitats of the Tarbela colony (Roughly between Surveyed Sites 1 and 2 as shown in **Figure 5.50)**

No.	Name	Status	Ecological linkages
1.	**Pariah Kite** *Milvus migrans*	Resident	Mainly scavenger.
2.	**Goshawk** *Accipiter gentilis*	Passage migrant along the Indus valley side-mountains	Predator of small & medium size birds. Day time and night roosting is in thick trees.
3.	**Eurasian Sparrow Hawk** *Accipiter nisus*	Winter visitor	Predator of small & medium size birds. Day time and night roosting is in thick trees.
4.	**Indian Ring Dove** *Streptopelia decaocto*	Resident	Eats grains and seeds. Night roosting is in trees.
5.	**Oriental Turtle Dove** *Streptopelia orientalis*	Winter visitor from temperate ecozones in mountains	Eats grains and seeds. Night roosting is in trees.
6.	**Little Brown Dove** *Streptopelia senegalensis*	Resident	Eats grains and seeds. Night roosting is in trees.
7.	**Spotted Dove or Chinese Dove** *Streptopelia chinensis*	Two way passage mibrant from Chir Pine ecozone	Eats grains and seeds. Night roosting is in trees.
8.	**Rose-ringed Parakeet** *Psittacula krameri*	Resident	Eats fruits, figs, maize, chillies, seeds of shisham tree.
9.	**Pied Crested Cuckoo** *Clamator jacobinus*	Summer breeder	It is a brood parasitic bird, which arrives in early summer from eastern subcontinent and migrates back after the summer monsoons. It is omnivorous, but eats mainly the insects. In day time it is often seen sitting on electric wires.
10.	**Common Hawk Cuckoo** *Hierococcyx varius*	Summer breeder	It is a brood parasitic bird, which arrives in early summer.
11.	**Plaintive Cuckoo** *Cacomantis passerinus*	Summer breeder	It is a brood parasitic bird, which arrives in early summer.
12.	**Eurasian Cuckoo** *Cuculus canorus*	Summer breeder	It is a brood parasitic bird, which arrives in early summer.
13.	**Koel** *Euedynamys scolopaceus*	Summer breeder	It is a brood parasitic bird, which arrives in early summer.
14.	**West Himalayan Barred Owlet** *Glaucidium cuculoides*	Resident	Nocturnal hunter of small rodents and large size insects.
15.	**Spotted Owlet** *Athene brama*	Resident	Nocturnal hunter of small rodents and large size insects.
16.	**Hoopoe** *Upupa epops*	Two way passage migrant	Digs ground worms and grubs.
17.	**Wryneck** *Jynx torquilla*	Two way passage migrant	Eats insects from the bark of trees.
18.	**Golden-backed Woodpecker** *Dinopium benghalensis*	Summer visitor	Eats insects from the bark of trees.
19.	**Sindh Pied Woodpecker***Dendrocopos assimilis*	Summer visitor	Eats insects from the bark of trees.

20.	**Brown-fronted Woodpecker** *Dendrocopos auriceps*	Two way passage migrant	Eats insects from the bark of trees.
21.	**Long-tailed Minivet** *Pericrocotus ethologus*	Winter visitor	Small flocks pick insects from trees.
22.	**White-cheeked Bulbul** *Pycnonotus leucogenys*	Resident	Omnivorous, but prefers insects.
23.	**Red-vented Bulbul** *Pycnonotus cafer*	Resident	Omnivorous, but prefers insects.
24.	**Pale Strong-footed Bush-Warbler** *Cettia fortipes*	Winter visitor	Eats tiny insects from branches.
25.	**Brown Hill Warbler** *Prinia criniger*	Winter visitor	Eats tiny insects from branches.
26.	**Booted Warbler** *Hippolais caligata*	Winter visitor	Eats tiny insects from branches.
27.	**Desert Warbler** *Sylvia nana*	Winter visitor	Eats tiny insects from branches.
28.	**Grey-headed Flycatcher Warbler** *Seicercus xanthoschistos*	Winter visitor	Eats tiny insects from branches.
29.	**Large Crowned Leaf Warbler** *Phylloscopus occipitalis*	Winter visitor	Eats tiny insects from branches.
30.	**Greenish Warbler or Dull Green Leaf Warbler** *Phylloscopus torchiloides*	Winter visitor	Eats tiny insects from branches.
31.	**Brook's Leaf Warbler** *Phylloscopus subviridis*	Winter visitor from higher altitudes	Eats tiny insects from branches.
32.	**Yellow-browed or Hume's Leaf Warbler** *Phyllosopus inornatus*	Two way passage migrant	Eats tiny insects from branches.
33.	**Sulpher-bellied Warbler** *Phylloscopus griseolus*	Winter visitor	Eats tiny insects from branches
34.	**Chinese Leaf Warbler** *Phylloscopu affinis*	Winter visitor	Eats tiny insects from branches
35.	**Eurasian Chiffchaff orBrown Chiffchaff** *Pylloscopus collybita*	Winter visitor	Eats tiny insects from branches
36.	**Asian Paradise Flycatcher** *Terpsiphone paradisi*	Spring breeder	Eats flying insects.
37.	**Common Babbler** *Turdoides caudatus*	Resident	Ground insect feeder.
38.	**Jungle Babbler** *Turdoides striatus*	Resident	Ground insect feeder.
39.	**Black-crested Tit or Simla Tit** *Parus rufonuchalis*	Winter visitor	Eats tiny insects and soft buds.
40.	**Crested Black Tit** *Parus melanolophus*	Winter visitor	Eats tiny insects and soft buds.
41.	**Great Tit** *Parus major*	Winter visitor	Eats tiny insects and soft buds.
42.	**Oriental White-eye** *Zosterops palpebrosa*	Resident	Eats tiny insects and soft buds.
43.	**Golden Oriole** *Oriolus oriolus*	Passage migrant	Eats insects and soft buds.
44.	**Rufous-backed Shrike** *Lanius schach*	Resident	Eats flying insects
45.	**Black Drongo** *Dicrurus macrocercus*	Residen	Eats flying insects
46.	**Indian Tree Pie** *Dendrocitta vagabunda*	Resident	Omnivorous
47.	**House Crow***Corvus splendens*	Resident	Omnivorous and scavenger

48.	**Common Myna** *Acredotheres tristis*	Resident	Omnivorous
49.	**House Sparrow** *Passer domesticus*	Resident	Grainivorous and omnivorous.
50.	**Goldfinch** *Carduelis carduelis*	Winter visiotor	Eats seed & soft vegetation.
52.	**Red-mantled Rosefinch** *Caprodacus grandis*	Winter visiotor	Eats seed & soft vegetation.

Table A4.6: the birds of the rural habitats along the proposed sites of the transmission towers and the 500 m. Wide linear areas under the transmission lines and their ecological linkages with the habitats (Roughly between Surveyed Sites 6 and 10 as shown in **Figure 5.50**).

No.	Name	Status	Ecological linkages
1.	**Pariah Kite** *Milvus migrans*	Resident	Mainly scavenger.
2.	Black-shouldered Kite	Resident	Eats rodents and large insects. Hovers in seach of prey.
3.	**Eurasian Sparrow Hawk** *Accipiter nisus*	Winter visitor	Predator of small & medium size birds. Day time and night roosting is in thick leafy trees.
4.	**Long-legged Buzzard** *Buteo rufinis*	Winter visitor	Predator of small mammals and reptiles. Flies and scans prey from agricultural fields
6.	**Northern Hobby** *Falco subbuteo*	Two way passage migrant and rare winter visitor	Predator of small & medium size birds. Day time and night roosting is in thick leafy trees.
7.	**Grey Partridge** *Francolinus pondicerianus*	Resident	Grains and insects eater in dry bushy areas. Night roosting is in thick trees.
8.	**Indian Ring Dove** *Streptopelia decaocto*	Resident	Eats grains and seeds. Night roosting is in trees.
9.	**Oriental Turtle Dove** *Streptopelia orientalis*	Winter visitor from temperate ecozones in mountains	Eats grains and seeds. Night roosting is in trees.
10.	**Little Brown Dove** *Streptopelia senegalensis*	Resident	Eats grains and seeds. Night roosting is in trees.
11.	**Rose-ringed Parakeet** *Psittacula krameri*	Resident	Eats fruits, figs, maize, chillies, seeds of shisham tree.
12.	**Spotted Owlet** *Athene brama*	Resident	Nocturnal hunter of small rodents and large size insects.
13.	**Savanna or Allied Nightjar***Caprimulgus affinis*	Summer visitor	Hunts flying insects at dusk and dawn.
12.	**Little Green Bee-eater** *Merops orientalis*	Resident	Hunts flying insects
13.	**Blue-cheeked Bee-eater** *Merops superciliosus*	Summer visitor	Hunts flying insects
14.	**Blue-tailed Bee-eater** *Merops philippinus*	Summer visitor	Hunts flying insects
15.	**European Bee-eater** *Merops apiaster*	Winter visitor	Hunts flying insects
16.	**Kashmir Roller** *Coracias garrulous*	Two way passage migrant	Hunts insects in the air and on ground.
17.	**Indian Roller** *Coracias benghalensis*	Resident	Hunts insects in the air and on ground.
18.	**Hoopoe** *Upupa epops*	Two way passage migrant	Digs ground worms and grubs.
19.	**Coppersmith or Crimson-breasted Barbet** *Megalaima haemacephala*	Resident	Feeds in Banyan and Pipal trees
20.	**Wryneck** *Jynx torquilla*	Summer visitor	Feeds on insects from the bark of trees.
21.	**Golden-backed Woodpecker** *Dinopium benghalensis*	Resident	Seen on trunks of the trees feeding on bark insects.
22.	**Sindh Pied Woodpecker***Dendrocopos assimilis*	Resident	Seen on trunks of the trees feeding on bark insects.

23.	**Singing Bush Lark** *Mirafra cantillans*	Resident	Feeds on ground insects.
24.	**Rufous tailed Finch-lark** *Ammomanes phoenicurus*	Resident	Feeds on ground insects.
25.	**Eastern Calandra Lark** *Melanocorypha bimaculata*	Winter visitor	Feeds on ground insects.
26.	**Greater Short-toed Lark** *Calandrella brachydactyla*	Winter visitor	Feeds on ground insects.
27.	**Crested Lark** *Galerida cristata*	Resident	Feeds on ground insects.
28.	Feeds on ground insects.	Winter visitor	Feeds on ground insects.
29.	**Richard's Pipit** *Anthus novaeseelandiae*	Resident	Feeds on ground insects.
30.	**Grey Wagtail** *Motacilla cinerea*	Passage migrant	Feeds on ground insects
31.	**Large Pied Wagtail** *Monticilla maderaspatensis*	Resident	Feeds on ground insects
32.	**Common Wood Shrike***Tephrodornis pondicerianus*	Resident	Feeds on flying as well as ground insects
33.	**White-cheeked Bulbul** *Pycnonotus leucogenys*	Resident	Omnivorous, but prefers insects. It is most common in bushy waste land
34.	**Red-vented Bulbul** *Pycnonotus cafer*	Resident	Omnivorous, but prefers insects.
35.	**Black Redstart** *Phoenicurus ochruros*	Two way passage migrant	Insect eater from ground.
36.	**IndianMagpie Robin** *Copsychus saularis*	resident	Insect eater from ground
37.	**Indian Robin***Saxicoloides fulicata*	resident	Insect eater from ground
38.	**Stonechat or Collard Indian Bush-Chat** *Saxicola torquata*	resident	Eats low flying and ground insects.
39.	**Pied Bush-Chat** *Saxicola caprata*	resident	Eats low flying and ground insects.
40.	**Eastern Pied Wheatear** *Oenanthe picata*	Winter visitor	Eats low flying and ground insects.
41.	**Chinese Leaf Warbler** *Phylloscopu affinis*	Winter visitor	Eats tiny insects from branches
42.	**Eurasian Chiffchaff orBrown Chiffchaff** *Pylloscopus collybita*	Winter visitor	Eats tiny insects from branches
43.	**Rufous-tailed Flycatcher** *Muscicapa ruficauda*	Winter visitor	As above
44.	**Common Babbler** *Turdoides caudatus*	Resident	Ground insect feeder.
45.	**Jungle Babbler** *Turdoides striatus*	Resident	Ground insect feeder.
46.	**Bay-backed Shrike** *Lanius vittatus*	Summer visitor	Insectivore.
47.	**Rufous-backed Shrike** *Lanius schach*	Resident	Eats flying insects
48.	**Great Grey Shrike** *Lanius excubitor*	Resident	Eats flying insects
49.	**Tawny or Plain-coloured Prinia** *Prinia inornata*	Resident	Eats insects from crop
50.	**Purple Sunbird** *Nectarinia asiatica*	Summer visitor	Eats pollen and nectar
51.	**Oriental White-eye** *Zosterops palpebrosa*	Residen	Eats tiny insects and pollen.
52.	**Black Drongo** *Dicrurus macrocercus*	Residen	Eats flying insects

53.	**Indian Treepie** *Dendrocitta vagabunda*	Resident	Omnivorous
54.	**House Crow***Corvus splendens*	Resident	Omnivorous and scavenger
55.	**Rook** *Corvus frugilegus*	Winter visitor	Omnivorous
56.	**Common Starling** *Sturnus vulgaris*	Winter visitor	Insectivorous
57.	**Common Myna** *Acredotheres tristis*	Resident	Omnivorous
58.	**Bank Myana** *Acridotheres ginginianus*	Resident	Insectivorous
59.	**Rufous-backed Shrike***Lanius schach*	Resident	Insectivorous
60.	**Great Grey Shrike** *Lanius excubitor*	Resident	Insectivorous
61.	**House Sparrow** *Passer domesticus*	Resident	Grainivorous and omnivorous.
62.	**Cinnamon Tree Sparrow***Passer rutilans*	Winter visitor	Grainivorous and omnivorous

Table A4.7: The birds of the proposed west Islamabad West grid station and their ecological linkages with the habitats.

No.	Name	Status	Ecological linkages
1.	**Pariah Kite** *Milvus migrans*	Resident	Mainly scavenger.
2.	Black-shouldered Kite	Resident	Eats rodents and large insects. Hovers in seach of prey.
3.	**Eurasian Sparrow Hawk** *Accipiter nisus*	Winter visitor	Predator of small & medium size birds. Day time and night roosting is in thick leafy trees.
4.	**Long-legged Buzzard** *Buteo rufinis*	Winter visitor	Predator of small mammals and reptiles. Flies and scans prey from agricultural fields
6.	**Northern Hobby** *Falco subbuteo*	Two way passage migrant and rare winter visitor	Predator of small & medium size birds. Day time and night roosting is in thick leafy trees.
7.	**Grey Partridge** *Francolinus pondicerianus*	Resident	Grains and insects eater in dry bushy areas. Night roosting is in thick trees.
8.	**Indian Ring Dove** *Streptopelia decaocto*	Resident	Eats grains and seeds. Night roosting is in trees.
9.	**Oriental Turtle Dove** *Streptopelia orientalis*	Winter visitor from temperate ecozones in mountains	Eats grains and seeds. Night roosting is in trees.
10.	**Little Brown Dove** *Streptopelia senegalensis*	Resident	Eats grains and seeds. Night roosting is in trees.
11.	**Rose-ringed Parakeet** *Psittacula krameri*	Resident	Eats fruits, figs, maize, chillies, seeds of shisham tree.
12.	**Spotted Owlet** *Athene brama*	Resident	Nocturnal hunter of small rodents and large size insects.
13.	**Savanna or Allied Nightjar***Caprimulgus affinis*	Summer visitor	Hunts flying insects at dusk and dawn.
12.	**Little Green Bee-eater** *Merops orientalis*	Resident	Hunts flying insects
13.	**Blue-cheeked Bee-eater** *Merops superciliosus*	Summer visitor	Hunts flying insects
14.	**Blue-tailed Bee-eater** *Merops philippinus*	Summer visitor	Hunts flying insects
15.	**European Bee-eater** *Merops apiaster*	Winter visitor	Hunts flying insects
16.	**Kashmir Roller** *Coracias garrulous*	Two way passage migrant	Hunts insects in the air and on ground.
17.	**Indian Roller** *Coracias benghalensis*	Resident	Hunts insects in the air and on ground.
18.	**Hoopoe** *Upupa epops*	Two way passage migrant	Digs ground worms and grubs.
19.	**Coppersmith or Crimson-breasted Barbet** *Megalaima haemacephala*	Resident	Feeds in Banyan and Pipal trees
20.	**Wryneck** *Jynx torquilla*	Summer visitor	Feeds on insects from the bark of trees.
21.	**Golden-backed Woodpecker** *Dinopium benghalensis*	Resident	Seen on trunks of the trees feeding on bark insects.
22.	**Sindh Pied Woodpecker***Dendrocopos assimilis*	Resident	Seen on trunks of the trees feeding on bark insects.
23.	**Singing Bush Lark** *Mirafra cantillans*	Resident	Feeds on ground insects.

24.	**Rufous tailed Finch-lark** *Ammomanes phoenicurus*	Resident	Feeds on ground insects.
25.	**Eastern Calandra Lark** *Melanocorypha bimaculata*	Winter visitor	Feeds on ground insects.
26.	**Greater Short-toed Lark** *Calandrella brachydactyla*	Winter visitor	Feeds on ground insects.
27.	**Crested Lark** *Galerida cristata*	Resident	Feeds on ground insects.
28.	Feeds on ground insects.	Winter visitor	Feeds on ground insects.
29.	**Richard's Pipit** *Anthus novaeseelandiae*	Resident	Feeds on ground insects.
30.	**Grey Wagtail** *Motacilla cinerea*	Passage migrant	Feeds on ground insects
31.	**Large Pied Wagtail** *Monticilla maderaspatensis*	Resident	Feeds on ground insects
32.	**Common Wood Shrike***Tephrodornis pondicerianus*	Resident	Feeds on flying as well as ground insects
33.	**White-cheeked Bulbul** *Pycnonotus leucogenys*	Resident	Omnivorous, but prefers insects. It is most common in bushy waste land
34.	**Red-vented Bulbul** *Pycnonotus cafer*	Resident	Omnivorous, but prefers insects.
35.	**Black Redstart** *Phoenicurus ochruros*	Two way passage migrant	Insect eater from ground.
36.	**IndianMagpie Robin** *Copsychus saularis*	resident	Insect eater from ground
37.	**Indian Robin***Saxicoloides fulicata*	resident	Insect eater from ground
38.	**Stonechat or Collard Indian Bush-Chat** *Saxicola torquata*	resident	Eats low flying and ground insects.
39.	**Pied Bush-Chat** *Saxicola caprata*	resident	Eats low flying and ground insects.
40.	**Eastern Pied Wheatear** *Oenanthe picata*	Winter visitor	Eats low flying and ground insects.
41.	**Chinese Leaf Warbler** *Phylloscopu affinis*	Winter visitor	Eats tiny insects from branches
42.	**Eurasian Chiffchaff orBrown Chiffchaff** *Pylloscopus collybita*	Winter visitor	Eats tiny insects from branches
43.	**Rufous-tailed Flycatcher** *Muscicapa ruficauda*	Winter visitor	As above
44.	**Common Babbler** *Turdoides caudatus*	Resident	Ground insect feeder.
45.	**Jungle Babbler** *Turdoides striatus*	Resident	Ground insect feeder.
46.	**Bay-backed Shrike** *Lanius vittatus*	Summer visitor	Insectivore.
47.	**Rufous-backed Shrike** *Lanius schach*	Resident	Eats flying insects
48.	**Great Grey Shrike** *Lanius excubitor*	Resident	Eats flying insects
49.	**Tawny or Plain-coloured Prinia** *Prinia inornata*	Resident	Eats insects from crop
50.	**Purple Sunbird** *Nectarinia asiatica*	Summer visitor	Eats pollen and nectar
51.	**Oriental White-eye** *Zosterops palpebrosa*	Residen	Eats tiny insects and pollen.
52.	**Black Drongo** *Dicrurus macrocercus*	Residen	Eats flying insects
53.	**Indian Treepie** *Dendrocitta vagabunda*	Resident	Omnivorous

54.	**House Crow***Corvus splendens*	Resident	Omnivorous and scavenger
55.	**Rook** *Corvus frugilegus*	Winter visitor	Omnivorous
56.	**Common Starling** *Sturnus vulgaris*	Winter visitor	Insectivorous
57.	**Common Myna** *Acredotheres tristis*	Resident	Omnivorous
58.	**Bank Myana** *Acridotheres ginginianus*	Resident	Insectivorous
59.	**Rufous-backed Shrike***Lanius schach*	Resident	Insectivorous
60.	**Great Grey Shrike** *Lanius excubitor*	Resident	Insectivorous
61.	**House Sparrow** *Passer domesticus*	Resident	Grainivorous and omnivorous.
62.	**Cinnamon Tree Sparrow***Passer rutilans*	Winter visitor	Grainivorous and omnivorous

Annex 5 Environmental Code of Practices

Citation in Section 10.5.2 and Section 11.5.2

ECP 1: Waste Management

Project Activity/ Impact Source	**Environmental Impacts**	**Mitigation Measures/ Management Guidelines**
General Waste	Soil and water pollution from the improper management of wastes and excess materials from the construction sites.	The Contractor shall • Develop waste management plan for various specific waste streams (e.g., reusable waste, flammable waste, construction debris, food waste etc.) prior to commencing of construction and submit to CSC for approval. • Organize disposal of all wastes generated during construction in an environmentally acceptable manner. This will include consideration of the nature and location of disposal site, so as to cause less environmental impact. • Minimize the production of waste materials by 3R (Reduce, Recycle and Reuse) approach. • Segregate and reuse or recycle all the wastes, wherever practical. • Prohibit burning of solid waste • Collect and transport non-hazardous wastes to all the approved disposal sites. Vehicles transporting solid waste shall be covered with tarps or nets to prevent spilling waste along the route • Train and instruct all personnel in waste management practices and procedures as a component of the environmental induction process. • Provide refuse containers at each worksite. • Request suppliers to minimize packaging where practicable. • Place a high emphasis on good housekeeping practices. • Maintain all construction sites in a cleaner, tidy and safe condition and provide and maintain appropriate facilities as temporary storage of all wastes before transportation and final disposal.
Hazardous Waste	Health hazards and environmental impacts due to improper waste management practices	The Contractor shall • Collect chemical wastes in 200 liter drums (or similar sealed container), appropriately labeled for safe transport to an approved chemical waste depot. • Store, transport and handle all chemicals avoiding potential environmental pollution. • Store all hazardous wastes appropriately in bunded areas away from water courses. • Make available Material Safety Data Sheets (MSDS) for hazardous materials on-site during construction. • Collect hydrocarbon wastes, including lube oils, for safe transport off-site for reuse, recycling, treatment or disposal at approved locations. • Construct concrete or other impermeable flooring to prevent seepage in case of spills

ECP 2: Fuels and Hazardous Goods Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Fuels and hazardous goods.	Materials used in construction have a potential to be a source of contamination. Improper storage and handling of fuels, lubricants, chemicals and hazardous goods/materials on-site, and potential spills from these goods may harm the environment or health of construction workers.	The Contractor shall • Prepare spill control procedures and submit the plan for CSC approval. • Train the relevant construction personnel in handling of fuels and spill control procedures. • Store dangerous goods in bunded areas on a top of a sealed plastic sheet away from watercourses. • Refueling shall occur only within bunded areas. • Make available MSDS for chemicals and dangerous goods on-site. • Transport waste of dangerous goods, which cannot be recycled, to a designated disposal site approved by DoE. • Provide absorbent and containment material (e.g., absorbent matting) where hazardous material are used and stored and personnel trained in the correct use. • Provide protective clothing, safety boots, helmets, masks, gloves, goggles, to the construction personnel, appropriate to materials in use. • Make sure all containers, drums, and tanks that are used for storage are in good condition and are labeled with expiry date. Any container, drum, or tank that is dented, cracked, or rusted might eventually leak. Check for leakage regularly to identify potential problems before they occur. • Store hazardous materials above flood plain level. • Put containers and drums in temporary storages in clearly marked areas, where they will not be run over by vehicles or heavy machinery. The area shall preferably slope or drain to a safe collection area in the event of a spill. • Put containers and drums in permanent storage areas on an impermeable floor that slopes to a safe collection area in the event of a spill or leak. • Take all precautionary measures when handling and storing fuels and lubricants, avoiding environmental pollution. • Avoid the use of material with greater potential for contamination by substituting them with more environmentally friendly materials. • Return the gas cylinders to the supplier. However, if they are not empty prior to their return, they must be labeled with the name of the material they contained or contain, information on the supplier, cylinder serial number, pressure, their last hydrostatic test date, and any additional identification marking that may be considered necessary.

ECP 3: Water Resources Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Hazardous Material and Waste	Water pollution from the storage, handling and disposal of hazardous materials and general construction waste, and accidental spillage	The Contractor shall • Follow the management guidelines proposed in ECPs 1 and 2. • Minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes). These substances must not enter waterways, storm water systems or underground water tables
Discharge from construction sites	During construction both surface and groundwater quality may be deteriorated due to construction activities in the river, sewerages from construction sites and work camps. The construction works will modify groundcover and topography changing the surface water drainage patterns of the area including infiltration and storage of storm water. These changes in hydrological regime lead to increased rate of runoff, increase in sediment and contaminant loading, increased flooding, groundwater contamination, and effect habitat of fish and other aquatic biology.	The Contractor shall • Install temporary drainage works (channels and bunds) in areas required for sediment and erosion control and around storage areas for construction materials • Install temporary sediment basins, where appropriate, to capture sediment-laden run-off from site • Divert runoff from undisturbed areas around the construction site • Stockpile materials away from drainage lines • Prevent all solid and liquid wastes entering waterways by collecting solid waste, oils, chemicals, bitumen spray waste and wastewaters from brick, concrete and asphalt cutting where possible and transport to an approved waste disposal site or recycling depot • Wash out ready-mix concrete agitators and concrete handling equipment at washing facilities off site or into approved bunded areas on site. Ensure that tires of construction vehicles are cleaned in the washing bay (constructed at the entrance of the construction site) to remove the mud from the wheels. This shall be done in every exit of each construction vehicle to ensure the local roads are kept clean.
Soil Erosion and siltation	Soil erosion and dust from the material stockpiles will increase the sediment and contaminant loading of surface water bodies.	The Contractor shall • Stabilize the cleared areas not used for construction activities with vegetation or appropriate surface water treatments as soon as practicable following earthwork to minimize erosion • Ensure that roads used by construction vehicles are swept regularly to remove sediment. • Water the material stockpiles, access roads and bare soils on an as required basis to minimize dust. Increase the watering frequency during periods of high risk (e.g. high

		winds)
Construction activities in water bodies	Construction works in the water bodies will increase sediment and contaminant loading, and effect habitat of fish and other aquatic biology.	The Contractor Shall • Dewater sites by pumping water to a sediment basin prior to release off site – do not pump directly off site • Monitor the water quality in the runoff from the site or areas affected by dredge plumes, and improve work practices as necessary • Protect water bodies from sediment loads by silt screen or bubble curtains or other barriers • Minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris and any form of waste (particularly petroleum and chemical wastes). These substances must not enter waterways, storm water systems or underground water tables. • Use environment friendly and nontoxic slurry during construction of piles to discharge into the river. • Reduce infiltration of contaminated drainage through storm water management design • Do not discharge cement and water curing used for cement concrete directly into water courses and drainage inlets.
Drinking water	Groundwater at shallow depths is contaminated with arsenic and hence not suitable for drinking purposes.	The Contractor Shall • Pumping of groundwater shall be from deep aquifers of more than 300 m to supply arsenic free water. Safe and sustainable discharges are to be ascertained prior to selection of pumps. • Tube wells will be installed with due regard for the surface environment, protection of groundwater from surface contaminants, and protection of aquifer cross contamination • All tube wells, test holes, monitoring wells that are no longer in use or needed shall be properly decommissioned
	Depletion and pollution of groundwater resources	• Install monitoring wells both upstream and downstream areas near construction yards and construction camps to regularly monitor the water quality and water levels. • Protect groundwater supplies of adjacent lands

ECP 4: Drainage Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Excavation and earth works, and construction yards	Lack of proper drainage for rainwater/liquid waste or wastewater owing to the construction activities harms environment in terms of water and soil	The Contractor shall • Prepare a program for prevent/avoid standing waters, which CSC will verify in advance and confirm during implementation • Provide alternative drainage for rainwater if the construction works/earth-fillings cut the established drainage line

	contamination, and mosquito growth.	• Establish local drainage line with appropriate silt collector and silt screen for rainwater or wastewater connecting to the existing established drainage lines already there • Rehabilitate road drainage structures immediately if damaged by contractors' road transports. • Build new drainage lines as appropriate and required for wastewater from construction yards connecting to the available nearby recipient water bodies. Ensure wastewater quality conforms to the relevant standards provided by DoE, before it being discharged into the recipient water bodies. • Ensure the internal roads/hard surfaces in the construction yards/construction camps that generate has storm water drainage to accommodate high runoff during downpour and that there is no stagnant water in the area at the end of the downpour. • Construct wide drains instead of deep drains to avoid sand deposition in the drains that require frequent cleaning. • Provide appropriate silt collector and silt screen at the inlet and manholes and periodically clean the drainage system to avoid drainage congestion • Protect natural slopes of drainage channels to ensure adequate storm water drains. • Regularly inspect and maintain all drainage channels to assess and alleviate any drainage congestion problem. • Reduce infiltration of contaminated drainage through storm water management design
Ponding of water	Health hazards due to mosquito breeding	• Do not allow ponding of water especially near the waste storage areas and construction camps • Discard all the storage containers that are capable of storing of water, after use or store them in inverted position

ECP 5: Soil Quality Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Filling of Sites with dredge spoils	Soil contamination will occur from drainage of dredged spoils	The Contractor shall • Ensure that dredged sand used for land filling shall be free of pollutants. Prior to filling, sand quality shall be tested to confirm whether soil is pollution free. Sediments shall be properly compacted. Top layer shall be the 0.5 m thick clay on the surface and boundary slopes along with grass. Side Slope of Filled Land of 1:2 shall be constructed by suitable soils with proper compaction as per design. Slope surface shall be covered by top soils/ cladding materials (0.5m thick) and grass turfing with suitable grass. • Leaching from the sediments shall be contained to seep into the subsoil or shall be discharged into settling lagoons before final disposal. • No sediment laden water in the adjacent lands near the construction sites, and/or wastewater of suspended materials excessive of 200mg/l from dredge spoil storage/use area in the adjacent agricultural lands.

Storage of hazardous and toxic chemicals	Spillage of hazardous and toxic chemicals will contaminate the soils	The Contractor shall • Strictly manage the wastes management plans proposed in ECP1 and storage of materials in ECP2 • Construct appropriate spill contaminant facilities for all fuel storage areas • Establish and maintain a hazardous materials register detailing the location and quantities of hazardous substances including the storage, use of disposals • Train personnel and implement safe work practices for minimizing the risk of spillage • Identify the cause of contamination, if it is reported, and contain the area of contamination. The impact may be contained by isolating the source or implementing controls around the affected site • Remediate the contaminated land using the most appropriate available method to achieve required commercial/industrial guideline validation results
Construction material stock piles	Erosion from construction material stockpiles may contaminate the soils	The Contractor shall • Protect the toe of all stockpiles, where erosion is likely to occur, with silt fences, straw bales or bunds

ECP 6: Erosion and Sediment Control

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Clearing of construction sites	Cleared areas and slopes are susceptible for erosion of top soils, that affects the growth of vegetation which causes ecological imbalance.	• Reinstate and protect cleared areas as soon as possible. • Mulch to protect batter slopes before planting • Cover unused area of disturbed or exposed surfaces immediately with mulch/grass turfings/tree plantations
Construction activities and material stockpiles	The impact of soil erosion are (i) Increased run off and sedimentation causing a greater flood hazard to the downstream, (ii) destruction of aquatic environment in nearby lakes, streams, and reservoirs caused by erosion and/or deposition of sediment damaging the spawning grounds of fish, and (iii) destruction of vegetation by burying or	The Contractor shall • Locate stockpiles away from drainage lines • Protect the toe of all stockpiles, where erosion is likely to occur, with silt fences, straw bales or bunds • Remove debris from drainage paths and sediment control structures • Cover the loose sediments and water them if required • Divert natural runoff around construction areas prior to any site disturbance • Install protective measures on site prior to construction, for example, sediment traps • Control drainage through a site in protected channels or slope drains • Install 'cut off drains' on large cut/fill batter slopes to control water runoff speed and hence erosion • Observe the performance of drainage structures and erosion controls during rain and modify as required.

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ECP 7: Top Soil Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Land clearing and earth works	Earthworks will impact the fertile top soils that are enriched with nutrients required for plant growth or agricultural development.	The Contractor shall • Strip the top soil to a depth of 15 cm and store in stock piles of height not exceeding 2m. • Remove unwanted materials from top soil like grass, roots of trees and similar others. • The stockpiles will be done in slopes of 2:1 to reduce surface runoff and enhance percolation through the mass of stored soil. • Locate topsoil stockpiles in areas outside drainage lines and protect from erosion. • Construct diversion channels and silt fences around the topsoil stockpiles to prevent erosion and loss of topsoil. • Spread the topsoil to maintain the physico-chemical and biological activity of the soil. The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites • Prior to the re-spreading of topsoil, the ground surface will be ripped to assist the bunding of the soil layers, water penetration and revegetation
Transport	Vehicular movement outside ROW or temporary access roads will affect the soil fertility of the agricultural lands	• Limit equipment and vehicular movements to within the approved construction zone • Construct temporary access tracks to cross concentrated water flow lines at right angles • Plan construction access to make use, if possible, of the final road alignment • Use vehicle-cleaning devices, for example, ramps or wash down areas

ECP 8: Topography and Landscaping

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Land clearing and earth works	Flood plains of the existing Project area will be affected by the construction of various project activities. Construction activities especially earthworks will change topography and disturb the natural	The Contractor shall • Ensure the topography of the final surface of all raised lands (construction yards, approach roads, access roads, bridge end facilities, etc.) are conducive to enhance natural draining of rainwater/flood water; • Keep the final or finished surface of all the raised lands free from any kind of depression that insists water logging • Undertake mitigation measures for erosion control/prevention by grass-turfing and tree plantation, where there is a possibility of rain-cut that will change the shape of

	rainwater/flood water drainage as well as will change the local landscape.	topography. • Cover immediately the uncovered open surface that has no use of construction activities with grass-cover and tree plantation to prevent soil erosion and bring improved landscaping

ECP 9: Borrow Areas Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Development and operation of borrow areas	Borrow areas will have impacts on local topography, landscaping and natural drainage.	The Contractor shall • Use only approved quarry and borrow sites • Identify new borrow and quarry areas in consultation with Project Director, if required. • Reuse excavated or disposed material available in the project to the maximum extent possible. • Store top soil for reinstatement and landscaping. • Develop surface water collection and drainage systems, anti-erosion measures (berms, revegetation etc.) and retaining walls and gabions where required. Implement mitigation measures in ECoP 3: Water Resources Management, ECoP 6: Erosion and Sediment Control • The use of explosive should be used in as much minimum quantity as possible to reduce noise, vibration and dust. • Control dust and air quality deterioration by application of watering and implementing mitigation measures proposed in ECoP 10: Air Quality Management • Noise and vibration control by ECoP 11: Noise and Vibration Management.

ECP 10: Air Quality Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Air quality can be adversely affected by vehicle exhaust emissions and combustion of fuels.	The Contractor shall • Fit vehicles with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition. • Operate the vehicles in a fuel efficient manner • Cover haul vehicles carrying dusty materials moving outside the construction site • Impose speed limits on all vehicle movement at the worksite to reduce dust emissions • Control the movement of construction traffic • Water construction materials prior to loading and transport • Service all vehicles regularly to minimize emissions • Limit the idling time of vehicles not more than 2 minutes

Construction machinery	Air quality can be adversely affected by emissions from machinery and combustion of fuels.	The Contractor shall • Fit machinery with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition in accordance with the specifications defined by their manufacturers to maximize combustion efficiency and minimize the contaminant emissions. Proof or maintenance register shall be required by the equipment suppliers and contractors/subcontractors • Focus special attention on containing the emissions from generators • Machinery causing excess pollution (e.g. visible smoke) will be banned from construction sites Service all equipment regularly to minimize emissions • Provide filtering systems, duct collectors or humidification or other techniques (as applicable) to the concrete batching and mixing plant to control the particle emissions in all its stages, including unloading, collection, aggregate handling, cement dumping, circulation of trucks and machinery inside the installations
Construction activities	Dust generation from construction sites, material stockpiles and access roads is a nuisance in the environment and can be a health hazard.	• Water the material stockpiles, access roads and bare soils on an as required basis to minimize the potential for environmental nuisance due to dust. Increase the watering frequency during periods of high risk (e.g. high winds). Stored materials such as gravel and sand shall be covered and confined to avoid their being wind-drifted • Minimize the extent and period of exposure of the bare surfaces • Reschedule earthwork activities or vegetation clearing activities, where practical, if necessary to avoid during periods of high wind and if visible dust is blowing off-site • Restore disturbed areas as soon as practicable by vegetation/grass-turfing • Store the cement in silos and minimize the emissions from silos by equipping them with filters. • Establish adequate locations for storage, mixing and loading of construction materials, in a way that dust dispersion is prevented because of such operations • Crushing of rocky and aggregate materials shall be wet-crushed, or performed with particle emission control systems

ECP 11: Noise and Vibration Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction vehicular traffic	Noise quality will be deteriorated due to vehicular traffic	The Contractor shall • Maintain all vehicles in order to keep it in good working order in accordance with manufactures maintenance procedures

		• Make sure all drivers will comply with the traffic codes concerning maximum speed limit, driving hours, etc. • Organize the loading and unloading of trucks, and handling operations for the purpose of minimizing construction noise on the work site
Construction machinery	Noise and vibration may have an impact on people, property, fauna, livestock and the natural environment.	The Contractor shall • Appropriately site all noise generating activities to avoid noise pollution to local residents • Use the quietest available plant and equipment • Modify equipment to reduce noise (for example, noise control kits, lining of truck trays or pipelines) • Maintain all equipment in order to keep it in good working order in accordance with manufactures maintenance procedures. Equipment suppliers and contractors shall present proof of maintenance register of their equipment. • Install acoustic enclosures around generators to reduce noise levels. • Fit high efficiency mufflers to appropriate construction equipment • Avoid the unnecessary use of alarms, horns and sirens
Construction activity	Noise and vibration may have an impact on people, property, fauna, livestock and the natural environment.	The Contractor shall • Notify adjacent landholders prior any typical noise events outside of daylight hours • Educate the operators of construction equipment on potential noise problems and the techniques to minimize noise emissions • Employ best available work practices on-site to minimize occupational noise levels • Install temporary noise control barriers where appropriate • Notify affected people if major noisy activities will be undertaken, e.g. pile driving • Plan activities on site and deliveries to and from site to minimize impact • Monitor and analyze noise and vibration results and adjust construction practices as required. • Avoid undertaking the noisiest activities, where possible, when working at night near the residential areas

ECP 12: Protection of Flora

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Vegetation clearance	Local flora are important to provide shelters for the birds, offer fruits and/or timber/fire wood, protect soil erosion and overall keep the environment very friendly to human-living. As such damage to flora has wide range of adverse	The Contractor shall • Reduce disturbance to surrounding vegetation • Use appropriate type and minimum size of machine to avoid disturbance to adjacent vegetation. • Get approval from supervision consultant for clearance of vegetation. • Make selective and careful pruning of trees where possible to reduce need of tree removal. • Control noxious weeds by disposing of at designated dump site or burn on site.

	environmental impacts.	• Clear only the vegetation that needs to be cleared in accordance with the plans. These measures are applicable to both the construction areas as well as to any associated activities such as sites for stockpiles, disposal of fill and construction of diversion roads, etc. • Do not burn off cleared vegetation – where feasible, chip or mulch and reuse it for the rehabilitation of affected areas, temporary access tracks or landscaping. Mulch provides a seed source, can limit embankment erosion, retains soil moisture and nutrients, and encourages re-growth and protection from weeds. • Return topsoil and mulched vegetation (in areas of native vegetation) to approximately the same area of the roadside it came from. • Avoid work within the drip-line of trees to prevent damage to the tree roots and compacting the soil. • Minimize the length of time the ground is exposed or excavation left open by clearing and re-vegetate the area at the earliest practically possible. • Ensure excavation works occur progressively and re-vegetation done at the earliest • Provide adequate knowledge to the workers regarding nature protection and the need of avoid felling trees during construction • Supply appropriate fuel in the work caps to prevent fuel wood collection

ECP 13: Protection of Fauna

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities	The location of construction activities can result in the loss of wild life habitat and habitat quality,.	The Contractor shall • Limit the construction works within the designated sites allocated to the contractors • check the site for animals trapped in, or in danger from site works and use a qualified person to relocate the animal
	Impact on migratory birds, its habitat and its active nests	The Contractor shall • Not be permitted to destruct active nests or eggs of migratory birds • Minimize the tree removal during the bird breeding season. If works must be continued during the bird breeding season, a nest survey will be conducted by a qualified biologist prior to commence of works to identify and located active nests • Minimize the release of oil, oil wastes or any other substances harmful to migratory birds to any waters or any areas frequented by migratory birds.
Vegetation clearance	Clearance of vegetation may impact shelter,	The Contractor shall • Restrict the tree removal to the minimum required.

	feeding and/or breeding and/or physical destruction and severing of habitat areas	• Retain tree hollows on site, or relocate hollows, where appropriate • Leave dead trees where possible as habitat for fauna • Fell the hollow bearing trees in a manner which reduces the potential for fauna mortality. Felled trees will be inspected after felling for fauna and if identified and readily accessible will be removed and relocated or rendered assistance if injured. After felling, hollow bearing trees will remain unmoved overnight to allow animals to move of their own volition.
Construction camps	Illegal poaching	• Provide adequate knowledge to the workers regarding protection of flora and fauna, and relevant government regulations and punishments for illegal poaching.

ECP 14: Protection of Fisheries

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities in River	The main potential impacts to fisheries are hydrocarbon spills and leaks from riverine transport and disposal of wastes into the river	The Contractor shall • Ensure the riverine transports, vessels and ships are well maintained and do not have oil leakage to contaminate river water. • Contain oil immediately on river in case of accidental spillage from vessels and ships and in this regard, make an emergency oil spill containment plan to be supported with enough equipment, materials and human resources • Do not dump wastes, be it hazardous or non-hazardous into the nearby water bodies or in the river
Construction activities on the land	The main potential impacts to aquatic flora and fauna River are increased suspended solids from earthworks erosion, sanitary discharge from work camps, and hydrocarbon spills	The Contractor shall • follow mitigation measures proposed in ECoP 3 : Water Resources Management and EC4: Drainage Management
	Filling of ponds for site preparation will impact the fishes.	The Contractor shall • Inspect any area of a water body containing fish that is temporarily isolated for the presence of fish, and all fish shall be captured and released unharmed in adjacent fish habitat • Install and maintain fish screens etc. on any water intake with drawing water from any water body that contain fish

ECP 15: Road Transport and Road Traffic Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines

Construction vehicular traffic	Increased traffic use of road by construction vehicles will affect the movement of normal road traffics and the safety of the road-users.	The Contractor shall • Prepare and submit a traffic management plan to the CSC for his approval at least 30 days before commencing work on any project component involved in traffic diversion and management. • Include in the traffic management plan to ensure uninterrupted traffic movement during construction: detailed drawings of traffic arrangements showing all detours, temporary road, temporary bridges temporary diversions, necessary barricades, warning signs / lights, and road signs. • Provide signs at strategic locations of the roads complying with the schedules of signs contained in the Bangladesh Traffic Regulations. • Install and maintain a display board at each important road intersection on the roads to be used during construction, which shall clearly show the following information in Bangla: • Location: chainage and village name • Duration of construction period • Period of proposed detour / alternative route • Suggested detour route map • Name and contact address/telephone number of the concerned personnel • Name and contact address / telephone number of the Contractor • Inconvenience is sincerely regretted.
	Accidents and spillage of fuels and chemicals	• Restrict truck deliveries, where practicable, to day time working hours. • Restrict the transport of oversize loads. • Operate road traffics/transport vehicles, if possible, to non-peak periods to minimize traffic disruptions. • Enforce on-site speed limit

ECP 16: Construction Camp Management

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Siting and Location of construction camps	Campsites for construction workers are the important locations that have significant impacts such as health and safety hazards on local resources and infrastructure of nearby communities.	The Contractor shall • Locate the construction camps at areas which are acceptable from environmental, cultural or social point of view. • Consider the location of construction camps away from communities in order to avoid social conflict in using the natural resources such as water or to avoid the possible adverse impacts of the construction camps on the surrounding communities. • Submit to the CSC for approval a detailed layout plan for the development of the construction camp showing the relative locations of all temporary buildings and facilities that are to be constructed together with the location of site roads, fuel

		storage areas (for use in power supply generators), solid waste management and dumping locations, and drainage facilities, prior to the development of the construction camps. • Local authorities responsible for health, religious and security shall be duly informed on the set up of camp facilities so as to maintain effective surveillance over public health, social and security matters
Construction Camp Facilities	Lack of proper infrastructure facilities , such as housing, water supply and sanitation facilities will increase pressure on the local services and generate substandard living standards and health hazards.	Contractor shall provide the following facilities in the campsites • Adequate housing for all workers • Safe and reliable water supply. Water supply from deep tube wells of 300 m depth that meets the national standards • Hygienic sanitary facilities and sewerage system. The toilets and domestic waste water will be collected through a common sewerage. Provide separate latrines and bathing places for males and females with total isolation by wall or by location. The minimum number of toilet facilities required is one toilet for every ten persons. • Treatment facilities for sewerage of toilet and domestic wastes • Storm water drainage facilities. Both sides of roads are to be provided with shallow v drains to drain off storm water to a silt retention pond which shall be sized to provide a minimum of 20 minutes retention of storm water flow from the whole site. Channel all discharge from the silt retention pond to natural drainage via a grassed swale at least 20 meters in length with suitable longitudinal gradient. • Paved internal roads. Ensure with grass/vegetation coverage to be made of the use of top soil that there is no dust generation from the loose/exposed sandy surface. Pave the internal roads of at least haring-bond bricks to suppress dusts and to work against possible muddy surface during monsoon. • Provide child crèches for women working construction site. The crèche shall have facilities for dormitory, kitchen, indoor and outdoor play area. Schools shall be attached to these crèches so that children are not deprived of education whose mothers are construction workers • Provide in-house community/common entertainment facilities. dependence of local entertainment outlets by the construction camps to be discouraged/prohibited to the extent possible.
Disposal of waste	Management of wastes is crucial to minimize impacts on the environment	The Contractor shall • Ensure proper collection and disposal of solid wastes within the construction camps • Insist waste separation by source; organic wastes in one pot and inorganic wastes in another pot at household level. • Store inorganic wastes in a safe place within the household and clear organic wastes on daily basis to waste collector. Establish waste collection, transportation and disposal systems with the manpower and equipments/vehicles needed. • Dispose organic wastes in a designated safe place on daily basis. At the end of the day cover the organic wastes with a

		thin layer of sand so that flies, mosquitoes, dogs, cats, rats, are not attracted. One may dig a large hole to put organic wastes in it; take care to protect groundwater from contamination by leachate formed due to decomposition of wastes. Cover the bed of the pit with impervious layer of materials (clayey or thin concrete) to protect groundwater from contamination. • Locate the garbage pit/waste disposal site min 500 m away from the residence so that peoples are not disturbed with the odor likely to be produced from anaerobic decomposition of wastes at the waste dumping places. Encompass the waste dumping place by fencing and tree plantation to prevent children to enter and play with. • Do not establish site specific landfill sites. All solid waste will be collected and removed from the work camps and disposed in approval waste disposal sites.
Fuel supplies for cooking purposes	Illegal sourcing of fuel wood by construction workers will impact the natural flora and fauna	The Contractor shall • Provide fuel to the construction camps for their domestic purpose, in order to discourage them to use fuel wood or other biomass. • Made available alternative fuels like natural gas or kerosene on ration to the workforce to prevent them using biomass for cooking. • Conduct awareness campaigns to educate workers on preserving the protecting the biodiversity and wildlife of the project area, and relevant government regulations and punishments on wildlife protection.
Health and Hygiene	There will be a potential for diseases to be transmitted including malaria, exacerbated by inadequate health and safety practices. There will be an increased risk of work crews spreading sexually transmitted infections and HIV/AIDS.	The Contractor shall • Provide adequate health care facilities within construction sites. • Provide first aid facility round the clock. Maintain stock of medicines in the facility and appoint fulltime designated first aider or nurse. • Provide ambulance facility for the laborers during emergency to be transported to nearest hospitals. • Initial health screening of the laborers coming from outside areas • Train all construction workers in basic sanitation and health care issues and safety matters, and on the specific hazards of their work • Provide HIV awareness programming, including STI (sexually transmitted infections) and HIV information, education and communication for all workers on regular basis • Complement educational interventions with easy access to condoms at campsites as well as voluntary counseling and testing • Provide adequate drainage facilities throughout the camps to ensure that disease vectors such as stagnant water bodies and puddles do not form. Regular mosquito repellant sprays during monsoon. • Carryout short training sessions on best hygiene practices to be mandatorily participated by all workers. Place display boards at strategic locations within the camps containing

		messages on best hygienic practices
Safety	In adequate safety facilities to the construction camps may create security problems and fire hazards	The Contractor shall • Provide appropriate security personnel (police / home guard or private security guards) and enclosures to prevent unauthorized entry in to the camp area. • Maintain register to keep a track on a head count of persons present in the camp at any given time. • Encourage use of flameproof material for the construction of labor housing / site office. Also, ensure that these houses/rooms are of sound construction and capable of withstanding wind storms/cyclones. • Provide appropriate type of firefighting equipments suitable for the construction camps • Display emergency contact numbers clearly and prominently at strategic places in camps. • Communicate the roles and responsibilities of laborers in case of emergency in the monthly meetings with contractors.
Site Restoration	Restoration of the construction camps to original condition requires demolition of construction camps.	The Contractor shall • Dismantle and remove from the site all facilities established within the construction camp including the perimeter fence and lockable gates at the completion of the construction work. • Dismantle camps in phases and as the work gets decreased and not wait for the entire work to be completed • Give prior notice to the laborers before demolishing their camps/units • Maintain the noise levels within the national standards during demolition activities • Different contractors shall be hired to demolish different structures to promote recycling or reuse of demolished material. • Reuse the demolition debris to a maximum extent. Dispose remaining debris at the designated waste disposal site. • Handover the construction camps with all built facilities as it is if agreement between both parties (contactor and land-owner) has been made so. • Restore the site to its condition prior to commencement of the works or to an agreed condition with the landowner. • Not make false promises to the laborers for future employment in O&M of the project.

ECP 17: Cultural and Religious Issues

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Construction activities near religious and cultural sites	Disturbance from construction works to the cultural and religious sites, and contractors lack of knowledge on cultural	The Contractor shall • Communicate to the public through community consultation and newspaper announcements regarding the scope and schedule of construction, as well as certain construction activities causing disruptions or access restriction.

	issues cause social disturbances.	• Do not block access to cultural and religious sites, wherever possible • Restrict all construction activities within the foot prints of the construction sites. • Stop construction works that produce noise (particularly during prayer time) shall there be any mosque/religious/educational institutions close to the construction sites and users make objections. • Take special care and use appropriate equipment when working next to a cultural/religious institution. • Stop work immediately and notify the site manager if, during construction, an archaeological or burial site is discovered. It is an offence to recommence work in the vicinity of the site until approval to continue is given by the CSC/PMU. • Provide separate prayer facilities to the construction workers. • Show appropriate behavior with all construction workers especially women and elderly people • Allow the workers to participate in praying during construction time • Resolve cultural issues in consultation with local leaders and supervision consultants • Establish a mechanism that allows local people to raise grievances arising from the construction process. • Inform the local authorities responsible for health, religious and security duly informed before commencement of civil works so as to maintain effective surveillance over public health, social and security matters

ECP 18: Worker Health and Safety

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines
Best practices	Construction works may pose health and safety risks to the construction workers and site visitors leading to severe injuries and deaths. The population in the proximity of the construction site and the construction workers will be exposed to a number of (i) biophysical health risk factors, (e.g. noise, dust, chemicals, construction material, solid waste, waste water, vector transmitted diseases etc),	The Contractor shall • Implement suitable safety standards for all workers and site visitors which shall not be less than those laid down on the international standards (e.g. International Labor Office guideline on ‘Safety and Health in Construction; World Bank Group’s ‘Environmental Health and Safety Guidelines’) and contractor’s own national standards or statutory regulations, in addition to complying with the national standards of the Government of Bangladesh (e.g. `The Bangladesh Labor Code, 2006’) • Provide the workers with a safe and healthy work environment, taking into account inherent risks in its particular construction activity and specific classes of hazards in the work areas, • Provide personal protection equipment (PPE) for workers, such as safety boots, helmets, masks, gloves, protective clothing, goggles, full-face eye shields, and ear protection. Maintain the PPE properly by cleaning dirty ones and replacing them with the damaged ones. • Safety procedures include provision of information,

	(ii) risk factors resulting from human behavior (e.g. STD, HIV etc) and (iii) road accidents from construction traffic.	training and protective clothing to workers involved in hazardous operations and proper performance of their job • Appoint an environment, health and safety manager to look after the health and safety of the workers • Inform the local authorities responsible for health, religious and security duly informed before commencement of civil works and establishment of construction camps so as to maintain effective surveillance over public health, social and security matters
	Child and pregnant labor	The Contractor shall • not hire children of less than 14 years of age and pregnant women or women who delivered a child within 8 preceding weeks, in accordance with the Bangladesh Labor Code, 2006
Accidents	Lack of first aid facilities and health care facilities in the immediate vicinity will aggravate the health conditions of the victims	• Provide health care facilities and first aid facilities are readily available. Appropriately equipped first-aid stations shall be easily accessible throughout the place of work • Document and report occupational accidents, diseases, and incidents. • Prevent accidents, injury, and disease arising from, associated with, or occurring in the course of work by minimizing, so far as reasonably practicable, the causes of hazards. In a manner consistent with good international industry practice. • Identify potential hazards to workers, particularly those that may be life-threatening and provide necessary preventive and protective measures. • Provide awareness to the construction drivers to strictly follow the driving rules Provide adequate lighting in the construction area and along the roads
Construction Camps	Lack of proper infrastructure facilities, such as housing, water supply and sanitation facilities will increase pressure on the local services and generate substandard living standards and health hazards.	The Contractor shall provide the following facilities in the campsites to improve health and hygienic conditions as mentioned in ECoP 17 Construction Camp Management • Adequate ventilation facilities • Safe and reliable water supply. Water supply from deep tube wells that meets the national standards • Hygienic sanitary facilities and sewerage system. The toilets and domestic waste water will be collected through a common sewerage. • Treatment facilities for sewerage of toilet and domestic wastes • Storm water drainage facilities. • Recreational and social facilities • Safe storage facilities for petroleum and other chemicals in accordance with ECoP 2 • Solid waste collection and disposal system in accordance with ECP1. • Arrangement for trainings • Paved internal roads. • Security fence at least 2 m height. • Sick bay and first aid facilities
Water and	Lack of Water sanitation	The contractor shall provide portable toilets at the construction

sanitation facilities at the construction sites	facilities at construction sites cause inconvenience to the construction workers and affect their personal hygiene.	sites, if about 25 people are working the whole day for a month. Location of portable facilities shall be at least 6 m away from storm drain system and surface waters. These portable toilets shall be cleaned once a day and all the sewerage shall be pumped from the collection tank once a day and shall be brought to the common septic tank for further treatment. Contractor shall provide bottled drinking water facilities to the construction workers at all the construction sites.
Other ECPs	Potential risks on health and hygiene of construction workers and general public	The Contractor shall follow the following ECPs to reduce health risks to the construction workers and nearby community ECoP 2: Fuels and Hazardous Goods Management ECoP 4: Drainage Management ECoP 10: Air Quality Management ECoP 11: Noise and Vibration Management ECoP 15: Road Transport and Road Traffic Management ECoP 16: River Transport management
Trainings	Lack of awareness and basic knowledge in health care among the construction workforce, make them susceptible to potential diseases.	The Contractor shall • Train all construction workers in basic sanitation and health care issues (e.g., how to avoid malaria and transmission of sexually transmitted infections (STI) HIV/AIDS. • Train all construction workers in general health and safety matters, and on the specific hazards of their work Training shall consist of basic hazard awareness, site specific hazards, safe work practices, and emergency procedures for fire, evacuation, and natural disaster, as appropriate. • Commence the malaria, HIV/AIDS and STI education campaign before the start of the construction phase and complement it with by a strong condom marketing, increased access to condoms in the area as well as to voluntary counseling and testing. • Implement malaria, HIV/AIDS and STIeducation campaign targeting all workers hired, international and national, female and male, skilled, semi- and unskilled occupations, at the time of recruitment and thereafter pursued throughout the construction phase on ongoing and regular basis. This shall be complemented by easy access to condoms at the workplace as well as to voluntary counseling and testing.

ECP 19: Tunneling and Underground Construction Works

Project Activity/ Impact Source	Environmental Impacts	Mitigation Measures/ Management Guidelines

Ventilation	Poor ventilation results in to oxygen depletion and exposure to excessive heat and fumes, which can lead to acute or long-term health problems;	The Contractor shall • Supply fresh air to all underground work areas in sufficient amounts to prevent any dangerous or harmful accumulation of dusts, fumes, mists, vapors, or gases. • Provide mechanical ventilation to ensure oxygen is available for respiration from fresh air; have enough air flow to eliminate or minimize contaminants; and provide cooling for people working in warm and humid environments. • Follow technical specifications in the bid documents for ventilation and lighting for underground works. international standards (OSHA, BSS, Australian, etc.) and industry best practices while determining the quantity of air to be supplied or extracted from the tunnels.
Atmospheric pollution	Release of toxic gases, fumes and vapors.	The Contractor shall • Identify possible sources of the generation of dust in a tunnel and control measures implemented to eliminate or minimise, so far as is reasonably practicable, the generation of the dust at the source. • Maintain extraction at or close to the point of • Use extractors or dust collection devices in-line near the face • Increase ventilation capacity by increasing the extraction rate when and where needed • Use wet spraying to suppress dust at the point of generation e.g. conveyors, spoil heaps after blasting, while loading and on roadways • providing PPE like respirators rated for the concentration and duration of exposure
Work Place Facilities	All underground workers should have access to adequate water and sanitation facilities	The Contractor shall • Provide adequate facilities for workers including toilets, drinking water, washing facilities and eating facilities • Ensure the facilities are maintained in good working order, clean, safe and accessible • Ensure the eating facilities (crib rooms) should be away from dusty environments • Ensure regular collection and disposal of solid waste and other construction waste from underground areas.
Heat Stress	Heat stress causes tiredness, irritability, light-headedness, muscular cramps, etc.	The Contractor shall • Regulate the air flow or modifying ventilation to ensure cooling • Reduce items of heat producing equipment in the tunnel • Provide extra ventilation fans to create air flows in low-flow areas • Provide cool drinking water
	Fire and explosion	The Contractor shall • Conduct fuelling in designated fueling bays • Eliminate ignition sources underground where practicable • Isolate fuel sources from remaining ignition sources • Remove potential fuel sources from the work area • Store only necessary fuel underground • Implement fire fighting training and procedures • Ensure availability of fire fighting resources • Restrict smoking to designated areas
	Collisions with moving plant (vehicle and	The contractor shall • plan pedestrian movements are separated from vehicle movements

	equipment)	• providing lighting for safe movement • provide a system to warn workers when plant is reversing or special loads like explosives are being moved
Emergency Response	Emergency Plan	The Contractor shall prepare an emergency response plan with • emergency procedures including • an effective response to an emergency • evacuation procedures • notifying emergency service organisations at the earliest opportunity • effective communication between the person authorised by the person conducting the business or undertaking to co-ordinate the emergency response and people at the workplace • testing emergency procedures including the frequency of testing, and • Information, training and instruction to relevant workers about implementing the emergency procedures.
	Check-in/check-out procedures	The Control shall • Maintain a check-in/check-out procedure to ensure that above ground personnel maintain an accurate accounting of the number of persons underground and to prevent unauthorized persons from gaining access to the site. This is especially important in the event of an emergency but is a common sense requirement at all times. • Any time an employee is working underground, at least one designated person must be on duty above ground. This person is responsible for calling for immediate assistance and keeping an accurate count of employees who remain underground in the event of an emergency.
	Communication system	• The contractor shall establish a communication system throughout the construction site to pass the information and instructions, the monitoring of systems and the control of operations such as lifting; transporting persons, materials and plant; coordinating maintenance and managing emergencies.

Annex 6 Participants Attendance Sheets at Public Consultations

31st December 2015 at Ghazi

Consultation Workshop
Tarbela 5th Extension Hydropower Project
Attendance Sheet

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Consultation Workshop
Tarbela 5th Extension Hydropower Project
Attendance Sheet

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Consultation Workshop
Tarbela 5th Extension Hydropower Project
Attendance Sheet

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63	Zaheer Rehman	03015659108	[illegible]

1st January 2016 at At Kamalpur Miyan

ATTENDANCE SHEET FOR PUBLIC HEARING OF ISLAMABAD WEST GRID STATION

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Annex 7 Social Action Plan for Resolution of Pending Resettlement Cases of Tarbela and Ghazi Barotha Projects

(prepared by WAPDA as part of Tarbela 4th Extension Hydropwer Project in 2011)
(reproduced here from copy available at the World Bank website http://documents.worldbank.org/curated/en/2011/08/15668007/pakistan-tarbela-fourth-extension-hydropower-project-resettlement-plan)

1. Background and Objectives of Action Plan

1.1 Tarbela Dam and Ghazi Barotha Projects

The Tarbela Dam Project (TDP) was constructed on the River Indus in the Khyber Pakhtoon khwa (KPK) Province of Pakistan. The dam construction was completed in 1976 resulting in a reservoir consisting of an area of about 260 square kilometres. Project impacts included land acquisition and resettlement. In the 1990s, the Ghazi Barotha Hydropower Project (GBHP) was designed to generate 1,450 MW of energy. Addressing TDP outstanding resettlement claims was part of GBHP loan conditions. The Environmental and Resettlement Management Plan included an Integrated Rural Development Plan to address project induced impacts and promote long term sustainable development in the project area. A Panel of Experts (POE) for environmental and social/resettlement issues was established. A project NGO “Ghazi Barotha Tarqiati Idara” (GBTI) was established to facilitate resettlement process in a smooth and transparent manner. WAPDA provided funding for its formation in the form of a trust fund with Rs.100 million as seed money. Interest on the fund was utilized to manage its administrative overheads and field operations.

1.2 Resettlement Impacts, Activities and Outstanding Issues under TDP and GBHP

The reservoir of Tarbela submerged 120 villages. About 82,000 acres of land was acquired and 96,000 people were displaced as project affectees. Resettlement Planning for TDP was based on the Pakistan Land Acquisition Act (1894 and its subsequent amendments). The main work related to Tarbela Dam resettlement was completed by the beginning of July 1985. However, many resettlement issues remained unsettled.

To address the outstanding claims, the Tarbela Dam Commission was established in 1998. Through newspaper advertisements, people with claims still outstanding were invited to inform the Commission. Consequently, the Commission received 12,000 applications including 112 applications already pending with WAPDA and 385 applications from tribal areas. The review committee determined that a total of 2,197 farms and 1,282 residential plots had not been compensated despite claimants being entitled to this through the resettlement plan and that 4,089 additional claims for farms and 7,649 for residential plots were justified. On completion of its tenure in 1999, the Commission submitted its conclusions and recommendations with a view to settling the claims of the Tarbela Dam affectees. These were accepted and adopted as the updated inventory of outstanding resettlement claims under Tarbela Dam Project. A series of follow up actions were then passed to GBHP to address. Nevertheless, some Tarbela Dam claims remain outstanding.

The GBHP required a total of 4,770 hectares of land to build, 1,180 hectares for the barrage and pond, 2,640 hectares for power channel and 950 hectares for the power complex at Barotha in Attock district of Punjab Province.. About 179 families (involving 899 persons) were relocated. A Resettlement Plan was developed with the objective to improve /restore the standard of living and earning capacity of all affectees. However, its implementation experienced various difficulties, leading to many court cases by both the affectees and WAPDA. Some of these continue outstanding today.

1.3 Brief Description of the Tarbela 4th Extension Project

The Water and Power Development Authority (WAPDA) in Pakistan, through funding by the World Bank (WB), has commissioned a Feasibility Consultant to conduct an environmental and social impact assessment in accordance with the Pakistan national permitting process and WB financing guidelines for the “Tarbela 4th Extension Project” (hereafter referred to as the Project).

Pakistan continues to face a severe power deficit. Enhancement of power generation capacity of the Tarbela Dam is one of the cheaper options of power generation available. Therefore, the Project has been planned to produce additional1350 MW electricity by installing three turbines at tunnel No. 4 of Tarbela Dam without affecting water supply for irrigation.

The Tarbela Dam is located on the Indus River in the Khyber Pakhtunkhwa (KPK) Province of Pakistan at a distance of about 70 km from the capital Islamabad in both Swabi and Haripur Districts. The salient features of the proposed Project are set out in the table below.

Table 1.1 Salient Features of the Tarbela 4th Extn. Project

Parameter	Detail
Tunnel 4	
Location	Tunnel 4 runs from the intake and through the right abutment of the dam for approximately 900m. The downstream control structure is connected to the tunnel at the portal in the rock face. The control structure is located between the foot of a steep slope to the west and the tunnel No.3 control structure to the east.
Purpose	Irrigation releases when reservoir level below the spillway level
Type	Concrete/Steel Lined
Cross Section	Circular 13.7 m – 11 m
Length	914 m
Outlet Type	Flip Bucket
Intake Level	353.6 m at Invert
Design Flow	2000 m3/s
Proposed Powerhouse	
Location	Location B-1 was chosen as the site for the powerhouse
Type of Turbine	Vertical Francis Turbine
Number of Units	3
Unit Generator Rating	450 MW

Parameter	Detail
Total Generating Capacity	1,350 MW
Type of Generator	Vertical Shaft Umbrella
Generating Voltage	18 kV or 20 kV
Turbine Centre Line Level	327.6 m
Annual Energy	2,809 GWh
Tailrace Channel	
Length	Water flows directly from turbines to Ghazi Barotha head pond
Type	Not available
Tailrace Water Level	Between EL 344.1 m and 335.3 m
Penstock Connection to Tunnel 4	
Type of Penstock	Steel, probably concrete encased and buried

Source: T4CJV

The main construction site would be at Tunnel 4 and areas directly adjacent to construction material storage places, excavated material dumping sites, borrow areas, vehicles and other machinery parking areas would be located. WAPDA owns the land where the Project activities will take place and the infrastructure built. The land is currently uninhabited and has low productivity value. The land required for expanding the switchyard and upgrading the access roads is also unused.

The proposed Project has no resettlement and rehabilitation issue and minimal environmental and social adverse impacts. However, to make the Project socially acceptable and beneficial for the local communities some enhancement measures have been included in the Project design. Resolution of pending resettlement and rehabilitation issues of Tarbela Dam and Ghazi Barotha projects is a key measure identified.

1.4 Objectives of Action Plan

The present Action Plan has been developed on the basis of a review conducted in August 2010 of the past and the current situation regarding resettlement claims for TDP and GBHP. Results of the review include an analysis of outstanding claims and consultation with a range of claimants and stakeholders.

The main objective of this Action Plan is to facilitate a faster process to conclude all land and resettlement related Tarbela and GBHP outstanding cases pending with various courts of law. The current Action Plan is a follow up of the Retrofit Resettlement Action for Tarbela Dam, developed and implemented under GBHP, on the basis of the Commission's findings and recommendations. This Action Plan is developed specifically for the known outstanding resettlement claims pending with various courts and is not meant to review and address any fresh claim.

During the past few decades of Tarbela Dam impacts, the affected population, including these who relocated to the developed resettlement sites, have achieved progress in their livelihoods while some are still experiencing difficulties due to various factors. Part of the profits generated under the Tarbela Hydro Project is allocated to the provincial authority and this fund is expected to help support and improve the general development in the project areas and benefit its population at large, including the affected population. This Action Plan is not meant to address the development challenges and needs of the local population, including the affected population under the old Tarbela Hydropower Project and the Ghazi

Barotha Project. However it is aimed at resolving long standing court cases to the possible satisfaction of the affecteees involved in claims.

1.5 Action Plan Structure

This Action Plan identifies arrangements that build on the recommendations of the resettlement legacy assessment report. The Action Plan is structured to present the:

- resettlement claim legacy and action plan coverage;
- implementation approach and arrangements;
- costs of pending claims and action plan budget; and,
- Organisational arrangements.

2 Resettlement Claim Legacy and Action Plan Coverage

2.1 Overview

This section provides key details of the outstanding claims of the TDP and GBHP. Appendix A provides further details and a full analysis is presented in the Assessment Report on Resettlement Issues for Tarbela and Ghazi Barotha Projects dated March 2011.

2.2 Existing Tarbela Dam Claims

As of June 2010 according to WAPDA, there were 40 existing outstanding claims, 27 with District Courts, 10 pending with the High Court Peshawar Circuit Bench at Abbottabad, and three under trial at the Supreme Court/Sharriah Court in Islamabad. **Error! Reference source not found.** summarises the category and court location for the pending resettlement and grievance cases for TDP.

Table 2.1: Distribution of Pending TDP Court Cases by Court of Law

Category	Court of Law			Total
	Lower Court	High Court	Supreme/Sharrih Court	
Compensation	09	03	02	14
Recovery/ Overpayment	-	03	-	03
Allotment/ Transfer of plot	11	01	-	12
Land possession	06	-	-	06
Others	01	03	01	05
TOTAL	27	10	03	40

Source of data for MMP analysis: WAPDA Resettlement and Legal Cell, Ghazi, July 2010.

There are ten TDP cases in the higher courts. These courts are already overburdened with cases of national and provincial interests. Cases of such minor nature may not be given priority by these courts and consequently these cases are likely to be further delayed. Appendix A provides additional details of the 40 pending cases under trial in various courts.

The total disputed amount from the Tarbela Dam resettlement claims and related issues was Rs. 182,437,263 as of June 2010. Out of this, Rs. 13,621,218 was claimed by WAPDA in respect of recovery for over payment and an amount of Rs.168,816,045 was by Project Affectees (PAs) against compensation package enhancement, interest and compensation against land. The compensation amounts (requested by the seven affectees) analysed are individually considered to be small and basically insignificant in magnitude.

WAPDA has already deposited its share for potential compensation payments with GoP treasuries through district collectors in Haripur and Mansehra. The compensation amount deposited by WAPDA is invested in various national investment schemes. The affectees will get compensation amount with interest (profit), if decisions are given in their favour by the Court.

2.3 Existing Ghazi Barotha Claims

As of mid July 2010 according to WAPDA, there were 410 pending court cases related to GBHP, 279 cases in Punjab Province and 131 in KPK Province. See **Error! Reference source not found.** for details. The majority of GBHP outstanding cases are recovery/overpayment claims by WAPDA against PAs, of which 207 (51 percent) are in the Province of the Punjab concentrated in two villages of Attock District. A vast majority of cases (285 or 69.5%) are under trial in lower level District courts. Tables 4.2, 4.3 and 4.4 provide statistics on pending court cases by category, province, claimant and court of law.

Table 2.2: GBHP Pending Cases by Province and Category

Category	Province		
	Punjab	KPK	Total
Compensation	61	79	140
Recovery/ Overpayment	207	35	242
Allotment/ Transfer of Plot	-	05	05
Land Possession	-	03	03
Others	11	09	20
Total	279	131	410

Source of data for MMP analysis: WAPDA Resettlement and Legal Cell, Ghazi, July 2010.

Table 2.3: GBHP Pending Claims by Type of Court and Province

Courts	Province		Total
	Punjab	KPK	
Lower	212	73	285
High	62	44	106
Supreme	05	14	19
Total	279	131	410

Source of data for MMP analysis: WAPDA Resettlement and Legal Cell, Ghazi, July 2010.

Table 2.4: Province Wise Distribution of GBHP Pending Cases by Appellants

Province	Affectees Vs. WAPDA	WAPDA Vs. Affectees, LACs and Patwaris	Affectees Vs. Affectees	Total
Punjab	66	212	01	279
KPK	83	34	14	131
Total	149	246	15	410

Source of data for MMP analysis: WAPDA Resettlement and Legal Cell, Ghazi, July 2010.

The analysis of pending court cases has already been discussed in our earlier Assessment Report on Resettlement Issues for Taebela and Ghazi Barotha Projects.

2.4 Resolution of Pending Cases

A vast majority (93 %) of the affectees surveyed for the legacy study indicated they were willing to resolve their claims out of court. See details in Table 2.5:.

Table 2.5: Surveyed Affectees' Willingness to Resolve Pending Resettlement Issues Out of Court

Project and Province	Yes Number	%	No Number	%	Total
Tarbela Dam	4	100			4
Ghazi Barotha	38	93	3	7	41
Punjab	27	96	1	4	28
KPK	11	85	2	15	13
TOTAL	42	93	3	7	45

Source: MMPakistan

3 Implementation Approach and Arrangements

3.1 Overview

Various options were discussed to speed up the process to conclude the cases out of court. These options included village Jirga, council of elders, commissioners' appointment and jointly empowered commission of WAPDA and affectees.

After thorough investigation of the complex problem of resettlement claims pending with various courts of law and on the basis of feedback of consultation process, we enunciated a novel approach of "Resettlement Claim Commissioner" for prompt and satisfactory resolution of these issues. This approach is the basis of this Action Plan. Implementation details for this option are presented below with regard to Commissioner's selection criteria and procedures, office establishment and staffing, working procedures, the grievance mechanism and implementation schedule.

3.2 The Resettlement Claim Commissioners Resolution Mechanism

The mechanism suggested for the resolution of resettlement issues (pending court cases) of Tarbela and Ghazi Barotha is the appointment Resettlement Claim Commissioners, one placed at Hattian and other at Haripur. The mechanism was evolved as an outcome of thematic exercise, literature review and consultation with WAPDA officials, NGOs and project affectees (claimants). The elected Mechanism (Resettlement Claim Commissioners) was prioritized by a vast majority of stakeholders. Moreover, the mechanism is believed to be in line with the philosophy of the World Bank Resettlement Policy. Mechanism is also considers an independent and impartial commission which produce just decisions after hearing both the parties.

3.3 Selection Criterion and Procedures

The selection of two Commissioners would be based on:

- Senior practicing lawyer / retired judge of High Court/Session Court/retired government official with vast experience in the field of revenue, general administration and having sufficient knowledge of land cases;
- Having linguistic abilities for the concerned district;
- Having a reputation for integrity and being honest, and
- Possessing at least ten years relevant experience, for instance dealing with civil suit cases related to revenue, land or property disputes.

The WAPDA Legal Advisor will be responsible for approaching candidates and advertising the positions to shortlist a reasonable number of competent candidates. An interviewing panel involving a team of three members (for instance a representative of WAPDA, a representative of Ministry of Water and Power, and Registrar, Peshawar High Court Bench, Abbottabad). The panel will interview the short listed candidates to select the two appropriate candidates. The selection of the candidates would be approved by the Ministry of Water and Power. WAPDA will appoint two Commissioners and enter into an eight month agreement with them.

3.4 Office Establishment and Staffing

Offices of Resettlement Claim Commissioners will be established at Hattian (probably in the premises of GM office GBHP) and Haripur. WAPDA would provide office space with furniture and fixture and will be responsible for utility expenses.

Each Commissioner will be supported by social mobilisation staff, a record keeper and an attendant along with security arrangements by WAPDA.

3.5 Working Procedures

It is anticipated that the working procedure will consist of social mobilisation, the organisation of hearings, the signing of applications to withdraw pending court claims, decision making by the Commissioners and payments. These are discussed in more detail below. :

3.5.1 Activation of Social Sciences Branch (SSB)

Social Sciences Branch(SSB) of WAPDA will be reactivated to provide momentum to the activities of the commissioners by mobilizing the claimant for the withdrawal of cases from the courts, reaching an agreement with claimants for cases with drawl and resolves these cases by adopting commissioners mechanism. Social mobilization teams will be organized keeping in view the number of claimant to be consulted and spread of claimants.

3.5.2 Social Mobilization

Social mobilization will be necessary to approach affectees involved. The social mobilization team will consist of experts, with rich experience working with rural communities and grievance redress to be selected from SSB of WAPDA. Head of the SSB will lead the Social Mobilization Team.

Social Mobilization Teams will obtain complete record of claims, lying within their respective area of operations, from Legal Branch of WAPDA. After receiving the record teams will formulate a detailed schedule of mobilization under the leadership the head of SSB. Mobilization will consist of two phases. During first phase, teams will survey the area and will inform the claimant about their purpose of visit, exchanging general information regarding the resolution activities and intended negotiation and resolution process.

The first phase mobilization visits will also involve leaving a brochure which describes the objectives of the Resettlement Claim Commissioners resolution mechanism, the main steps involved in organising a hearing to explain the proposed mechanism, its intention, setup, procedures and operating principles as well as the pros and cons vs the traditional court approach..In the second phase mobilisation will include more detailed consultation with claimants over the pros and cons, advantages and disadvantages of the proposed faster approach vs the court approach. The team will explain the options and work with the claimants for their thorough understanding. The team will help reach a decision over the options and for withdrawal of cases from the courts. The consultation process may be conducted at village common place (mosque, school or any meeting place). It is recommended that simple cases that are likely to be resolved quickly be dealt at the beginning for the teams to gather experience of negotiation process. Mobilization teams will seek the cooperation of local communities or the successful completion of their task.

3.5.3 Revival of Land Acquisition and Resettlement Committee (LARC)

Land Acquisition and Resettlement Committee (LARC) will be revived, LARC will also include two additional members, apart from its regular body, representing horizontal (bonding) and vertical (bridging) social capital from affected villages. Inclusion of these members will strengthen the LARC. The revival of LARC will be beneficial for the efficient and prompt functioning of the resolution mechanism as the organisation has the experience of Implementation of resettlement plans of Tarbela and Ghazi Barotha Projects. The LARC will play an advisory function and assist the social mobilization team. LARC will report to the Team Leader of the Social Mobilization Team. It will perform the following tasks.

- Resolutions of problem encountered by social mobilization teams during mobilization process.
- Facilitation to social mobilization process in reaching at an informal agreement for withdrawal cases from courts and developing consensus among both the parties.

- Conducting joint meetings with claimants and social mobilization teams in collaboration with SSB to resolve grievances at the possible extent at claimants door steps prior to withdrawal agreement.
- LARC will hold such meetings twice a month in the affected villages at common places such as mosque or school.

3.5.4 Withdrawal of Cases from Courts

On successful mobilization and reaching on consensus, the cases will be referred to Legal Branch of WAPDA at Ghazi for withdrawal, which will prepare withdrawal document (application) complying the court procedure. The withdrawal document will also include the condition of acceptance of commissioners' decision by both the parties (WAPDA and claimant).

3.5.5 Hearings

After withdrawal the cases will be referred to commissioners for hearing and decision. One of the first tasks to be completed by the Resettlement Claim Commissioners upon appointment will be deciding on the accepted hearing format or formats (claims involving group actions may have a different format than that involving individuals). The format agreed upon will identify the amount of time each side has for present their case, and the amount of time the Resettlement Claim Commissioners have for announcing their decision. It is anticipated that one sitting with no more than multiple days be allowed.

In principle, both sides will require equal opportunity and time to present their evidence and claims. All claimants will be informed of the process so they can properly prepare. All claimants, in particular project affectees, will be allowed to invite a personal representative to help present their claim request and negotiate with or on their behalf.

The hearing will be presided over by the Resettlement Claim Commissioner and follow the agreed format. The minutes of hearings will be prepared by the assistants of commissioners.

3.5.6 Claim Decision

After withdrawal from courts the cases will be referred for decision..Commissioner will give his decision after hearing. Each case will be decided in a single hearing to avoid further delay In the absence records or record gaps, verbal evidence will be given sufficient merit for case decisions The hearing environment will be kept democratic and friendly rather than traditional court atmosphere. Each commissioner will decide at least five cases during a week. The decision of the Commissioner will be considered final and will not be challengeable in any court of law or authority.

3.5.7 Record Keeping

Commissioners will prepare the summary of each decision and maintain documentation of pending cases at their office. Copies of all decisions will be sent to the Legal Branch of WAPDA. Every two months the Commissioners will send status reports of pending cases to the Legal Branch of WAPDA. This procedure will help in monitoring the progress and adopting appropriate measures/actions, if required.

3.5.8 Mode of Payment

Based on the Commissioners' decisions, within seven working days the agreed amount will be paid through crossed cheque payable at local branches of the bank. Cheques may be delivered by the social mobilization team. The Superintending Engineer, Ghazi Barotha Hydropower Project, Ghazi shall be the Drawing and Disbursing Officer and will be responsible to issue cheques according to the Commissioner's decision..

3.6 Implementation Schedule

Recruitment of Resettlement Claim Commissioners, offices establishment and social mobilization teams formation will be completed prior to regular eight month's schedule during a month mentioned as zero month in the following Schedule. Depending on success levels, the results should be evaluated either internally or externally at the end of the eight months. If more than half are settled an external evaluation is recommended to capture the lessons learned. Commissioners will need to provide an end of contract report on progress, status, challenges and achievements. An eight month implementation period is detailed in the Table below.

Table 3.1: Indicative Implementation Schedule for Action Plan

Activities		Months								
		0	1	2	3	4	5	6	7	8
1	Recruitment and notification of Commissioners, social mobilization teams formation and support staff arrangement									
2	Decision on hearing formatting, schedule of work, production of brochure and other preparations for social mobilisation									
3	Social mobilisation to get claimants to agree to attend hearing									
4	Preparation of withdrawal agreements to sign at hearing									
5	Hearings									
6	Decisions by Commissioners									
7	Payments related to decisions									
8	Evaluation of process									

4. Cost of Pending Claims and Action Plan Budget

4.1 Overview

The Action Plan budget includes two parts. The first part is the cost of the out of court settlements to be determined by the appointed Commissioners and agreed among the relevant parties. The second part is the operation costs for the functioning of the resolution mechanism, namely the Commissioner option. These are detailed below.

4.2 Costs of Pending Claims in Various Courts of Law

The maximum amount of compensation claims required for the outstanding cases with various courts of Laws related to TDP is Rs.168.816 million claimed by affectees versus WAPDA. The amount claimed by

WAPDA versus affectees was Rs. 13.621 million. The total amount of claims currently pending in courts pending from TDP is presented in Table 13.1.

Table 13.1: Indicative Amount of Pending TDP Claims by Type of Court

Claimant	District Courts (Rs. Millions)	Higher Courts (Rs. Millions)	Total (Rs. Millions)
Affectees	26.816	142.000	168.816
WAPDA	3.005	10.616	13.621
Total	29.821	152.666	182.437

For GBHP, three sets of outstanding claims have implications for the compensation amount including those dealing with straightforward losses, those dealing with refunds and taxes, and the last, more complicated set dealing with loss of potential investment, land use and damages.

For the set of claims from affectees regarding loss of land, property, crop damage, trees and orchards, it is understood from WAPDA that a full (100%) amount of these claims based on the amount at the time of the claim has been set aside into Government Treasury or in the accounts of LAC. They are accruing interest which would go to the awardee along with the principal amount. This amount totals approximately Rs. 652.16 million (Rs. 650.36 million for land and structure and Rs.1.80 million for trees and orchards).

A second set of GBHP refers to claims by PAs to refund monies in the form of taxes and fees already spent that they wish to be reimbursed. It is understood that 100% of the required funds to address these cases totalling Rs 69.33 million has also been deposited. It is understood that WAPDA has set aside funding related to these two sets of claims which total approximately Rs721.49 million.

A third set of GBHP claims pertains to loss of potential investment from proprietary rights and in other cases for use of mineral extraction, fishing, etc which was not paid in addition to the resource itself. For this set of claims (which are called “reference claims” under 18/1 and 18/30), the original claimed amount for the reference cases has already been deposited in government treasury by WAPDA. There are about 40 reference claims in the Punjab and 39 reference claims in KPK. Details for the various types of claims, compensation amounts and availability of funds are provided in the table below.

Table 4.2: Indicative Compensation Payment Claims for GBHP

No	Item	Total (Rs. Millions)	Comment
1.	Land & Structure Compensation (Built up property)	650.36	WAPDA has money set aside for affectee claims
2.	Compensation against fruit/ fire wood trees	1.80	WAPDA has money set aside for affectee claims
3.	Twenty five percent of total claimed amount for compensation related to claims against land use and loss of investment	1019.17	Additional funds needed for these claims
4.	Refund of taxes/ fees	69.33	WAPDA has money set aside for affectee claims
	Indicative amount for resolving GBHP claims	1740.66	

Total costs for resolving TDP and GBHP Claims are provided in the following table..

Table 4.3: Indicative Cost Required for Resolving TDP and GBHP Claims

No	Item	Total (Rs. Millions)	Total (US$ Millions)
1	Tarbela Dam Project	168.82	2.01
2	Ghazi Barotha Hydropower Project	1740.66	20.72
	Total	1909.48	22.73

4.3 Operating Costs for the Resettlement Claim Commissioners

An operational budget for the Commissioners and their support team (social mobilizers, record keepers, and attendants) to function for eight months based on the implementation arrangements described in the previous chapter is summarised in Table 4.4.

Table 4.4: Operating Cost Estimates for Commissioners

No	Item	Total Rs	Total US$
a	Commissioners X 2 for 8 months at Rs.250,000/no	4,032,000	48,000
b	Office rent, furniture & utility bills X2 offices X8 mo	537,600	6,400
c	Social mobilisers – 4 at 50,000/month for 8 months each	1,600,000	19,050
d	Social mobilisation expenses - $2000 lump sum each for WAPD	336,000	4,000
e	Record keeper (2)and Assistants (2) at Rs. 40000 /month and attendant (2) at Rs. 20000/month for 8 mo each	1,600,000	19,050
f	Evaluation (external) costs	840,000	10,000
	Contingency56 (15 % of a+b+c+d+e+f)	1,341,840	15,940
	Total Operating Cost	10,287,440	122,440

Note: Based roughly on One US$=PK Rupee 84

[56] It includes honoraria and out of pocket expenses incurred by two additional members (social capital) suggested to be included in LARC body. However, amount of honoraria shall be determined by WAPDA authority PMU.

5. Organisational Arrangements

The sections below identify management responsibilities, monitoring arrangement and reporting needs.

5.1 Action Plan Management

The General Manager, Ghazi Barotha Hydropower Project (GBHP) based at Hattian will be responsible for overall implementation of the Action Plan. WAPDA will be responsible for holding any funds provided for settlements. They will also be responsible for managing the operating cost funds and paying salaries of staff in a timely fashion.

5.2 Monitoring Arrangements

Monitoring refers to a time bond process to judge performance in achieving objectives, in this case resolving and reducing the number of claims and disbursing funds to the satisfaction of those involved in the claims. Monitoring will also review the implementation of activities by comparing the allocated budget and actual expenditures.

The Commissioners will be responsible for producing bimonthly status reports on activities. The format of these reports will be decided in collaboration with the WAPDA Project Monitoring Cell and the WAPDA Legal Department who will interested in the results. The status reports will include reporting on activities and processes undertaken as well as results. Progress and status of achievement need to be addressed as well as a summary of the challenges that have affected achievement.

At month eight, the Commissioners will both present end-of-contract evaluation reports regarding activities undertaken and completed. Each evaluation report should include at least a half page summary of issues addressed or which were attempted to resolve. The discussion should provide documentation of the actions and efforts made, regarding “successes and “Failures” of the plan.

5.3 Reporting Requirements

WAPDA will forward a midterm report (based on the Commissioner’s month four reports) and final report (based on the Commissioners’ end of contract reports) to the World Bank.

Appendix A: Claim Details for Tarbela Dam and Ghazi Barotha

Status of Pending Court Cases Classified by Appellant, Court of Law and Duration of Cases for Tarbela Dam Project

Category	Appellant						Court of Law						Duration						Total
	Affectees vs WAPDA		WAPDA vs Affectees		Affectees vs Affectees		Lower Courts		High Court Peshwar and Bench at Abbotabad		Supreme Court/Federal Shriah Court Islamabad		1995-1999		2000-2005		2006-2010		
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	
Compensation	11	78.6	3	21.4	–	–	9	64.3	3	21.4	2	14.3	–	–	3	21.4	11	78.6	14
Recovery/ Overpayment	–	–	3	100.0	–	–	–	–	3	100.0	–	–	–	–	–	–	3	100.0	3
Allotment/ Transfer of Plot	12	100.0	–	–	–	–	11	91.7	1	8.3	–	–	–	–	–	–	12	100.0	12
Land Possession	2	33.3	3	50.0	1	16.67	6	100.0	–	–	–	–	–	–	5	83.3	1	16.7	6
Others	1	20.0	2	40.0	2	40	1	20.0	3	60.0	1	20.0	–	–	2	40.0	3	60.0	5
Total	26	65.0	11	27.5	3	7.5	27	67.5	10	25.0	3	7.5	–	–	10	25.0	30	75.0	40

Status of Pending Court Cases Classified by Appellant, Court of Law and Duration of Cases for Ghazi Barotha Hydropower Project (GBHP)

Category	Appellant						Court of Law						Duration						Total
	Affectees vs WAPDA		WAPDA vs Affectees		Affectees vs Affectees		Lower Courts		High Court (Lahore, Peshwar, Bench at Rawalpindi and Abbotabad)		Supreme Court/ Federal Shriah Court Islamabad		1995-1999		2000-2005		2006-2010		
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	
Compensation	126	90.0	1	0.714	13	9.3	66	47.1	65	46.4	9	6.4	4	2.9	57	40.71	79	56.4	140
Recovery/ Overpayment	4	1.7	237	97.93	1	0.4	199	82.2	39	16.1	4	1.7	–	–	189	78.1	53	21.9	242
Allotment/ Transfer of Plot	5	100.0	–	–	–	–	5	100.0	–	–	–	–	–	–	–	–	5	100.0	5
Land Possession	1	33.3	1	33.33	1	33.3	3	100.0	–	–	–	–	–	–	1	33.33	2	66.7	3
Others	13	65.0	7	35	–	–	12	60.0	2	10.0	6	30.0	2	10.0	5	25	13	65.0	20
Total	149	36.3	246	60	15	3.7	285	69.5	106	25.9	19	4.6	6	1.5	252	61.46	152	37.1	410

Note: Others include theft cases seniority dismissal cases on the part of WAPDA and issuance of gate pass, declatory suit, leasing rights of fisheries, dispute over record etc on the part of affectees.
_ Nil

Status of Pending Court Cases Classified by Appellant, Court of Law and Duration of Cases for Ghazi Barotha Hydropower Project (Punjab)

Category	Appellant						Court of Law						Duration						Total
	Affectees vs WAPDA		WAPDA vs Affectees		Affectees vs Affectees		Lower Courts		High Court (Lahore, Bench at Rawalpindi)		Supreme Court/ Federal Shriah Court Islamabad		1995-1999		2000-2005		2006-2010		
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	
Compensation	60	98	–	–	1	2	18	30	43	17	–	–	–	–	35	57	26	43	61
Recovery/ Overpayment	1	0.5	206	99.5	–	–	188	91	19	8	–	–	–	–	182	88	25	12	207
Allotment/ Transfer of Plot	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Land Possession	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Others	5	45	6	55	–	–	6	55	–	–	5	45	–	–	1	9	10	91	11
Total	66	23.6	212	76	1	0.4	212	76	62	22	5	2	–	–	218	78	61	22	279

3 of 4

Note: Others include theft cases seniority dismissal cases on the part of WAPDA and issuance of gate pass, declatory suit, leasing rights of fisheries, dispute over record etc on the part of affectees.
_ Nil

Status of Pending Court Cases Classified by Appellant, Court of Law and Duration of Cases for Ghazi Barotha Hydropower Project (KP)

Category	Appellant						Court of Law						Duration						Total
	Affectees vs WAPDA		WAPDA vs Affectees		Affectees vs Affectees		Lower Courts		High Court (Lahore, Peshwar, Bench at Rawalpindi and Abbotabad)		Supreme Court/ Federal Shriah Court Islamabad		1995-1999		2000-2005		2006-2010		
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	
Compensation	60	75.9	1	1.3	12	15.19	48	60.8	21	26.6	9	11.4	4	5.1	22	27.8	53	67.1	79
Recovery/ Overpayment	3	8.6	31	88.6	1	2.857	11	31.4	20	57.1	4	11.4	–	–	7	20.0	28	80.0	35
Allotment/ Transfer of Plot	5	100.0	–	–	–	–	5	100.0	–	–	–	–	–	–	–	–	5	100.0	5
Land Possession	1	33.3	1	33.3	1	33.33	3	100.0	–	–	–	–	–	–	1	33.3	2	66.7	3
Others	8	88.9	1	11.1	–	–	6	66.7	2	22.2	1	11.1	2	22.2	4	44.4	3	33.3	9
Total	83	63.4	34	26.0	14	10.69	73	55.7	43	32.8	14	10.7	6	4.6	34	26.0	91	69.5	131

Note: Others include theft cases seniority dismissal cases on the part of WAPDA and issuance of gate pass, declatory suit, leasing rights of fisheries, dispute