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RAPID ENVIRONMENT ANALYSIS AND EMMP

GOMAL ZAM MULTIPURPOSE DAM PROJECT

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GOMAL ZAM MULTIPURPOSE DAM PROJECT

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©USAID Energy Policy Program
House 4, Street 88, Sector G-6/3
Ataturk Avenue, Islamabad, Pakistan
Tel: +92 (51) 835 7072, Fax: +92 (51) 835 7071

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Executive Summary

This document presents the result of rapid environmental and social analysis, as well as the Environmental Mitigation and Monitoring Plan (EMMP) of the Gomal Zam Multipurpose Project, which is being constructed by the Government of Pakistan in South Waziristan Agency, Federally Administered Tribal Area (FATA), about 100 km west of Dera Ismail Khan (D. I. Khan), which is one of the southern districts of the Khyber Pakhtunkhwa (KP) province of Pakistan. This analysis is one of the several evaluations USAID is due diligently carrying out for the Project in response to a funding request from the Government of Pakistan.

Assignment Objective

The key objectives of the present assignment are to carry out a rapid environmental and social analysis of the under construction Project with the help of a field visit, and prepare an EMMP for: i) the remaining construction works at the dam and powerhouse sites; ii) the transmission line laying works; and iii) operation and maintenance of these facilities. Environment and social analysis of the irrigation network in the Project's command area is not included in the present assignment.

The present environmental/social analysis and the EMMP will be shared with WAPDA. Subsequently, WAPDA will seek Environmental Protection Agency's concurrence on this document.

Project Overview

Objectives of the Gomal Zam Multipurpose Project include supplying irrigation water to about 77,523 hectare (ha) of land, protecting the downstream areas from floods, and generating 17.4 MW of electricity. Being undertaken by the Government of Pakistan, the Project comprises a concrete dam on Gomal River, a powerhouse and a 55-km long transmission line connecting it with the Tank grid station, and a diversion barrage with an irrigation and drainage network downstream. The dam construction works are about 85% complete.

The dam and powerhouse are located in South Waziristan at Khajuri Kach, which is a deep and narrow gorge in the Gomal River, downstream of its confluence with the Zhob River. The reservoir area lies in South Waziristan and Zhob District (Balochistan). The diversion barrage is located in South Waziristan about 30 km downstream of the dam, and irrigation command area is located in Tank and D. I. Khan districts of the KP province.

The Gomal river originates in Afghanistan, and after entering in Pakistan, it receives water of Kundar river. The Zhob river, which originates in Balochistan, flows north-east to join the Gomal river, a few kilometers upstream from Khajuri Kach dam site. Gomal river then flows east-southeastward, and joins the Indus river south of D. I. Khan. The mean annual water flow in the Gomal river at the dam site is about 511 x 10^6 m^3 (0.414 million acre feet), corresponding to mean annual flow rate of 16.2 m^3/s.

A preliminary Environmental Impact Assessment (EIA) of the Project was carried out in 1995, however it did not meet the regulatory requirements. The apex environmental law in the Country is the Environmental Protection Act of 1997, which requires all projects having physical interventions to be preceded with EIA or Initial Environmental Examination, and also defines maximum permissible limits on the releases of various emissions and effluents.

Legislative Framework

The Pakistan Environmental Protection Act, 1997 (the Act) is the basic legislative instrument empowering the government to frame regulations for the protection of the environment. The Act is applicable to a broad range of issues and extends to socioeconomic aspects, land acquisition, air, water, soil, marine and noise pollution, as well as the handling of hazardous waste.

The Act requires an IEE to be conducted for any project involving physical works, or an EIA, if the project is likely to cause significant environmental impacts. The IEE or EIA report has to be submitted to the relevant EPA and their approval obtained, before construction can be started on the project. In addition, the Act prohibits the discharge or emission of any effluent, waste, air pollutant or noise in an amount, concentration or level in excess of the National Environmental Quality Standards (NEQS), and has prescribed penalties for those contravening the provisions of the Act.

According to the IEE/EIA Regulations 2000, the dams with reservoir having an area of more than 8 km^2 require an EIA to be carried out prior to the project construction. The reservoir of the Gomal Zam Project will have an area of 39 km^2; hence an EIA should have been carried out for the Project. Similarly, for constructing electricity transmission lines, EIA is required to be conducted, in accordance with these Regulations.

Description of Environment

The Gomal river originates from Shinkay Hills in Afghanistan. On entering in Pakistan, it receives water of Kundar river, a right bank tributary which forms a natural boundary between the two countries. Then it joins Indus river, south of

D. I. Khan. The Zhob river originates from Toba Kakar Range in Pakistan and flows north-east to join the Gomal river, a few kilometers upstream from Khajuri Kach dam site.

The catchment area (of the Gomal river at the dam site and gauging station is 32,780 km^2 (8.1 x 10^6 acres), including 17,540 km^2 (4.3 x 10^6 acres) from Gomal river and 15,240 km^2 (3.8 x 10^6 acres) from Zhob river. The mean annual runoff at the dam site is 511 x 10^6 m^3 (0.414 million acre-feet or MAF).

The watershed (area of influence) of the Gomal Dam presently displays features of high erodability, which may mainly be attributed to past deforestation. The present reference situation is therefore characterized by detrimental erosions in the catchment and high downstream ward sediment transport.

The watershed of Gomal Zam Dam Project is located in a semi arid climatic region. As a result the area is characterized by natural xerophitic vegetation, with slow plant regeneration. The development of tree is principally limited by the low rainfall (250 mm annually). No protected forest or wildlife protected area exists at or in the vicinity of the catchment or dam site.

Mahsoods and Wazirs are the main tribes living in South Waziristan, though Suleiman Khel, Bhittanis and Urmars are also present in the area. The literacy rate, access to educational and health facilities, and availability of infrastructure in FATA generally and South Waziristan particularly is lower than the rest of the Country. Cultivation and herding are the key occupations in the area.

The dam, as well as reservoir and its watershed are located in an area which is generally remote, desolate and barren. No settlements exist in the vicinity of the dam site; the reservoir area is also reported to be completely uninhabited.

Parts of the proposed command area, which is located in Tank and D. I. Khan districts, are currently irrigated with the Gomal river water.

Potential Impacts and Mitigation

The potentially significant issues relating to the Project's location and design – identified during the Preliminary EIA as well as the present assignment include: i) land sliding within the reservoir and soil erosion in the watershed area - and hence siltation in the reservoir; ii) erosion of riverbed downstream of dam caused by the release of silt-free water from the dam; iii) increased soil salinity in the command area caused by increased irrigation with the saline water; iv) decreased soil fertility in the command area caused by irrigation with the silt-free water; v) consequences of dam collapse; vi) modified water flow regime

after the completion of Project; vii) reservoir induced seismicity; viii) reservoir eutrophication; and ix) climate change effects.

Appropriate mitigation measures have been identified for most of the above potential adverse impacts. These include: i) planning and implementing watershed management and afforestation interventions to address reservoir siltation; ii) monitoring and repair of bridges and culverts across the Gomal river to address the river bed erosion downstream of the dam; iii) employing appropriate cultivation and irrigation techniques to address increased soil salinity; iv) rational use of fertilizers, integrated pest management, and other organic farming techniques to compensate for decreased soil fertility: and v) operation and maintenance of the dam and its auxiliaries within the design parameters and in accordance with the standard operating procedures to further reduce the remote possibility of the dam collapse.

For some of the other aspects such as reservoir induced seismicity, soil erosion at the construction sites, reservoir eutrophication, modified water flow regime, and climate change effects, additional studies will need to be carried out to determine the nature and extent of these potential issues and to identify appropriate mitigation measures.

The potentially significant adverse impacts associated with the Project's construction activities include soil and water contamination caused by improper waste disposal, air quality deterioration caused by exhaust emissions from vehicles and machinery, and safety hazards associated with the operation of heavy construction machinery, vehicular traffic, handling and storage of fuels and oils, heights, and high voltage. Similar concerns have been identified for the operation and maintenance phase of the Project. All of these concerns can be adequately addressed by implementing EMMP, adopting appropriate environment, health, and safety guidelines, and following the relevant standards as well as international best practices.

Environmental Mitigation and Monitoring Plan

The Environmental Mitigation and Monitoring Plan (EMMP) of the Project, prepared as part of the current assignment, provides the mechanism to implement the mitigation measures identified during the present environmental and social analysis. The EMMP includes a mitigation plan, which defines the mitigation actions against each of the potential adverse impacts. A monitoring plan is also included in the EMMP, which identifies the environmental and social parameters to be monitored during various project phases. EMMP also assigns responsibilities for the environmental management of the Project, in

addition to specifying trainings to be conducted to enhance the environmental and social performance of the Project.

The cost of EMMP implementation has been estimated to be Rs. 28.78 million (about US$ 339,000)[1]. This includes Rs.28.10 million as one time cost, and Rs. 0.68 million as recurrent costs on annual basis. However, these estimates do not include the implementation costs of various plans such as watershed management and afforestation plan, eutrophication control plan, and landscaping and plantation plan.

[1] US $ 1 = Pak Rupees 85.

List of Acronyms

BOD	Biological oxygen demand
D. I. Khan	Dera Ismail Khan
DISCOs	Distribution companies
ECA	Employment of Child Act
EEC	European Economic Community
EHS	Environment, Health, and Safety
EIA	Environmental Impact Assessment
EMMP	Environmental Management and Monitoring Plan
EPA	Environmental Protection Agency
EPC	Engineering, Procurement and Construction
ERP	Emergency response plan
FATA	Federally Administered Tribal Areas
FWO	Frontier Works Organization
GDI	Gender and development index
GoP	Government of Pakistan
GRAPs	Gender reform action plans
HDI	Human development index
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IPM	Integrated Pest Management
IUCN	International Union for Conservation of Nature
KP	Khyber Pakhtunkhwa
LAA	Land Acquisition Act
MAF	Million acre feet
MC	Management Consultants
MMR	Maternal mortality rate
NCSW	National Commission on the Status of Women
NEQS	National Environmental Quality Standards
NWFP	North West Frontier Province
OP	Operational Policy
O&M	Operation and Maintenance
Pak-EPA	Pakistan Environmental Protection Agency
PC-I	Proforma for obtaining project approval
PCB	Poly chlorinated biphenyl
PEPC	Pakistan Environmental Protection Council
PESCO	Peshawar Electric Supply Company
PM	Particulate matter

POPs	Persistent organic pollutants
PRSP	Poverty Reduction Strategy Paper
RCC	Roller compacted concrete
SOPs	Standards operating procedures
SWA	South Waziristan Agency
ToRs	Terms of Reference
UN	United Nations
USAID	United States Agency for International Development
USG	United States Government
WAPDA	Pakistan Water and Power Development Authority
WEC	WAPDA Environmental Cell
WB	World Bank

Conversion Table

1 meter	3.28 feet
1 km	0.62 miles
1 m^3	35.31 ft^3
1 m^3	0.00081 acre-feet
1 m^3/s	35.31 ft^3/s (cusecs)
1 hectare (ha)	2.47 acres

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1. Introduction

This document presents the result of environmental and social analysis, as well as the Environmental Mitigation and Monitoring Plan (EMMP) of the Gomal Zam Multipurpose Project, which is being constructed in South Waziristan Agency (SWA), Federally Administered Tribal Area (FATA), about 100 km west of Dera Ismail Khan (D. I. Khan), a southern district of the Khyber Pakhtunkhwa (KP) province of Pakistan (see **Figures 1.1** and **1.2** for Project location maps). The Government of Pakistan (GoP) has requested the United States Government (USG) to fund the Project, and in response, the USG through the United States Agency for International Development (USAID) is due diligently assessing various aspects of the Gomal Zam Project. To evaluate the environmental and social aspects of the Project, USAID, through its contractors, Advanced Engineering Associates International, has commissioned the present study.

1.1. Background

The Gomal Zam Multipurpose Project was first designed in 1960s, though some earlier field investigations date back to 1908. In 1963, the Pakistan Water and Power Development Authority (WAPDA) initiated the preliminary works at the site, including constructing the 50 mile (80 km) long road and site accommodation, as well as water and power supply arrangements. The Project was however discontinued due to resource constraints in the wake of the Indo-Pak war of 1965.

The Project was reactivated in 1983, and WAPDA appointed Coyne et Bellier of France as the Project Consultants. Additional investigations were carried out for the Project on the recommendations of the Consultants during 1987-89; subsequently a feasibility report was prepared in 1990, and a PC-I[2] in 1993. The feasibility was updated in 1994-95, as part of the additional studies conducted by Coyne et Bellier.

WAPDA awarded the construction contract to a Chinese firm in 2002; however the works had to be stopped due to the security concerns in 2004. In 2007, WAPDA awarded the Engineering, Procurement and Construction (EPC) contract to the Frontier Works Organization (FWO), who engaged the Chinese contractors for the construction works at the dam and powerhouse sites. The

[2] The PC-I is a document the Government prepares for describing its proposed project in detail. The PC-I after preparation is submitted to the competent authority, such as the Planning Commission, for review and according approval. Approved PC-I is necessary for undertaking any Government project.

construction works at the dam site are now nearing completion, whereas substantial works are still pending on the transmission line and irrigation network.

A preliminary Environmental Impact Assessment (EIA) of the Project was also conducted by the Consultants in 1995 as part of the additional studies mentioned earlier. This EIA report was not submitted to the Environmental Protection Agency (EPA) for their review and approval, primarily because it recommended a formal EIA to be conducted during the detailed design stage. However, this formal EIA was never carried out, and hence no approval was obtained from the EPA, although the environmental legislation was in place at that time in the form of the Pakistan Environmental Protection Ordinance, 1983.

No environmental management or monitoring is being carried out at the construction sites, primarily because no Environmental Mitigation and Monitoring Plan (EMMP) has ever been prepared for the Project.

The U.S. Government's Quick Impact Energy Program started in October 2009 to address Pakistan's severe electricity shortages that have created an energy crisis threatening the country's political and economic stability. As part of Phase-II of the Energy Program, the USG through USAID is considering Satpara and Gomal Zam multi-purpose projects for USG funding at the request of Government of Pakistan. Both projects are under different phases of construction and USAID is assessing the remaining work required for completion. For the purpose of projects' evaluation, USAID would want to ensure that the environmental assessments for both the projects are compliant with the local and US environmental regulations. To carry out this environmental assessment, the present study has been commissioned.

The present document provides the environmental analysis of the Gomal Zam Multipurpose Project; analysis of the Satpara Dam Project is presented under a separate cover.

1.2. Objective and Scope of Assignment

Objectives of the present assignment are to:

- review the preliminary "first stage" EIA report, which was prepared in 1995, as mentioned in **Section 1.1** above;
- carry out a rapid environmental and social analysis with the help of a field visit;
- determine any changes in the environmental and social conditions caused by the construction works; and

- prepare an Environmental Mitigation and Monitoring Plan (EMMP) for:
  - remaining construction works at the dam and powerhouse sites
  - transmission line laying works
  - operation and maintenance (O&M) of the Project.

The irrigation network to be established in the command area of the Project is not included in the present analysis.

During the present study, the Project EIA report prepared in 1995 was reviewed, a reconnaissance field visit was carried out, a rapid environmental and social assessment was conducted, and on the basis of this rapid assessment, the EMMP was developed – in line with the assignment objectives described above. No data was collected for the environmental or social conditions of the area; the baseline description in the present report is primarily borrowed from the preliminary EIA report. The terms of reference (ToRs) of the assignment are provided in **Appendix A**. The list of specialists who conducted the present assignment is provided in **Appendix B**.

1.3. Project Overview [3]

Objectives of the Gomal Zam Multipurpose Project are to supply irrigation water, to protect from floods, and to generate electricity. The Project comprises a concrete dam on Gomal River, a powerhouse and a transmission line connecting it with the Tank grid station, and a diversion barrage with an irrigation and drainage network downstream.

The dam and powerhouse are located in South Waziristan at Khajuri Kach, which is a deep and narrow gorge in the Gomal River, downstream of its confluence with the Zhob River. The reservoir area lies in South Waziristan and Zhob District (Balochistan). The diversion barrage is located in South Waziristan about 30 km downstream of the dam, and irrigation command area is located in Tank and D. I. Khan districts of the KP province.

The proposed irrigation network is composed of a main concrete canal, three existing canals (Macali, Wah, Khan Wand, and Waran), fifteen distributaries on the left bank and, and a separate canal on the right bank, directly off-taking from the diversion barrage at Kot Murtaza.

The dam and power house construction is about 85% complete. Further details of the Project and its components are provided later in the document.

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[3] Sources: C. Bellier, 1995. *Gomal Zam Additional Studies – Environmental Impact Assessment (First Phase)*. WAPDA 2010. *Gomal Zam Multipurpose Project – Revised PC-I Proforma*.

Scope of Activities Proposed for USG Funding

The Project components being considered for the USG funding include the dam and reservoir, powerhouse, and transmission line; the irrigation network is not being considered for the funding. Hence the present analysis covers the dam and powerhouse construction, laying of the transmission line, and the O&M activities of the dam and powerhouse.

1.4. Review of the Past Environmental Analysis

The existing preliminary EIA, conducted in 1995, has been reviewed as part of the present assignment. This was essentially a first phase EIA study, and as stated in its report itself, "… is not intended to fulfill the requirements of the complete EIA. The latter will be issued after the second (and final) phase of the environmental studies will have been performed during detailed design stage."[4] However, the second phase EIA was never carried out. The preliminary EIA was submitted to the EPA either, for their review and approval, which was a mandatory requirement in accordance with the legislation in place even at that time.

The key gaps in the EIA report are summarized below; the detailed findings of this review are provided in **Appendix C**.

- The project description is not complete, and no details are provided for the construction activities, contractors' facilities or their machinery, equipment, or manpower, type and quantities of different materials and supplies, vehicular traffic, temporary facilities, type and quantity of wastes and their disposal arrangements. Similarly for the operation and maintenance (O&M) phase, no information is provided such as: offices and residences; type and quantity of different and materials; waste management arrangements; vehicular traffic; and manpower requirements.
- The description of policy, legal; and regulatory framework relevant to the environmental and social aspects of the project is not complete.
- Discussion of the project alternatives (such as dam siting, dam type, powerhouse size and type, construction methodology, configuration, and others) and their environmental implications is missing.
- Assessment of impacts caused by the construction activities, and the associated mitigation measures is missing.

[4] C. Bellier, 1995. *Environmental Impact Assessment (First Phase), Gomal Zam Additional Studies*. (pp 1).

- No environmental mitigation and monitoring plan (EMMP) is provided that would summarize the environmental impacts and mitigation measures, institutional arrangements, roles and responsibilities, environmental monitoring requirements, documentation and reporting protocol, environmental training needs, environmental management costs, and other necessary details.

On the basis of the above shortcomings/gaps, the existing EIA does not comply with the national legal/regulatory requirements and the USAID environmental compliance procedures.

1.5. Document Structure

The present document has five additional Chapters. **Chapter 2** discusses the legislative, regulatory, and institutional frameworks relevant to the environmental and social management of the Project. The Project history, objectives, location, and other details of its components are detailed in **Chapter 3**. **Chapter 4** describes the baseline conditions of the Project area's physical, biological, and socioeconomic environment – as recorded during the Preliminary EIA in 1995; in addition to providing an overview of the changes in these conditions. Rapid environmental and social assessment of the Project carried out during the present assignment is provided in **Chapter 5**. **Chapter 6** presents the EMMP for the remaining construction as well as for the operation and maintenance (O&M) phase – for the portion of the Project being considered for USG funding. Finally, **Chapter 7** lists the bibliographical references and sources used in this document, and also international best practice links.

Figure 1.1: Project Location

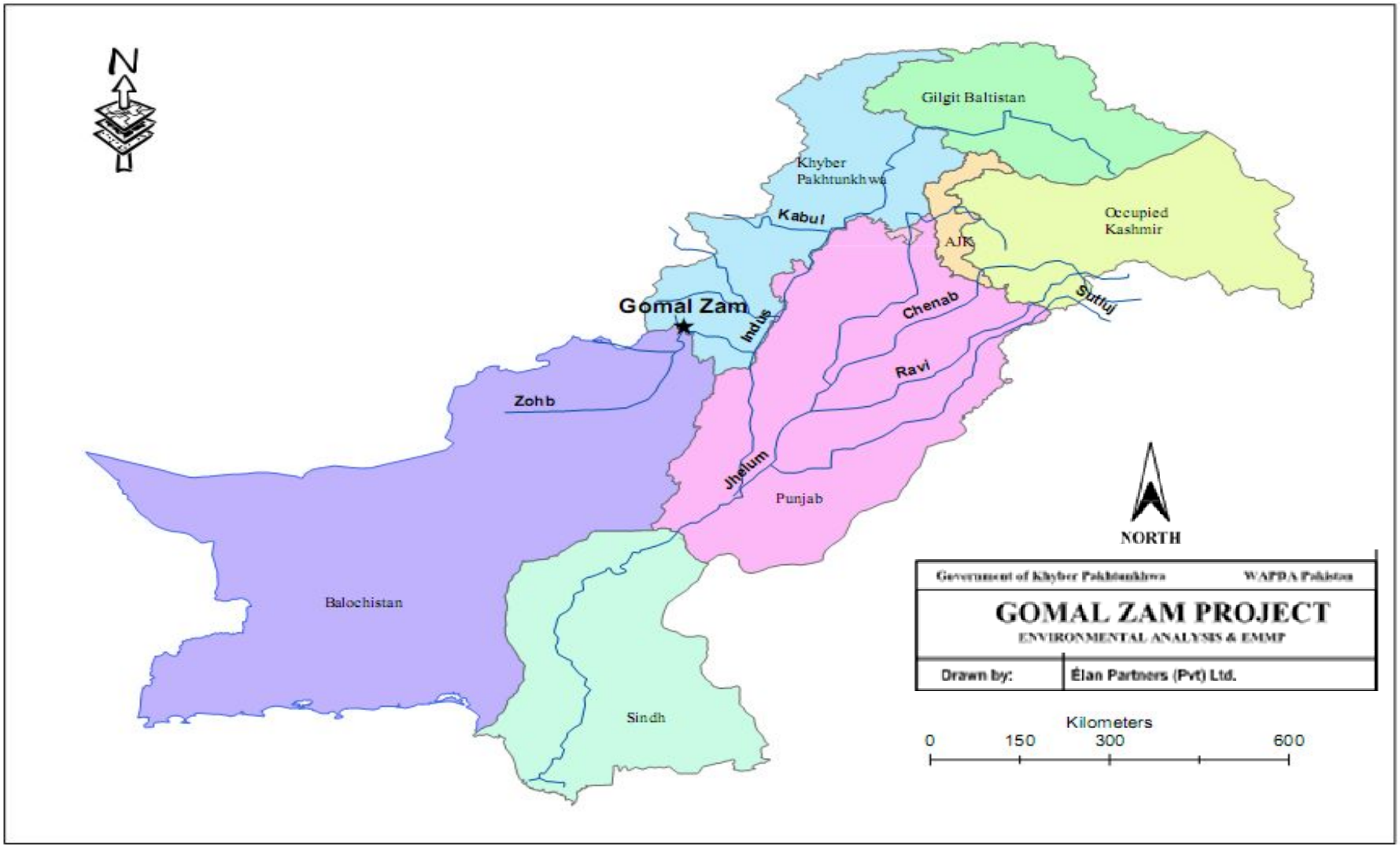
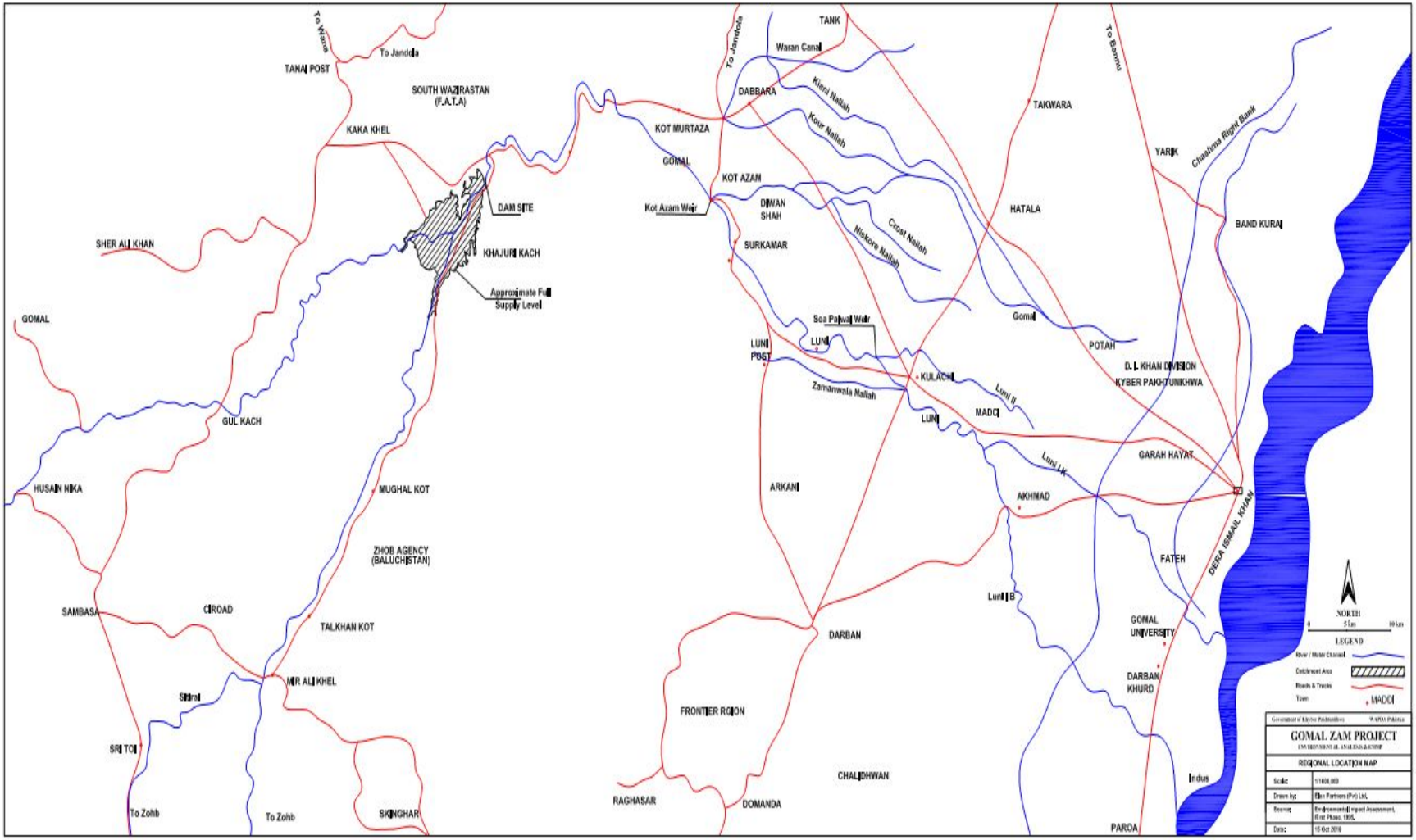


Figure 1.2: Project Area



2. Legislative, Regulatory, and Institutional Frameworks

This Chapter provides brief description of the national/provincial legislative, regulatory, and institutional frameworks relevant to the environmental and social aspects of the Project. Also covered under this Chapter are the international best practices for the environmental and social management of such projects.

2.1. National Legislative and Regulatory Framework

Pakistan's statute books contain a number of laws concerned with the regulation and control of the environmental and social aspects. However, the enactment of comprehensive legislation on the environment, in the form of an act of parliament, is relatively a new phenomenon. Most of the existing laws on environmental and social issues have been enforced over an extended period of time, and are context-specific. The laws relevant to the developmental projects are briefly reviewed below.

2.1.1. Pakistan Environmental Protection Act, 1997

The Pakistan Environmental Protection Act, 1997 (the Act) is the basic legislative instrument empowering the government to frame regulations for the protection of the environment (*the 'environment' has been defined in the Act as: (a) air, water and land; (b) all layers of the atmosphere; (c) all organic and inorganic matter and living organisms; (d) the ecosystem and ecological relationships; (e) buildings, structures, roads, facilities and works; (f) all social and economic conditions affecting community life; and (g) the inter-relationships between any of the factors specified in sub-clauses 'a' to 'f'*). The Act is applicable to a broad range of issues and extends to socioeconomic aspects, land acquisition, air, water, soil, marine and noise pollution, as well as the handling of hazardous waste. The discharge or emission of any effluent, waste, air pollutant or noise in an amount, concentration or level in excess of the National Environmental Quality Standards (NEQS) specified by the Pakistan Environmental Protection Agency (Pak-EPA) has been prohibited under the Act, and penalties have been prescribed for those contravening the provisions of the Act. The powers of the federal and provincial Environmental Protection Agencies (EPAs), established under the Pakistan Environmental Protection Ordinance 1983,[5] have also been considerably enhanced under this

[5] Superseded by the Pakistan Environmental Protection Act, 1997.

legislation and they have been given the power to conduct inquiries into possible breaches of environmental law either of their own accord, or upon the registration of a complaint.

The requirement for environmental assessment is laid out in Section 12 (1) of the Act. Under this section, no project involving construction activities or any change in the physical environment can be undertaken unless an Initial Environmental Examination (IEE) or an Environmental Impact Assessment (EIA) is conducted, and approval is received from the federal or relevant provincial EPA. Section 12 (6) of the Act states that this provision is applicable only to such categories of projects as may be prescribed. The categories are defined in the Pakistan Environmental Protection Agency Review of IEE and EIA Regulations, 2000 and are discussed in **Section 2.1.2** below.

2.1.2. Pakistan Environmental Protection Agency Review of IEE and EIA Regulations, 2000

The Pakistan Environmental Protection Agency Review of IEE and EIA Regulations, 2000[6] (the 'Regulations'), developed by the Pak-EPA under the powers conferred upon it by the Act 1997, provide the necessary details on preparation, submission and review of the IEE and the EIA. Categorization of projects for IEE and EIA is one of the main components of the Regulations. Projects have been classified on the basis of expected degree of potential adverse environmental impacts. Project types listed in Schedule I are designated as potentially less damaging to the environment, and those listed in Schedule II as having potentially serious adverse effects. Schedule I projects require an IEE to be conducted, provided they are not located in environmentally sensitive areas. For the Schedule II projects, conducting an EIA is necessary.

According to these Regulations, the dams with reservoir having an area of more than 8 km^2 require an EIA to be carried out prior to the project construction. The reservoir of the Gomal Zam Project will have an area of 39 km^2; hence an EIA should have been carried out for the Project.

As mentioned in **Section 1.1** earlier, a Preliminary EIA of the Project was conducted in 1995, however, it was not submitted to the EPA for review and approval. Now that the Project is nearing completion, EPA will not issue a 'No Objection Certificate' (NOC) of the Project, even if an EIA were to be submitted at this stage. Therefore, it is recommended that the present document, which assesses the existing and potential environmental as well as social issues

[6] S.R.O. 339 (1)/2001. Pakistan Environmental Protection Agency, Islamabad. 2000.

relating to the various phases of the Project, and also includes an EMMP to be implemented during the remaining construction works and also during the O&M phase, is submitted to the Pak-EPA for their information and concurrence.

2.1.3. National Environmental Quality Standards 2000

National Standards

The National Environmental Quality Standards (NEQS) have been promulgated under the PEPA 1997. The ones relevant to the Project are listed below.

- Maximum permissible limits for motor vehicle exhaust and noise,
- Maximum allowable concentration of pollutants (32 parameters) in municipal and liquid industrial effluents discharged to inland waters, sewage treatment and sea (three separate set of numbers).

Selected NEQS for liquid effluents discharged to inland waters and emissions from motor vehicles are provided in **Tables 2.1** and **2.2**, respectively. These standards are applicable to the gaseous emissions and liquid effluents discharged to the environment from the Project.

The Pak-EPA has also issued standards for drinking water quality. There are attached as **Table 2.3**.

International Standards

The NEQS do not cover the ambient air quality or water quality standards. The international standards for ambient air quality are presented in **Table 2.4**. Recently, the Pak-EPA has drafted the national ambient air quality standards, which are provided in **Table 2.5**. However, these standards are yet to be approved.

For noise, the NEQS are limited to the vehicular noise. For noise generated by other sources, the WB standards are usually applied.[7] According to these standards, the allowable noise limits for the residential, institutional, and educational receptors are 55 dB(A) for daytime and 45 dB(A) for nighttime, or a net increase in the background noise level by 3 dB. The noise from the proposed project has been analyzed against these standards.

2.1.4. Forest Act, 1927

The Act deals with the matters related with protection and conservation of natural vegetation / habitats. The Act empowers the concerned agency to declare protected and reserved forest areas and maintain these forests. In spite of the fact that Act recognizes the right of people for access to the natural

[7] World Bank, UNIDO, and UNEP. 1999. Pollution *Prevention and Abatement Handbook*: Towards Cleaner Production. Environment Department, The World Bank, UNIDO, UNEP.

resources for their household use, it prohibits unlawful cutting of trees and other vegetation. Therefore, for cutting trees for the construction purposes or otherwise, prior permission is required from the Forest Department.

2.1.5. Wildlife (Protection, Reservation, Conservation and Management) Act, Ordinances and Rules

This law has been enacted to protect the province's wildlife resources directly and other natural resources indirectly. It classifies wildlife 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. The Act specifies restrictions on hunting and trade in animals, trophies, or meat. The Act also defines various categories of wildlife protected areas, ie, National Parks, Wildlife Sanctuaries and Game Reserve.

This Act will be applicable to the construction as well as operation and maintenance (O&M) activities of the Project.

2.1.6. Antiquities Act, 1975

The Antiquities Act of 1975 ensures the protection of cultural resources in Pakistan. The Act is designed to protect 'antiquities' from destruction, theft, negligence, unlawful excavation, trade and export. Antiquities have been defined in the Act as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments, etc. The law prohibits new construction in the proximity of a protected antiquity and empowers the Government of Pakistan to prohibit excavation in any area that may contain articles of archeological significance.

Under this Act, the project proponents are obligated to:

- Ensure that no activity is undertaken in the proximity of a protected antiquity, and
- If during the course of the project an archeological discovery is made, it should be protected and reported to the Department of Archeology, Government of Pakistan, for further action.

This Act will be applicable to the construction as well as O&M activities of the Project.

2.1.7. Factories Act, 1934

The clauses relevant to the Project are those that address the health, safety and welfare of the workers, disposal of solid waste and effluents, and damage to private and public property. The Act also provides regulations for handling and disposing toxic and hazardous substances. The Pakistan Environmental

Protection Act of 1997 (discussed above), supersedes parts of this Act pertaining to environment and environmental degradation.

2.1.8. Explosives Act, 1884

Under the Explosives Act, the project contractors are bound by regulations on handling, transportation and using explosives during quarrying, blasting, and other purposes.

2.1.9. Employment of Child Act, 1991

Article 11(3) of the Constitution of Pakistan prohibits employment of children below the age of 14 years in any factory, mines or any other hazardous employment. In accordance with this Article, the Employment of Child Act (ECA) 1991 disallows the child 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 of the occupation set forth in the ECA (such as transport sector, railways, construction, and ports) or in any workshop wherein any of the processes defined in the Act is carried out. The processes defined in the Act include carpet weaving, bidi (kind of a cigarette) making, cement manufacturing, textile, construction and others).

The contractors will be bound by the ECA to disallow any child labor at the project sites or campsites.

2.1.10. Pakistan Penal Code, 1860

The Code deals with the offences where public or private property or human lives are affected due to intentional or accidental misconduct of an individual or organization. The Code also addresses control of noise, noxious emissions and disposal of effluents. Most of the environmental aspects of the Code have been superseded by the Pakistan Environmental Protection Act, 1997.

2.1.11. Canal and Drainage Ordinance, 1978

The KP Canal and Drainage Ordinance, 1978 entitles the provincial government to use and control for public purposes the water of all rivers and streams flowing in natural channels, all of lake, sub-soil and other natural collection of still water. Since the command area of the Project lies in KP province, this Ordinance will be applicable to the Project's irrigation network.

2.1.12. Land Acquisition Act, 1894

The Land Acquisition Act (LAA) of 1894 amended from time to time has been the de-facto policy governing land acquisition and compensation in the country. The LAA is the most commonly used law for acquisition of land and other

properties for development projects. It comprises of 55 sections pertaining to area notifications and surveys, acquisition, compensation and apportionment awards and disputes resolution, penalties and exemptions.

Any land acquisition for the Project will follow the procedures defined in the Act; certain additional procedures as defined by the international best practice (eg, WB Operational Policy on Resettlement – OP 4.12) will also be followed.

2.2. Provincial Environmental Legislation

The Environmental Protection Act of 1997 discussed in **Section 2.1.1** above currently applies to the entire country, and no separate provincial legislation is in place[8]. Hence this Act will be applicable to the Gomal Zam Project.

2.3. Environment Guidelines

2.3.1. Pak-EPA Guidelines

The Pak-EPA has published a set of environmental guidelines for conducting environmental assessments and the environmental management of different types of development projects. The guidelines that are relevant to the proposed project are discussed below:

Guidelines for Preparation and Review of Environmental Reports

The guidelines specify:

- The nature of the information to be included in environmental reports
- The minimum qualifications of the EIA consultant.
- The need to incorporate suitable mitigation measures at every stage or project implementation
- The need to specify monitoring procedures.

The guidelines also require that the EIA/IEE report must contain baseline data relating to the project area, an interpretation of the data and proposed mitigation measures.

Guidelines for Public Consultation

These guidelines deal with the recommended approaches to public consultation and techniques for designing an effective program of consultation that reaches out to all major stakeholders and ensures that their concerns are incorporated in any impact assessment study.

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8 In the wake of the 18th Amendment in the Constitution of Pakistan passed by the parliament in early 2010, the Environment subject would be completely devolved to the provinces, and as a consequence, the provinces would prepare and enact their respective provincial environmental legislation.

2.3.2. IFC and World Bank Environmental and Social Guidelines

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

- Environment, Health and Safety (EHS) Guidelines (IFC, 2007)
- Pollution Prevention and Abatement Handbook 1998: Towards Cleaner Production (WB, UNIDO, and UNEP. 1999)
- Environmental Assessment Sourcebook, Volume I: Policies, Procedures, and Cross-Sectoral Issues (WB 1991).
- Social Analysis Sourcebook (WB, 2003).

In the context of the Gomal Zam Project, these guidelines provide the international best practice for environmental assessment and management during different Project phases.

2.4. Institutional Framework

The Pakistan Environmental Protection Council (PEPC) and the Pakistan Environmental Protection Agency (Pak-EPA) are the two primary organizations responsible for administering the provisions of the Pakistan Environmental Protection Act, 1997.

Under the provision of the Act, the Pak EPA has empowered the provincial EPAs[9] to manage the environmental concerns of their respective provinces. The provincial EPAs can frame environmental regulations tailored to the requirements of their provinces, provided these regulations meet or exceed the minimum standards set by EPA. They are also required to review and approve EIAs of all development projects undertaken in their respective provinces, including those projects implemented by federal agencies.

The Pakistan Environmental Protection Act, 1997, empowers the Pak-EPA to:

- Delegate powers, including those of environmental assessment, to provincial EPAs
- Identify categories of projects to which the IEE/EIA provision will apply
- Develop guidelines for conducting Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) and procedures for the submission, review and approval of the same.
- Develop environmental emission standards for various parameters such as air, water and noise.

[9] Currently, a total of seven EPAs exist in the Country: Pak-EPA; KP EPA; Gilgit Baltistan EPA; Azad Jammu and Kashmir EPA; Punjab EPA; Balochistan EPA; and Sindh EPA. No EPA currently exists for FATA; the Pak-EPA is responsible for environmental matters concerning this area.

- Enforce the provision of the Act through environmental protection order and Environmental Tribunals headed by magistrates with wide ranging powers including the right to fine violators of the Act.

The Pak-EPA and KP EPA are the relevant environmental authorities for the Project components falling in FATA and KP, respectively.

2.5. USAID Environmental Procedures

Since early 80's, 22 CFR 216 (Reg. 216) has been USAID's mandatory environmental compliance procedures established to ensure that environmental (and social) factors are integrated into Agency's decision-making on every program, project, activity and that appropriate safeguards are adopted. Environmental sustainability is integral to USAID overall goal and must be mainstreamed into all activities to achieve optimal results.

Reg. 216 seeks to prevent adverse environmental impacts on the environment. It helps to identify environmental limiting factors that constrain development and seeks to restore the renewable resources base of host countries upon which sustainable and social development depends.

Reg. 216 stipulates preparation of an Initial Environmental Examination (IEE), which is the first review of the reasonably foreseeable significant adverse and beneficial effects of a proposed action on the environment. Its function is to provide a brief statement of the factual basis for a Threshold Decision by a Bureau Environmental Officer (BEO) as to whether an environmental assessment (EA) will be required.

Although USAID environmental compliance procedures have established in 22 CFR 216.2(d)(I) that certain classes of activities normally have a significant effect on the environment, for which an EA is required, as appropriate, they also permit the use of specially prepared project design considerations or guidance to be substituted for environmental analysis in selected situations.

After reviewing the nature and the scope of the activities, proposed for USAID consideration, and significance of their potential impacts on the environment, as analyzed in the respective IEE (attached in **Appendix D**) the BEO/Asia has approved certain Conditions, under which USAID funding can be provided. These Conditions have been translated into the TOR for the referred Consultant's assignment. The environmental mitigation and monitoring plan seeks to ensure that there are no significant adverse impacts, and beneficial environmental and social impacts are enhanced during project implementation and operation.

Table 2.1: Selected NEQS for Waste Effluents [10]

Parameter	Unit	Standards (Maximum Allowable Limit)
Temperature increase	°C	< 3
pH value (acidity/basicity)	pH	6-9
5-day biochemical oxygen demand (BOD) at 20 °C	mg/l	80
Chemical oxygen demand (COD)	mg/l	150
Total suspended solids	mg/l	200
Total dissolved solids	mg/l	3,500
Grease and oil	mg/l	10
Phenolic compounds (as phenol)	mg/l	0.1
Chloride (as Cl)	mg/l	1,000
Fluoride (as F)	mg/l	10
Sulfate (SO_4)	mg/l	600
Sulfide (S)	mg/l	1.0
Ammonia (NH_3)	mg/l	40
Cadmium	mg/l	0.1
Chromium (trivalent and hexavalent)	mg/l	1.0
Copper	mg/l	1.0
Lead	mg/l	0.5
Mercury	mg/l	0.01
Selenium	mg/l	0.5
Nickel	mg/l	1.0
Silver	mg/l	1.0
Total toxic metals	mg/l	2.0
Zinc	mg/l	5
Arsenic	mg/l	1.0
Barium	mg/l	1.5
Iron	mg/l	8.0
Manganese	mg/l	1.5
Boron	mg/l	6.0
Chlorine	mg/l	1.0

Source: Government of Pakistan (2000).

Notes:

1. The standard assumes that dilution of 1:10 on discharge is available. That is, for each cubic meter of treated effluent, the recipient water body should have 10 m^3 of water for dilution of this effluent.
2. Toxic metals include cadmium, chromium, copper, lead, mercury, selenium, nickel and silver. The effluent should meet the individual standards for these metals as well as the standard for total toxic metal concentration.

[10] The full text of the NEQS is available at the Pak-EPA website: (http://www.environment.gov.pk/info.htm).

Table 2.2: NEQS for Motor Vehicles Exhaust and Noise [11]

(i) For In-use Vehicles

	Parameter	Standard (Maximum Permissible Limit)	Measuring Method	Applicability
1	Smoke	40% or 2 on the Ringlemann Scale during engine acceleration mode.	To be compared with Ringlemann Chart at a distance 6 or more. r	Immediate effect
2	Carbon Monoxide	6%	Under idling conditions: Non-dispersive infrared detection through gas analyzer.	
3	Noise	85 db (A).	Sound meter at 7.5 meters from the source.	

(ii) For new Vehicles

Emission Standards For Diesel Vehicles

(a) For Passenger Cars and Light Commercial Vehicles (g/Km)

Type of Vehicle	Category/Class	Tiers	CO	HC+ NOx	PM	Measuring Method	Applicability
Passenger Cars	M 1: with reference mass (RW) upto 2500 kg. Cars with RW over 2500 kg to meet NI category standards.	Pak-II IDI	1.00	0.70	0.08	NEDC (ECE 15+ EUDCL)	i. All imported and local manufactured diesel vehicles with effect from 01-07-2012
		Pak-II DI	1.00	0.90	0.10		
Light Commercial Vehicles	NI-I (RW<1250 kg)	Pak-II IDI	1.00	0.70	0.08		
		Pak-II DI	1.00	0.90	0.10		
	NI-II (1250 kg< RW <1700 kg0	Pak-II IDI	1.25	1.00	0.12		
		Pak-II DI	1.25	1.30	0.14		
	NI-III (RW>1700 kg)	Pak-II IDI	1.50	1.20	0.17		
		Pak-II DI	1.50	1.60	0.20		

Parameter	Standard (maximum permissible limit)	Measuring Method
Noise	85 db (A)	Sound meter at 7.5 meters from the source.

[11] Full text of the NEQS is available at the Pak-EPA website: (http://www.environment.gov.pk/info.htm).

(b) For Heavy Duty Diesel Engines and Large Goods Vehicles (g/Kwh)

Type of Vehicle	Category / Class	Tiers	CO	HC	NOx	PM	Measuring Method	Applicability
Heavy Duty Diesel Engines	Trucks and Buses	Pak-II	4.0	1.1	7.0	0.15	ECE-R-49	All Imported and local manufactured diesel vehicles with the effect 1-7-2012
Large goods Vehicles	N2 (2000 and up	Pak-II	4.0	7.0	1.10	0.15	EDC	

Parameter	Standard (maximum permissible limit)	Measuring Method
Noise	85 db (A)	Sound meter at 7.5 meters from the source.

Emission Standards for Petrol Vehicles (g/km)

Type of Vehicle	Category / Class	Tiers	CO	HC+ NOx	Measuring Method	Applicability
Passenger	M 1: With reference mass (RW) upto 2500 kg. Cars with RW over 2500 kg. to meet N1 category standards	Pak-II	2.20	0.50	NEDC (ECE 15 + EUDCL)	All imported and new models* locally manufactured petrol vehicles with effect from 1st July, 2009**
Light Commercial Vehicles	N1-I (RW<1250 kg)	Pak-II	2.20	0.50		
	N1-II (1250 kg>RW <1700 kg)	Pak-II	4.00	0.65		
	N1-III (RW>1700 kg)	Pak-II	5.00	0.80		
Motor Rickshaws & motor Cycles	2.4 strokes <150 cc	Pak-II	5.50	1.50	ECER 40	
	2.4 strokes>150 cc	Pak-II	5.50	1.30		

Parameters	Standard (maximum permissible limit)	Measuring Method
Noise	85 db (A)	Sound meter at 7.5 meters from the source

Explanations:	
DI:	Direct Injection
IDI:	Indirect Injection
EUDCL:	Extra Urban Driving Cycle
NEDC:	New Urban Driving Cycle
M:	Vehicles designed and constructed for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat
N:	Motor vehicles with at least four wheels designed and constructed for the carriage of goods.
*	New model means both model and engine type change
**	The existing models of petrol driven vehicles locally manufactured will immediately switch ever to Pak-II emission standards but not later than 30th June, 2012

Table 2.3: National Drinking Water Quality Standards (Draft) [12]

Properties/Parameters	Standard Values for Pakistan
Bacterial	
All water intended for drinking (e.Coli or Thermotolerant Coliform bacteria)	Must not be detectable in any 100 ml samples
Treated water entering the distribution system (E.Coli or thermotolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml samples
Treated water in the distribution system (E.Coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml samples In case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12- month period.
Physical	
Color	≤15 TCU
Taste	Non objectionable/Accept able
Odor	Non objectionable/Accept able
Turbidity	‹ 5 NTU
Total hardness as CaCO3	< 500 mg/l
TDS	‹ 1000
pH	6.5 – 8.5
Chemical	
Essential Inorganic	***mg/Litre***
Aluminum (Al)	≤0.2
Antimony (Sb)	≤0.005 (P)
Arsenic (As)	≤ 0.05 (P)
Barium (Ba)	0.7
Boron (B)	0.3
Cadmium (Cd)	0.01
Chloride (Cl)	<250
Chromium (Cr)	≤0.05
Copper (Cu)	2
Toxic Inorganic	***mg/Litre***
Cyanide (CN)	≤0.05
Fluoride (F)*	≤1.5
Lead (Pb)	≤0.05
Manganese (Mn)	≤ 0.5
Mercury (Hg)	≤0.001

[12] Full text of the Standards is available at the Pak-EPA website: (http://www.environment.gov.pk/info.htm).

Properties/Parameters	Standard Values for Pakistan
Nickel (Ni)	≤0.02
Nitrate (NO_3)*	≤50
Nitrite (NO_2)*	≤3 (P)
Selenium (Se)	0.01 (P)
Residual chlorine	0.2-0.5 at consumer end; 0.5-1.5 at source
Zinc (Zn)	5.0
Organic	
Pesticides mg/l	PSQCA No. 4639-2004, Page No. 4 Table No. 3 Serial No. 20- 58 may be consulted.**
Phenolic compound (as phenols) mg/l	
Polynuclear Aromatic hydrocarbon (as PAH) g/L	
Radioactive	
Alpha Emitters bq/L or pCi	0.1
Beta Emitters	1

* indicates priority health related inorganic constituents which need regular monitoring.

** PSQCA: Pakistan Standards Quality Control Authority.

Table 2.4: WHO Ambient Air Quality Standards

Pollutant	Maximum Allowable Limit	Units	Averaging Time
CO	35	ppm	1 hour
NO_X	106	ppb	1 hour
SO_2	134	ppb	1 hour
PM_{10}	70	$\mu g/m^3$	24 hours

Source: World Health Organization.

Table 2.5: National Ambient Air Quality Standards (Draft) [13]

Pollutants	Time-weighted Average	Concentration in Ambient Air		Method of Measurement
		Effective from 1st January 2009	Effective from 1st January 2012	
Sulfur Dioxide (SO_2)	Annual Average*	80 µg/m^3	80 µg/m^3	Ultraviolet Fluorescence Method
	24 hours**	120 µg/m^3	120 µg/m^3	
Oxides of Nitrogen as (NO)	Annual Average*	40 µg/m^3	40 µg/m^3	Gas Phase Chemiluminescence
	24 hours**	40 µg/m^3	40 µg/m^3	
Oxides of Nitrogen as (NO_2)	Annual Average*	40 µg/m^3	40 µg/m^3	Gas Phase Chemiluminescence
	24 hours**	80 µg/m^3	80 µg/m^3	
O_3	1 hour	180 µg/m^3	130 µg/m^3	Non dispersive UV absorption method
Suspended Particulate Matter (SPM)	Annual Average*	400 µg/m^3	360 µg/m^3	High Volume Sampling, (Average flow rate not less than1.1 m^3/minute).
	24 hours**	550 µg/m^3	500 µg/m^3	
Respirable Particulate Matter. PM_{10}	Annual Average*	200 µg/m^3	120 µg/m^3	β Ray absorption method
	24 hours**	250 µg/m^3	150 µg/m^3	
Respirable Particulate Matter. $PM_{2.5}$	Annual Average*	25 µg/m^3	15 µg/m^3	β Ray absorption Method
	24 hours**	40 µg/m^3	35 µg/m^3	
	1 hour	25 µg/m^3	15 µg/m^3	
Lead (Pb)	Annual Average* 24 hours**	2 µg/m^3	1.5 µg/m^3	ASS Method after sampling using EPM 2000 or equivalent Filter paper
Carbon Monoxide (CO)	8 hours**	5 mg/m^3	5 mg/m^3	Non Dispersive Infra Red (NDIR) method
	1 hour	10 mg/m^3	10 mg/m^3	

*Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

** 24 hourly /8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive days.

[13] Full text of the *Standards* is available at the Pak-EPA website: (http://www.environment.gov.pk/info.htm).

3. Project Description [14]

This Chapter describes the project, its history, objectives, location, and also details of its various components proposed for USG financing.

3.1. Project History

The Gomal Zam dam was first identified way back in 1880 by the British administration at the time of first settlement of Dera Ismail Khan. Field investigations were carried out after 28 years in 1908 and these continued till their termination during 1914 at the start of the World War I. But it remained somewhere on the files and a survey circle was established in 1922 for the project. This was also closed down in 1933. Technical studies through field investigations were this time resumed in 1944 and it was only after creation of Pakistan in August 1947 that a flood control-cum-irrigation scheme was proposed during 1951-52 on the basis of earlier work started and left incomplete by the British rulers. The Food and Agriculture Organization (FAO) experts prepared documents for a 250-foot-high concrete dam at Gulkach. This was approved by the North West Frontier Province (NWFP)[15] government in consultation with the federal government in 1957. Work on the preliminaries was, accordingly, started and it continued for about two years till 1959.

By this time, The WAPDA was in the offing, in the wake of the Indus Basin Treaty, for undertaking construction of big storage facilities and link canals. In 1963, Messrs Energoprojekt, a consulting firm of Yugoslavia, prepared a feasibility of the project at a new site.

WAPDA's general consultants, Messrs Harza Engineering Company, reviewed the project and did not agree with the proposal formulated by the Yugoslavian firm. So, it was still not ready to take off the ground and was subjected to reviews and consultations at various levels for more times.

A panel of international experts was arranged for seeking their opinion on the type of the dam. The experts favored construction of a concrete gravity dam. Then the Indo-Pakistan war broke out in September 1965 and serious resource constraint emanating from it forced suspension of entire activity on the site.

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[14] The Project description in this Chapter has been taken from the revised PC-I (*WAPDA 2010. Gomal Dam Multipurpose Project – Revised PC-I Proforma*); the preliminary EIA report (C. Bellier, 1995. *Environmental Impact Assessment (First Phase), Gomal Zam Additional Studies*); and Project's feasibility report (C. Bellier1995. *Updated Feasibility Study of the Irrigation System and Pre-feasibility of Hydroelectric Power Plant at the Toe of the Dam – Gomal Zam Additional Studies, Volume 1.*)

[15] NWFP has now been renamed as Khyber Pakhtunkhwa (KP).

The Project remained in the doldrums as a dormant project for another 17 long years.

The Gomal Zam Project was reactivated again in 1983, and French consultants, Coyne-et-Bellier, were appointed by WAPDA to review the earlier proposals. The revised technical feasibility report prepared by the French consultants was published in May 1990 with various parameters of the dam being defined more clearly. The feasibility studies for irrigation scheme and power plant at the toe of the dam, with an environmental impact assessment, was prepared not before 1995.

In 2002, the contract for the Project construction was awarded to a joint venture of China National Water Resources & Hydropower Engineering Corporation and Harbin Power Engineering Company. However work stopped in October 2006, after two Chinese engineers were kidnapped, one of whom was subsequently killed and the other injured in the recovery operation.

The contractors asked for negotiations for a new contract on the basis of prevailing market prices of material, but the government of Pakistan rejected this demand. Instead, the Government decided on September 27, 2007 to award the contract for construction to the Frontier Works Organization (FWO) and a Turkish firm Tekser.

The Sinohydro Corporation of China is the subcontractor for the dam and hydropower components (less the transmission line) and Tekser of Turkey is the subcontractor for the irrigation and flood protection component. The works were scheduled for completion within a period of 03 years and 120 days to be reckoned from 11 June 2007, the notified date of commencement. The Project was thus expected to be completed by 08 October 2010.

3.2. Project Justification

Insufficient irrigation water supply is a common and major problem of the proposed command area of the Project, resulting into very poor crop productivity in the area. On the other hand, floods in monsoon regularly damage property, infrastructure, and other public and private assets in the area. Construction of the Gomal Zam Project addresses both of these problems through providing regular irrigation water supplies and protecting against floods, thus positively contributing towards poverty reduction in the area. In addition, hydroelectric power generation from the Project would contribute towards resolving the chronic power shortage in the Country, while also substituting expensive imported fuel thus easing the national balance of payment problem.

3.3. Project Objectives

The key objectives of the Project comprise flood protection, water supply for irrigation, and power generation.

For the flood protection, it is intended that all floods with a recurrence lower than or equal to 50 years will be considerably reduced, and the rarer ones (having return period more than 50 years). The flood protection will have positive consequences on soil conservation, agriculture development, safety of population, and ease of communication. The Project will also contribute to the protection of Chashma Right Bank Canal.

The Project will provide about 400 x 10^6 m^3 (324,400 acre-feet) of water annually to irrigate about 77,523 hectares (ha) (191,062 acres) of land round the year (the preliminary EIA of 1995 mentions the cultivable command area to be 66,000 ha). This would include 12,072 ha (29,818 acres) of the perennial water rights area, and 65,451 ha or 161,664 acres of flood water rights area.

The energy stored in the reservoir will be used to produce electric power. A power plant having a capacity of 17.4 MW will produce up to 91 giga watt-hour (GWh) of electricity annually.

3.4. Project Components and their Location

The dam and powerhouse are located in South Waziristan at Khajuri Kach, which is a deep and narrow gorge in the Gomal River, downstream of its confluence with the Zhob River (see **Figure 3.1** for dam location). The reservoir area lies in South Waziristan and Zhob District (Balochistan). The diversion barrage is located in South Waziristan about 30 km downstream of the dam, and irrigation command area is located in Tank and D. I. Khan districts of the KP province. See **Figures 3.2** to **3.5** for the location and layout of various Project components; some selected photographs of these components are provided in **Appendix E**. The catchment area of the Gomal dam lies between 30° 30′ - 32° 45′ north, and 67° 30′ - 71° 00′ east, covers an area of 32,780 km^2 or 8.1 million acres (the revised PC-I of Feb 2010 indicates the catchment area to be 20,196 km^2 or 4.99 million acres), and is located in Afghanistan and Balochistan province of Pakistan; see **Figure 3.6** for the catchment area map.

These components are described in the Sections below; their key data is presented in **Table 3.1**.

3.4.1. Dam

Position and Shape

A 133 m (436 ft) high dam has been constructed at the gorge, which is only 24.4 m (80 ft) wide at the bottom and about 183 m (600 ft) wide at the top. The dam is slightly curved in plan producing a cylindrical shape with compound radii of 248 m (787 ft) and 180 m (590 ft). This will introduce a very moderate normal elastic strains. Although difficult to quantify with any accuracy, the arch effect can only be beneficial for overall dam stability, especially in the event of an earthquake producing non-elastic strains. See **Figure 3.4** for the dam layout.

Typical Section and General Design of Dam

A conventional gravity dam cross section with vertical upstream face and flattened downstream face has been chosen. One of the problems with the gravity dams is the differential settlement between the dam blocks of different heights resting on a rock of different compressibilities. It was therefore proposed to build most of the dam of roller compacted concrete (RCC) in order to overcome this problem we well as to speed up construction and also save cost.

The RCC construction has three advantages over the traditional concrete. Firstly, no construction joints are necessary; therefore the differential settlement problem is not the same as usual. Secondly, an RCC dam can be built much more quickly than the conventional concrete dam. Thirdly, the RCC method is cheaper than conventional concreting, primarily because no upstream and downstream grouting of construction joints, the cement content in the RCC mix is lower, and it can accommodate less stringent requirements as regards to the quantity and quality of fine material in the mix.

Consolidation Grouting

Consolidation grouting is necessary to obtain a uniformly competent foundation. The depth to which this treatment must extend was determined with the help of three-dimensional analyses of the dam deformations for the construction period and after filling of the reservoir. It was estimated that the treatment would to a depth of 20 to 30 m (66 to 100 ft) measured normal to the foundation line. The estimate was based on grout takes derived from the grouting trials with holes spacing 3 to 3.5 m (10 – 11.5 ft).

Grout Curtain

The water tests revealed quite a high permeability in depth, as well as near the surface. For the purpose of the estimates, it was assumed that the grout curtain

would be about 396 m (1,300 ft) wide at the top and about 169 m (555 ft) at the bottom, and would consist of two rows of holes (main and auxiliary) on 2 to 3 m (6 – 10 ft) centers. In addition, treatment with concrete and contact grouting was proposed to overcome the concentrated leakages.

3.4.2. Spillway

Objectives

In view of the great importance attached to flood control in D. I. Khan plain, it was decided that i) the reservoir should be given a surcharge capacity to store the whole inflows for floods with return period of 50 years or less; ii) floods with longer return period should be attenuated so that the outflow is distinctly less than the peak fold inflows; and iii) dam and its appurtenant works should be able to withstand floods with return periods of op to 5,000 years without significant damage. To meet these objectives, a spillway was included in the design of the Project.

General Design of Spillway

In order to take account of the silting of the reservoir and to optimize investment, two plans were prepared for operating the reservoir during two successive phases of the Project lifetime. During the first phase, which is expected to last 15-30 years, the reservoir would be operated in the following manner: i) from El. 635 (riverbed) to El. 711, there would be dead storage capacity of 300 hm^3 (243,213 a-f), which would retain sediments during the first fifteen years; ii) between El. 711 and El. 743.2, the storage capacity would be 1,100 hm^3 (891,784 a-f), necessary to ensure the electricity production and to provide irrigation water; iii) the full supply level would therefore be set at El. 743.2; and iv) from El. 743 to El. 750.40, the capacity is 300 hm^3, which would fully compensate for floods with return period of 50 years. After 15 years of operation, the sediments would begin to reduce the regulating capacity above El. 711, at a speed that would depend upon the efficiency of the anti-sediment equipment.

The supply lost would therefore be recovered by raising the full supply level, which presumes the addition of gates on the spillway sill. The new full supply level would be set at El. 750.4, and the supply located below this level will be sued for regulating purposes. Compensation of floods would therefore be conducted totally above. As long as the inflows do not increase 300 hm^3 (244,300 a-f), most of it would be stored between El. 750.4 and El. 753.5 and the un-gated sluices would discharge at the rate progressively increasing from 0 to 200 m^3/s, the other four spillway sluices will be closed by 6.2 m high flap gates – thus floods with return periods up to 50 years would be almost totally

damped, and discharge from the dam would not exceed 200 m^3/s. For the heavier floods, the flap gates of the other sluices would be totally opened. This would mean that the floods with return period of more than 50 years (and up to 5,000 years) would make the supply level rise up to El. 761.6.

3.4.3. Bottom Outlet

The role of the bottom outlet is to control the water surface during the entire lifetime of the dam, basically for safety reasons, but also to provide the possibility of conducting repair works on the upstream face of the dam, on the reservoir banks, and power water intake. The bottom outlet thus allows for the water level to be controlled when the diversion tunnel is closed at the end of the construction of the dam. In addition, the outlet would help discharge heavy floods particularly during the second phase of the dam operation.

The bottom outlet opening is installed at El.680 or about 45 m above the riverbed and 81.6 m below the maximum water level. This elevation is relatively low to facilitate the closing of the diversion tunnel and to keep the power intake in good protection from siltation. However, it is high enough not to be disturbed by the tail water during the heavy floods.

The discharge capacity of the bottom outlet is approximately 250 m^3/s. This value is chosen on the basis of: i) it corresponds to flood discharges during dry periods, every 10 years, and it should therefore be adequate to control the water level when the diversion tunnel is closed; and ii) two weeks are required to lower the reservoir from El. 750.4 to 743.2 when there is no inflow, which means that the water thrust against the dam is reduce by about 20%.

3.4.4. De-silting Sluices

Around the control gate of the bottom outlet, special bypasses have been installed for de-silting. Their role is to take discharge turbidity currents which arrive near the dam at the end of each flood.

At the end of the flood, the bottom outlets would be opened and would thus directly release sediment-loaded water for a certain time, then gate would be closed and the de-silting sluices would be opened. Since their discharge capacity is much lower, they would be opened for much longer duration without losing much water. They would be closed one after the other when the silt content in the water becomes low. Each opening is equipped with two 400 mm diameter valves, arranged I series. The first one would serve as a guard gate and would normally remain open. The second one would control the opening and would normally be closed. These are full-flow valves, least sensitive to the abrasion by transported sediments.

3.4.5. River Diversion during Construction

The diversion system was intended to handle only the dry season floods with a recurrence of 20 years and a peak discharge of 208m^3/s. Such an arrangement was acceptable for concrete dams, because occasional overtopping of the works induces only limited damage, which is less costly than complete protection. The probability of overtopping during some critical work steps must nevertheless be accurately checked. All diversion measures were fully reviewed so as to be able to adopt a strategy in keeping with the RCC dam construction technology.

Diversion Components

The diversion works were designed for a peak discharge of 500 m^3/s and were to prevent any spillage into the construction zone. The works were designed to withstand flood levels up to 1,400m^3/s without causing extensive damage. To ensure these requirements, the diversion works include a diversion tunnel, an upstream coffer dam, and a downstream coffer dam.

The diversion tunnel is a 392 m long, 6.8 m internal diameter concrete lined tunnel excavated at the base of the right bank. It descends from El. 638 upstream to El. 634.92 at the downstream end. The upstream converging approach is a simple concrete structure, enabling the tunnel to be closed off with concrete plugs at the end of the construction works. The tunnel would be sealed by a 10 m long concrete plug, which would be made in line with the main grout curtain and anchored to the surrounding rock by contact grouting.

Upstream Coffer Dam

The upstream coffer dam rises to El. 676; with its height above the ground line is about 41 m. The coffer dam is built with earth/rock fill with a filter layer in the main body and riprap on the upstream surface. The coffer dam is 8 m wide at the top with 2.5:1 slope on upstream and 1.75:1 slope on the downstream surface.

Downstream Coffer Dam

Then downstream coffer dam protects the site when all the water passes through the tunnel. The height of this coffer dam is 9 m, and made of RCC.

3.4.6. Access to Main Dam

A metallic road about 1.18 km in length has been constructed which connects the main dam to the main road near the saddle site.

3.4.7. Diversion Barrage at Kot Murtaza

The objectives of the diversion barrage are to raise the supply level to divert the required water quantity to the main canal, to reduce the fluctuations of the water level in the river, to control silt entry in the canal, and to preserve a clear and defined channel approaching the regulator.

An un-gated permanent structure across the river has been designed for the barrage. Its length is 140 m (460 ft) and width of 46 m (150 ft) excluding upstream and downstream stone aprons. Its maximum capacity is about 4,000m^3/s (141,200 cusecs), whereas the sluice section can handle a flow of 1,000m^3/s (35.300 cusecs). Under the maximum flood conditions of 5,000m^3/s (176,500 cusecs), the upstream maximum water level would remain slightly below El. 384.65 m, which is the elevation of the houses, training works, and head regulator breast wall protection. See **Figure 3.7** for Diversion Barrage layout.

The divide wall is designed to withstand differential head of about 1 m (3 ft) in the supper flood condition. The under sluices are designed to ensure satisfactory scouring and to pass 1-15% of high floods. It would also reduce the weir length. The head regulator is designed for a flow rate of 37m^3/s (1,300 cusecs) for the main canal with a minimum pond level at El. 378.85 m (1,243 ft).

3.4.8. Powerhouse

The powerhouse is located at the right bank, 320 m downstream of the dam. The power intake is arranged on the right side of the dam and the intake penstock goes through the dam and rock on the right bank. One intake penstock about 410 m long and with 3 m internal diameter is employed for the two units. The main powerhouse is 26 m high, 44.10 m long and 16.8 m wide. The switchyard is arranged near the powerhouse at an elevation higher than the maximum downstream flood water level.[16]

Two vertical axis Francis turbines with 10 m^3/s normal discharge under 103.5 m nominal head, with 600 rpm speed, and a power-on-shaft of 8,900 KW have been designed. Each turbine would be fitted with its own hydraulic speed governor of PID type. The generators would be of 50 Hz frequency, 10,300 KVA output, 8,700 KW with 5.5 KV voltage, equipped with combined

[16] The transformers in the switchyard have been washed away by a land slide during the Aug 2010 monsoon floods, hence the switchyard may need to be relocated, and slide-prone status of the area should be re-evaluated with necessary engineering and mitigation measured proposed.

guide and thrust bearing. An overhead moving crane of 35 tons capacity is provided for installation and maintenance works.

A 10.83 m long gravity flow, rectangular tailrace with 13.45 m width and with varying depth is designed for both of the generating units.

A 3.56 km long road has been constructed to connect the powerhouse with the main toad at Adam Kok.

3.4.9. Transmission Line

A 55 km long, 132 KV, single circuit transmission line on double circuit steel towers with three conductors and an earth wire is planned to connect the powerhouse with the existing 132 KV grid station in tank town. The previous Chinese contractor had started the transmission line works and completed some tower foundations. However, a new route may be selected along the main road leading to the site, in view of the ease of maintenance.

3.4.10. Saddle Treatment

A low, earth fill dam about 860 m (2,822 ft) long and its deepest point roughly 50 m (124 ft) wide is being built across a saddle on the left bank. The upper part of the saddle is round in shape. The width generally ranges from 10 to 20 m at the top. However the width at the maximum reservoir level is more than 100 m. On the upstream side, where the reservoir is located, at higher elevation there are steep slopes. The slope quickly becomes flatter, except in a narrow gully, at the lower level. On the downstream side, the slopes are comparatively easier and longer.

3.5. Implementation Arrangements

WAPDA has the overall control and implementation responsibility for the Project, and is undertaking the construction of the dam, powerhouse, barrage, and also the irrigation network. The transmission line would be constructed by the Peshawar Electric Supply Company (PESCO), the electricity distribution company for KP. WAPDA would also be responsible for the operation and maintenance of the dam, powerhouse, and the barrage, while PESCO would manage the O&M of the transmission line. The irrigation network, once completed, would be operated and maintained by the Government of KP province.

Table 3.1: Key Project Data [a]

Hydrology	
Catchment Area	32,780 km^2 (8.1 x 10^6 acres) [b]
Mean annual runoff	511 x 10^6 m^3 (0.414 MAF)
Mean annual flow	16.2 m^3/s (572.4 cusecs)
Design flood peak	13,000 m^3/s (459,000 cusecs)
Rate of sedimentation	24 x 10^6 m^3 per year (19,456 a-f per year)
Dam and Powerhouse	
Type of dam	Roller Compacted Concrete, curved, gravity
Height over foundation level	133 m (436 ft)
Crest level	El. 763 m
Bottom outlet level	El. 664 m
Installed capacity	17.4 MW
Mean annual generation	91 GWh
Reservoir	
Full supply level (first stage)	743.2 m
Full supply level (second stage)	750.4 m
Area (first stage)	39 km^2
Gross storage (first stage)	1,100 x 10^6 m^3 (0.892 MAF)
Gross storage (second stage)	1,400 x 10^6 m^3 (1.14 MAF)
Mean depth	27.5 m
Retention time	2.2 years
Diversion weir	
Height over river bed	2.7 m
Crest level	378.85 m
Irrigation system	
Cultivable command area	66,000 (163,000 acres) [c]
Main canal length	63 km
Total distributaries length	203 km
Flood protection	T < 50 years
Water supply for irrigation	400 x 10^6 m^3 per year

[a] Source: Preliminary EIA, Coyne et Bellier, 1995.
[b] Catchment area has been indicated to be 20,196 km^2 in the revised PC-I of 2010.
[c] Cultivable command area has been shown to be 77,523 ha in the revised PC-I of 2010.

Figure 3.1: Project Site

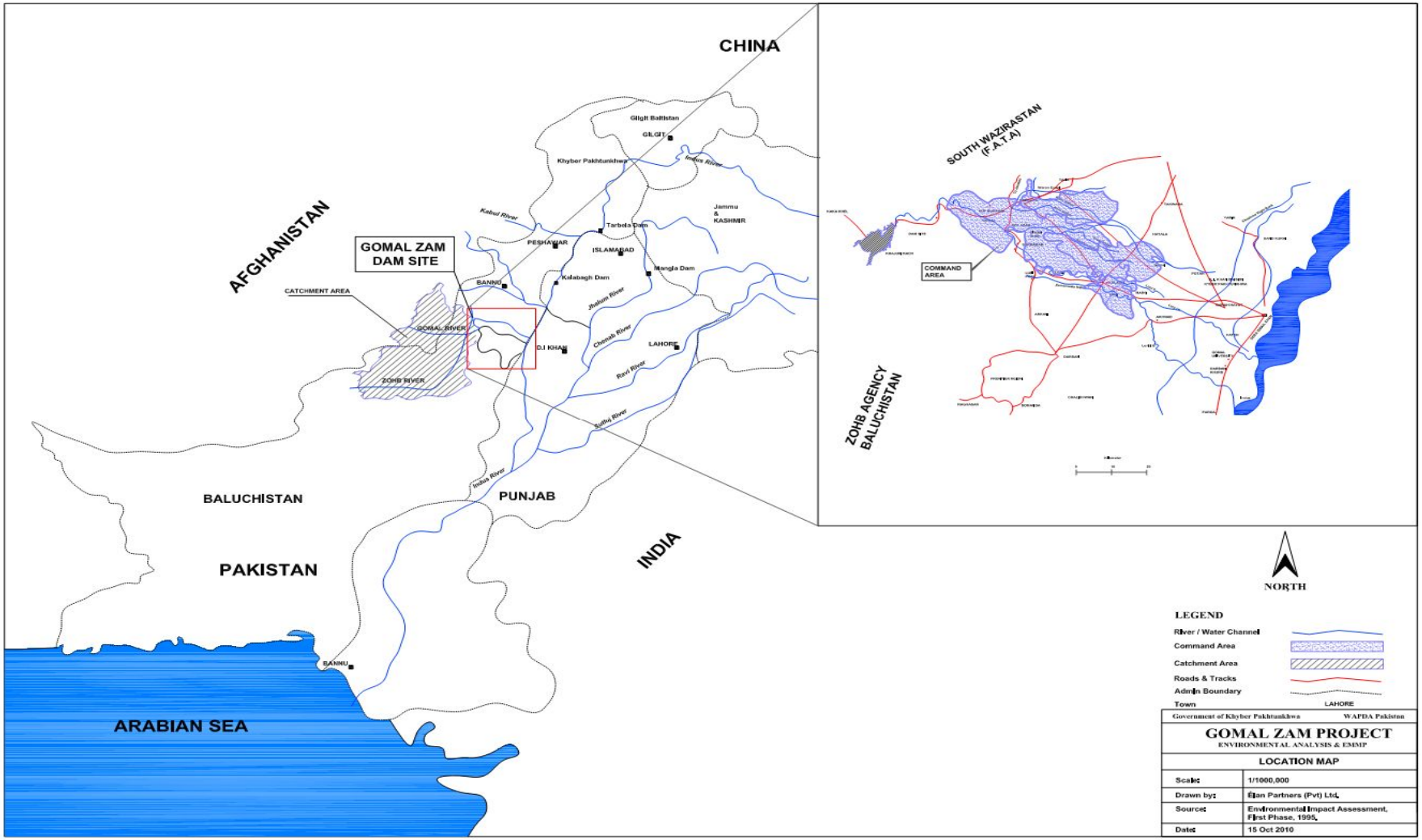


Figure 3.2: Project Layout

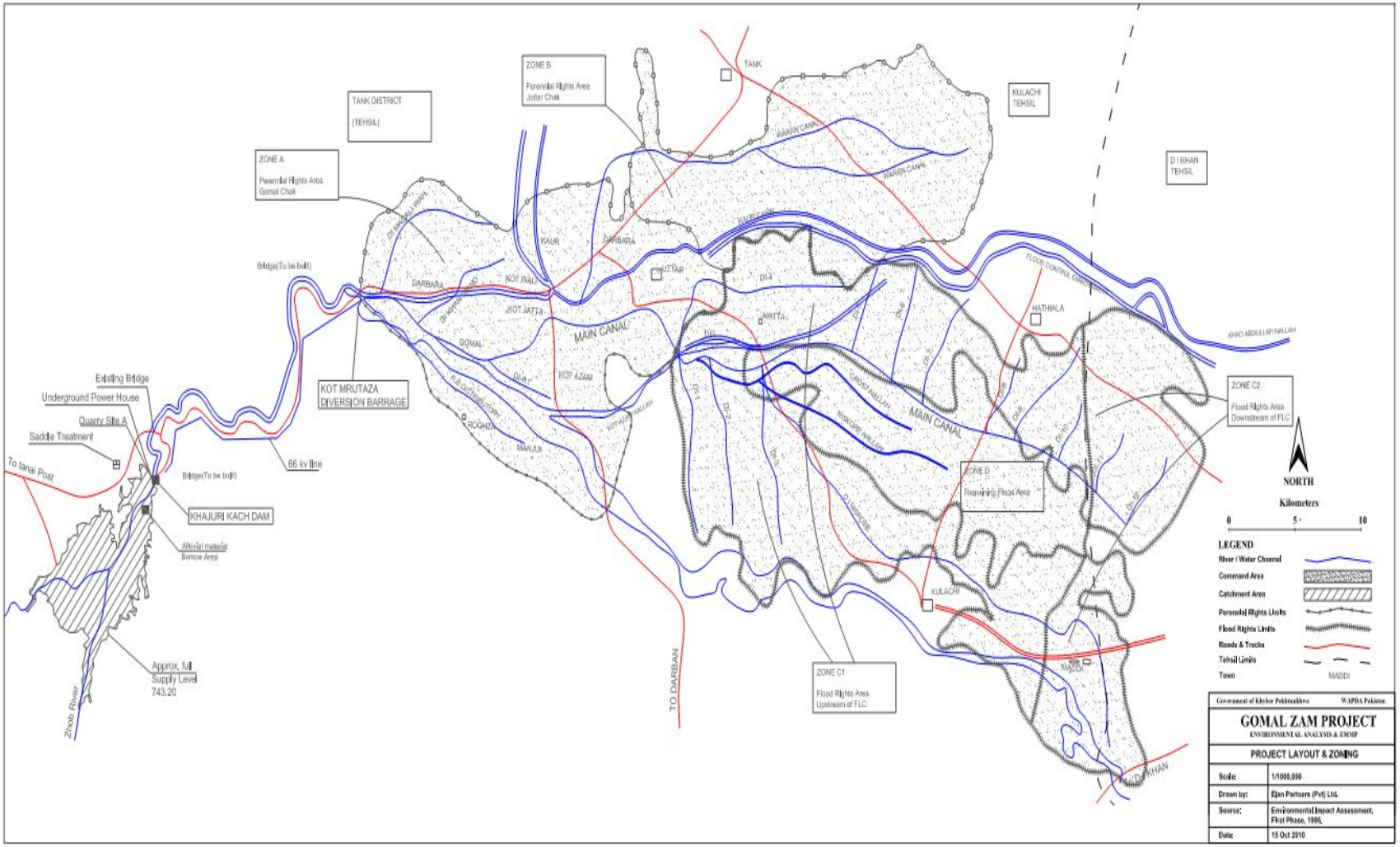


Figure 3.3: Gomal Zam Reservoir

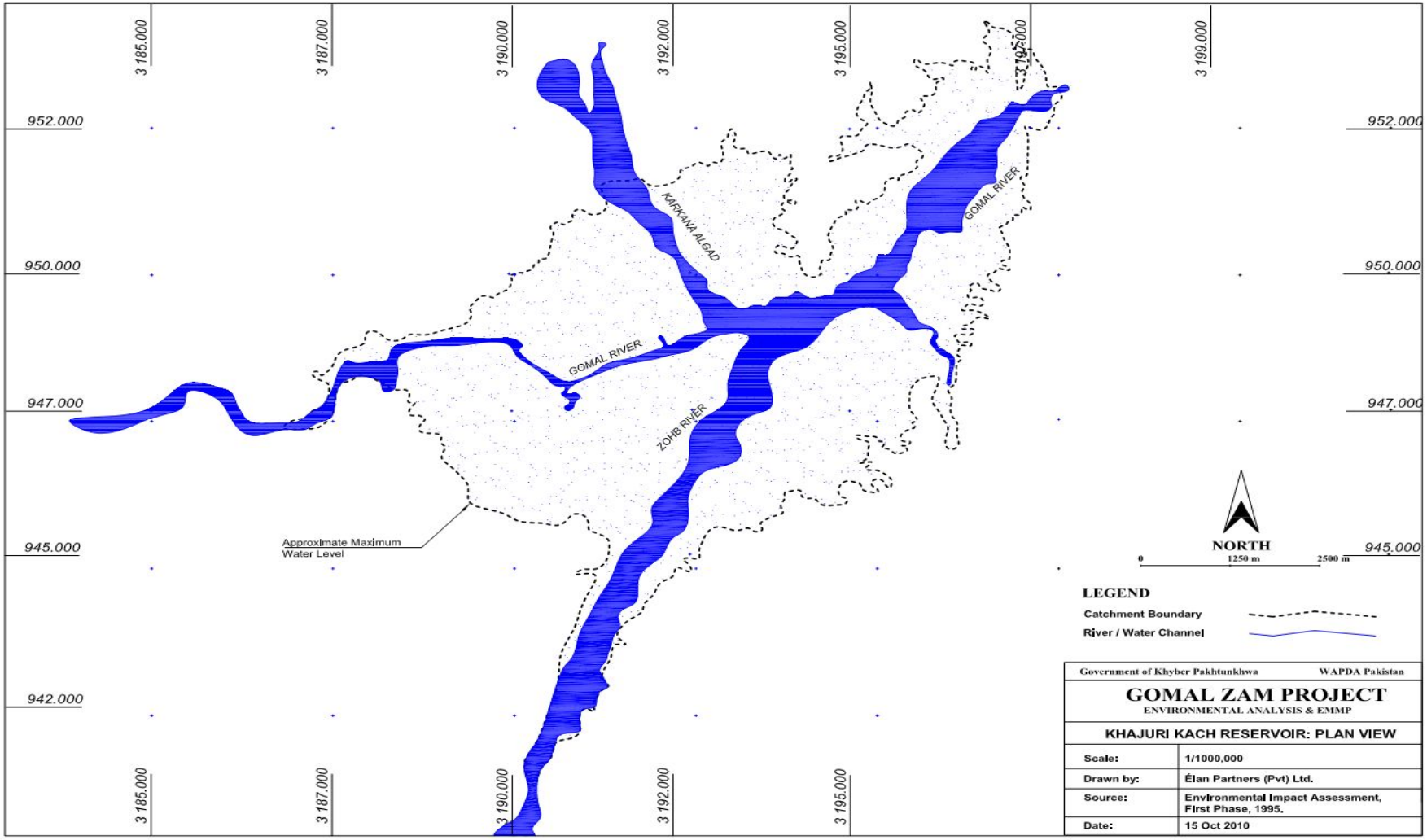


Figure 3.4: Gomal Zam Dam Layout

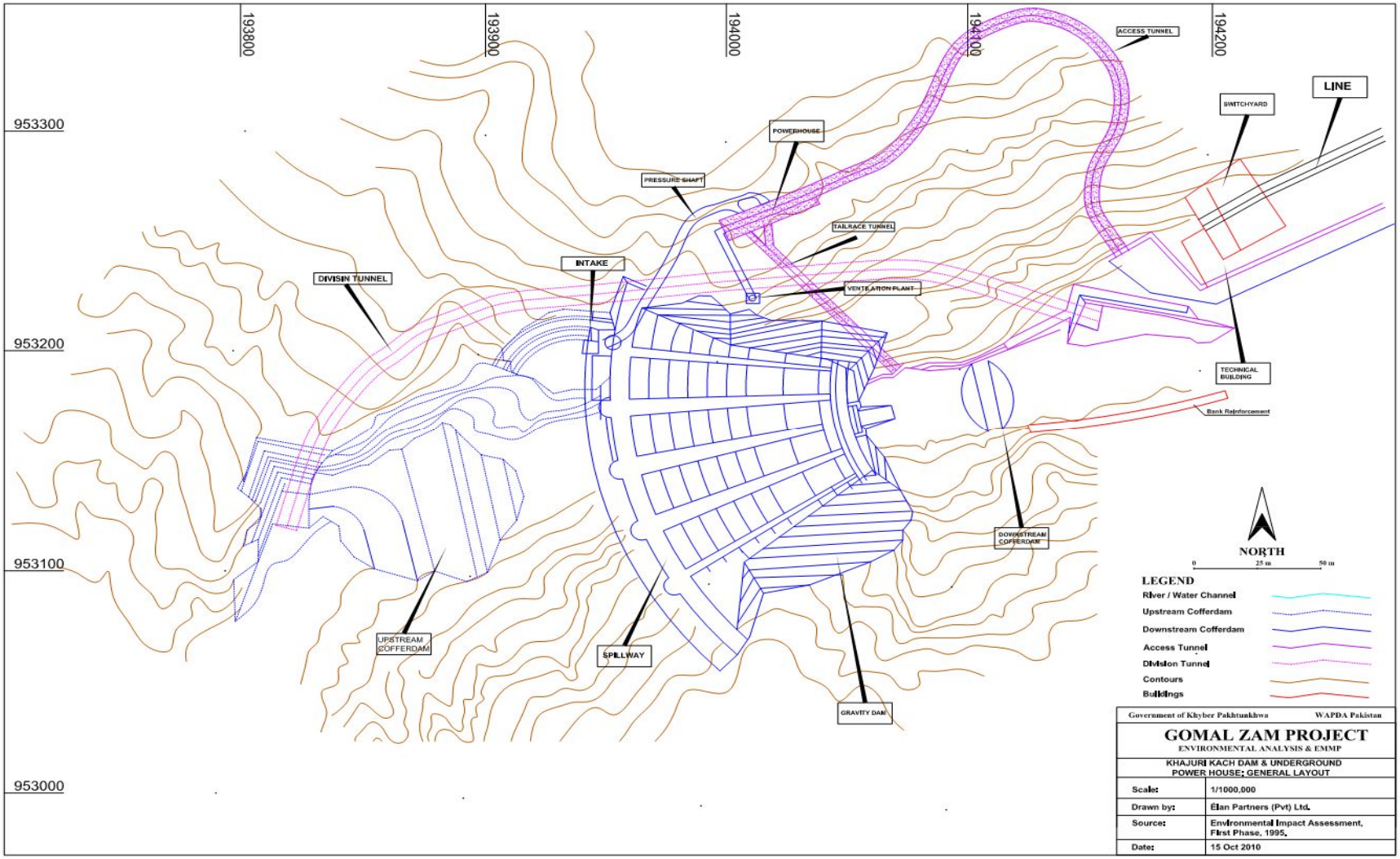


Figure 3.5: Command Area

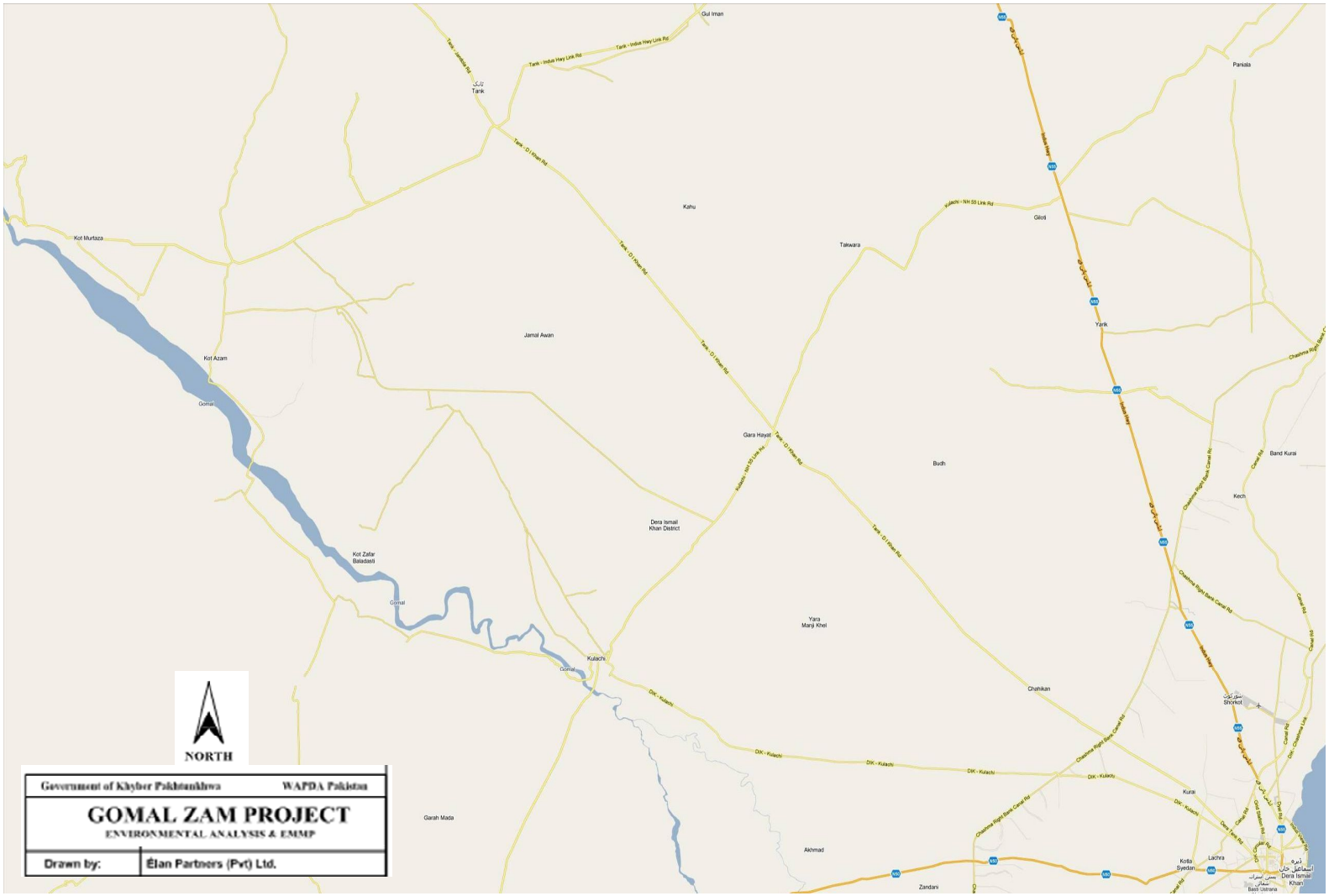


Figure 3.6: Catchment Area

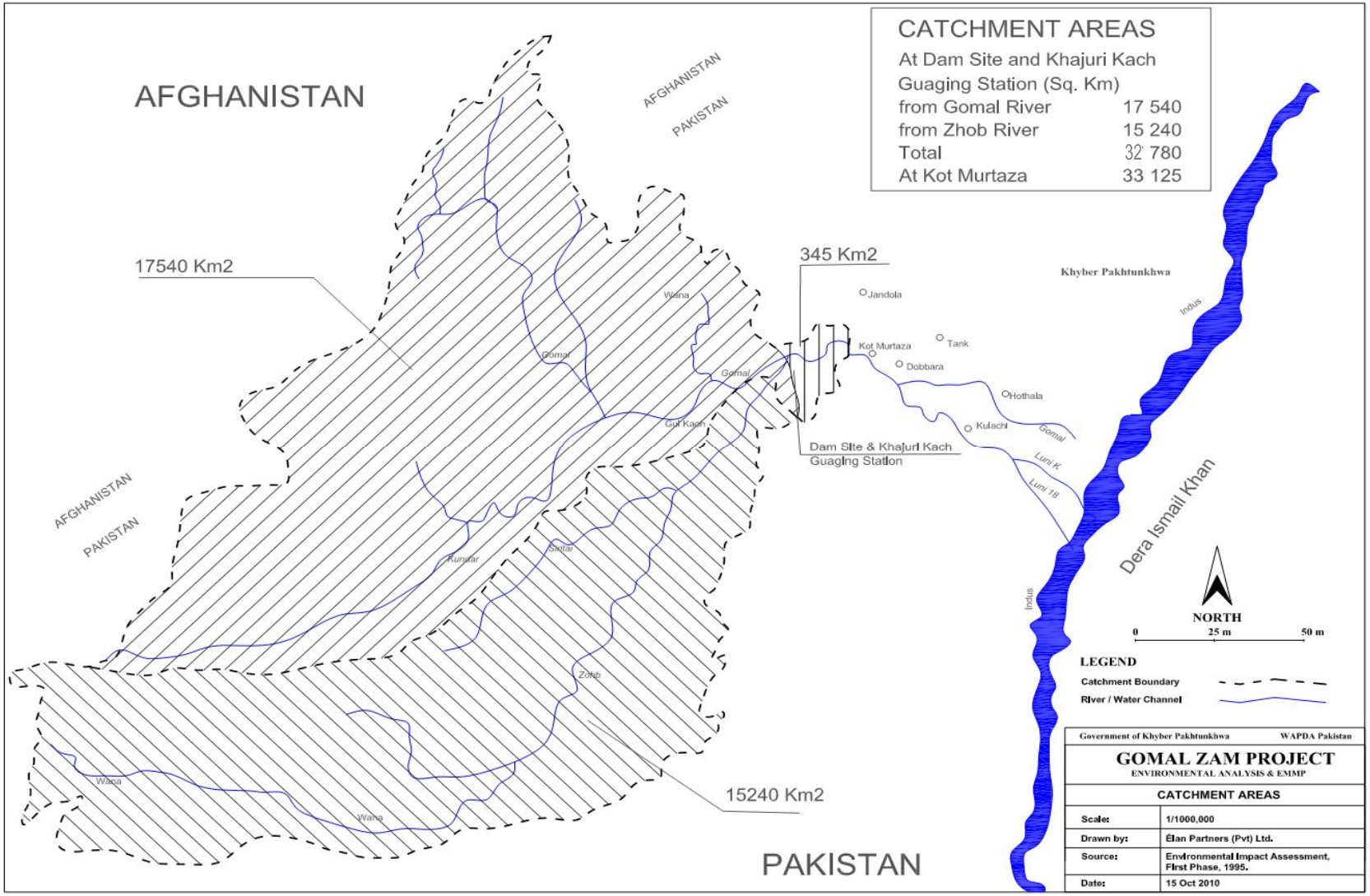
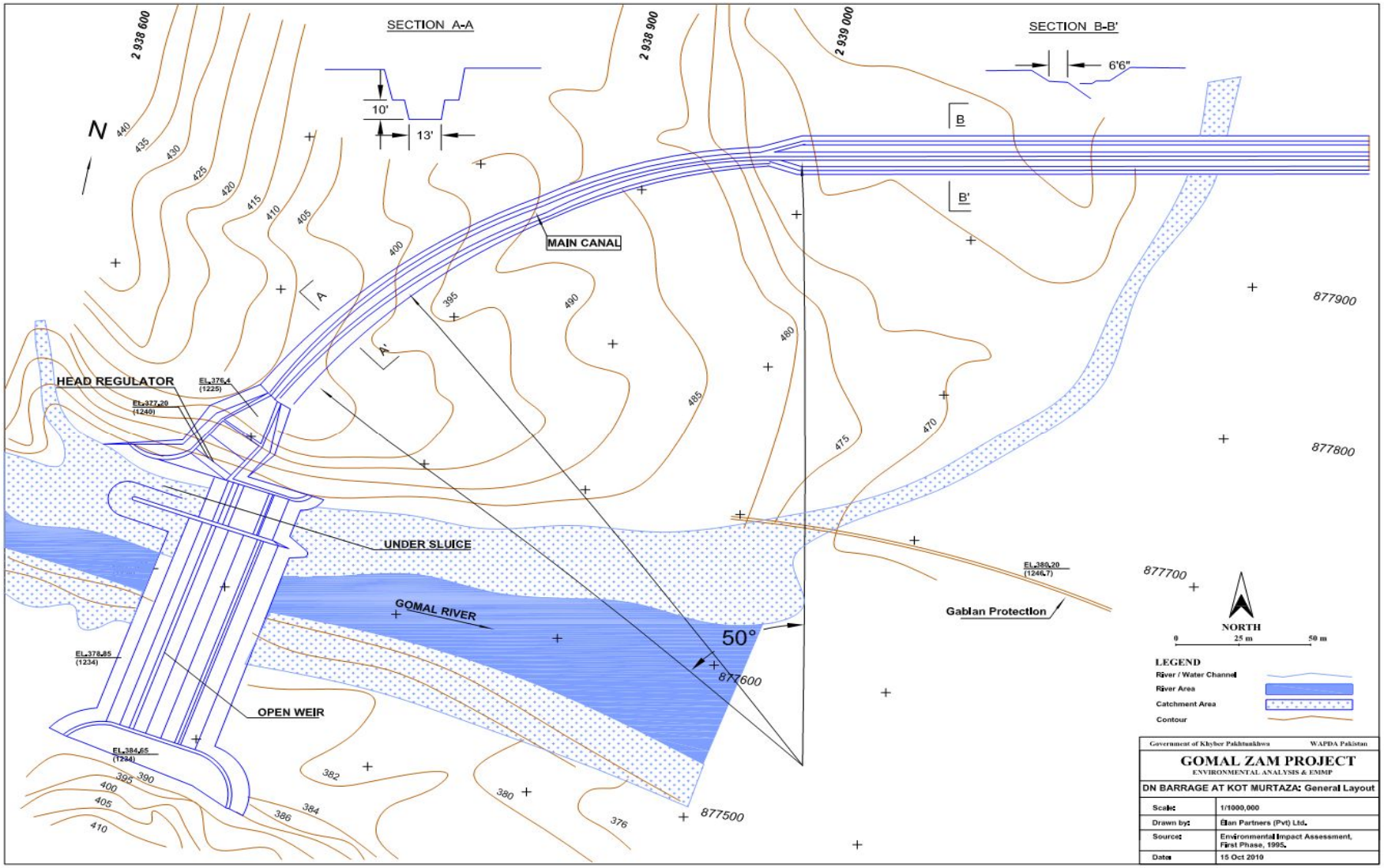


Figure 3.7: Diversion Barrage



4. Overview of Baseline Conditions

This Chapter presents an overview of the pre-project environmental and socioeconomic conditions of the area.[17] The present environmental and socioeconomic aspects observed during the recent field visit are also discussed in the Chapter.

4.1. Physical Environment

The discussion is divided into sections on climatology, erosions in the watershed and geodynamic features in the future reservoir.

4.1.1. Climatology

Much like the major part of Pakistan, the Gomal river watershed (see **Figure 3.6** for the watershed or catchment area) is dominated by dry climate. It nevertheless belongs to a specific climatic region of Pakistan: semi-aid, with warm summer and mild winter.

There are two sources of rain fall in Pakistan, the Monsoon and the Western Depressions. The monsoon rainfall takes place from July to September and the Western Depressions bring rainfall from December to March. The monsoon winds enter Pakistan from the east, after crossing India. Gomal river watershed, at the west of Pakistan, has a rainfall regime with winter maximum, in average between 125 and 250 mm. Climate data for D. I. Khan station, about 100 km from the dam site, was collected from the Regional meteorological Centre, Lahore for the irrigation study. Yearly rainfall calculated on the 1950-1992 period, was estimated at 276 mm. The maximum occurs in average in August, 59 mm/month, and the minimum in November, 2.4 mm/month.[18]

Warm summer (21°C to 32 ^{o}C) and cool winter (0 ^{o}C to 10 ^{o}C) is experienced in the major parts of the Western Highlands of Pakistan (Karim Khan, 1991, page 37). For the D. I. Khan station, monthly mean maximum temperature recorded during 1950-1992 was 38.5 ^{o}C in August, and monthly minimum mean temperature, 4.2 ^{o}C in January.[19]

The average humidity recorded at D. I. Khan station in 1963-1993 was in average 54% with monthly means ranging from 37% in May to 65.5% in

[17] Baseline description in this Chapter is based upon the detailed version provided in the EIA report (C. Bellier, 1995. *Environmental Impact Assessment (First Phase), Gomal Zam Additional Studies*.)

[18] Coyne et Beilier, 1995, 2, Appendix ID, Table 1.

[19] Coyne et Beilier, 1995, 2, Appendix ID 1.3.3 and ID 1.3.4.

August. Evapotranspriation ranged from 1.8 mm/day in December to 7.3 mm/day in June, i.e. a yearly mean of 1,635 mm.[20]

The recent climate data recorded at the meteorological station in D. I. Khan is presented in **Table 4.1**.

4.1.2. Hydrology

a) Rivers and Watersheds

The Gomal River originates from Shinkay Hills in Afghanistan. On entering in Pakistan, it receives water of Kundar river, a right bank tributary which forms a natural boundary between the two countries. Then it joins Indus, south of D. I. Khan. The Zhob river originates from Toba Kakar Range in Pakistan and flows north-east to join the Gomal river, a few kilometers upstream from dam site.

The catchment area of the Gomal river at the dam site and gauging station is 32,780 km^2 (8.1 x 10^6 acres), including 17,540 km^2 (4.3 x 10^6 acres) from Gomal river and 15,240 km^2 (3.8 x 10^6 acres) from Zhob river.[21] At Kot Murtaza Diversion Barrage, it becomes 33,125 km^2.

b) Water Availability and Flooding

Yearly and Monthly inflows at Gomal Zam Dam site have been studied for the period 1957 to 1993 (Coyne et Beilier, 1995, 1, Chapter 2.3). For the period 1987-1983, the monthly and yearly inflows appear to be significantly above the 1957-1986 mean, 1,373 x 10^6 m^3 and 511 x 10^6 m^3 respectively. For the purpose of the Project design, the average of 511 x 10^6 m^3 (0.414 million acre-feet or MAF) for a 30-year period has been chosen as the mean annual runoff. The corresponding mean annual flow is 16.2m^3/s (572.4 cfs or cusecs).

For the irrigation purposes, 400 x 10^6 m^3 (0.324 MAF) of water will be made available annually. The remaining water will be released in the Gomal river.

A flood frequency analysis was conducted in the 1983 Coyne et Beilier report. The 1995 updated feasibility study adopted the same conclusions, i.e. a design flood peak of 13,000m^3/s for a return period of 5,000 years. The design flood volume is 600 x 10^6 m^3 for 1 day and 1,800 x 10^6 m^3 for 6 days (Coyne et Beilier, 1995, 1, Chapter 2.3, Section 2.3.3 and Table 2.6).

c) Water Quality

This section has been derived from the Water Quality First Phase Study prepared by Aquascop, France (Coyne et Beilier, 1995, 2, Annex-H-1). The

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[20] Ibid, Appendix ID 1.3.6.

[21] In the revised feasibility study (*WAPDA 2010. Gomal Dam Multipurpose Project – Revised PC-I Proforma)*, the catchment area is given as 20,196 km^2 (see **Section 3.4**)

data on surface water quality used by Aquascop, were taken from the Water Quality and Human Health review of Available Basic Data (Coyne et Beilier, 1995, 2, Annex-H-2).

Data has been derived from surveys made at Khajuri Kach stream gauging station between 1980 and 1993, and Kot Murtaza station between 1972 and 1993. Parameters of surface water analyzed include pH, conductivity, dissolved solid, calcium, magnesium, sodium, chlorides, carbonates, bicarbonates, and sulfates. Moreover, data was collected from wells in Tank, Kulachi, and D. I. Khan, all in the area downstream of the planned reservoir and adjacent to the Indus valley. A comparison of Water Quality Standards of World Health Organization, European Economic Community (EEC), and France was also conducted.

The results revealed no significant differences between Khajuri and Kot Murtaza sites. The Gomal River water appears to be slightly basic, highly mineralized and very hard. According to the data collected, the pH, calcium. Sodium and chlorides values however do not make it unfit for human consumption (Coyne et Beilier, 1995, 2, Annex-H-1, Section 4).

On the other hand, recorded sulfate concentrations are higher than the treatability set by the EEC. Sulfates, sulfured hydrogen and high alkalinity may be factors triggering corrosion, affecting concrete in particular.

This water quality must probably be considered as arising from catchment geology and pedology. However, the possibility of anthropogenic pollution must not be overlooked.

As regards the subsurface water quality, the data refers to locations in the downstream plain, and not to the region of Gomal Dam reservoir. They do tend to indicate some inadequacies in local sewerage system (Ibid, and see also Section 4.3.3.c.).

4.1.3. Erodability of Watershed

The watershed of the Gomal Dam presently displays features of high erodability, which may mainly be attributed to past deforestation. The present reference situation is therefore characterized by detrimental erosions in the catchment and high downstream ward sediment transport.

An Important issue of Gomal Zam project lies, therefore is necessary to specify the ways and means of (i) preventing too fast a siltation of the reservoir and (ii) catching the opportunity of this project for implementing a better management of the catchment for the benefits of all.

According to the hydrological study, the average sediment concentration in Gomal river waters is 5.27%. The average sediment weight is therefore estimated at $5.11 \times 10^6 \times 5.27\% = 27 \times 10^6$ m^3/year (Coyne et Beiller, 1995, 1, Section 2.3.4, p 22). The agro-pedology expert interpreted Landsat imagery of the watershed, and performed a field trip to Gulkach and the region of the reservoir; the full report dealing with erosion control in dam watershed is given as Annex E to the preliminary EIA report.

The main erosion factors are the following (Coyne et Beiller, 1995, 2, Annex E, Section 1)

- erosivity, which a direct function of rainfall intensity. In this respect, monsoon precipitations with intensive local rainstorms appear as very erosive.
- erodability, which depends upon structure and particle size distribution of soils or of their parent material. Within the Khajuri Kach watershed, quaternary deposits unconsolidated or poorly cemented silt, sand, gravels, pebbles and clay appear like the most erodible formations.
- topography,
- land use. According to some testimonies dating bank to the early nineteenth century, most of the Wazir territory was at that time covered with pine forest. Grazing and the demand for timber and firewood have made this forest disappear, with the exception of the Ramsak reserved forest in the upper Wana Toi river basin.

Taking into account those factors, and according to the agro-pedology study, the main identified sources of the sediments carried by Gomal River at the Khajuri Kach site are the upper Zhob river valley on one hand, and Zamerian plain, (i.e. Gomal River valley between the Afghan boundary and Gul Kach) on the other hand. Indeed and according to the agro-pedology expert, (Coyne et Beiller, 1995, 2, Annex E, section 1.3), the alluvial and lacustrian deposits in those plains would be, in the whole watershed, the most sensitive landforms to erosion process. They consist of recent moderately fine to fine textured alluvial deposits, and in lacustrian deposits of silts. Both are affected by erosion which proceeds in two fronts.

- In the upper reaches, the network of channels concentrating run-off flows deep into the soils, locally developing wide badlands tracks,
- In the lower plains, flood waters scour the river banks and devastate the bordering alluvial deposits.

4.1.4. Geology of Reservoir Area

One of the possible environmental concerns relative to dam reservoirs in general is the risk of re-activating landslides and erosion in the area to be flooded by the reservoir.

An engineering-geological map of the reservoir at a scale of 1/10 000 was prepared by Engergoprojekt in 1961 (Energoprojeket, 1963, Vol VI/2 pages 1 to 9). That map was based on a detailed survey of the reservoir area.

This work was complemented, in November 1994, by a field survey of the Gomal Valley in the region of the reservoir. The full report for this assessment is presented in Annex D of the preliminary EIA report. The main findings are as follows:

The bed of the reservoir mainly consists of thick sedimentary deposits of alluvial and torrential origin. These late quaternary alluvial terraces are semi consolidated formations of sand, gravel, pebble and cobble layers with some boulders. These terraces are progressively mixed with torrential deposits, which themselves are widely extended in gentle slopes up to some abrupt relief formed by Jurassic and Cretaceous limestones.

It should be noted that recent landslides have been rare or insignificant, but that scree of clayey detritus are frequent along shale exposures. One of these thick detritus overlying black shale is located just upstream of the dam site on the right bank.

4.2. Biological Environment

The flowing text is derived from the flora and fauna study, prepared by Mascon Consultant Associates, Lahore, Pakistan. The full report is provided as Annex G of the preliminary EIA report (Coyne et Beiller, 1995, 2, Annex G).

4.2.1. Flora

The watershed of Gomal Zam dam project is located in a semi arid climatic region. As a result the area is characterized by natural xerophitic vegetation, with slow plant regeneration and heavy grazing. The development of tree is principally limited by the low rainfall, below 250 mm annually (see above **Section 4.1.1**).

The main part of the Gomal catchment has been classified in Balochistan juniper and Pistachio Scrub Forest vegetative zone (Map 2 in Annex G of the Preliminary EIA).

According to the flora study carried out during the Preliminary EIA, the watershed of Gomal Zam dam does not contain any reserve or protected

forest. However, some forest reserves and un-classed forests were located in the Pakistani part of the watershed on figure 2 of 1961 Energoprojeket report, entitled "Gomal river catchment area plan" (Energoprojekt, 1961, III).

Vegetation in the area to be flooded by the reservoir, Gomal river valley downstream of dam, and region to be irrigated is summarized below (see Annex G of the Preliminary EIA for further details).

a) Vegetation Communities

No detailed survey has been carried out during the first phase of environment studies (ie, Preliminary EIA) for the vegetation in the area to be flooded by the Gomal reservoir, Gomal River valley downstream of dam, and region to be irrigated.

The list of species presented in Annex G of the Preliminary EIA report is based on field observations (downstream Gomal Valley, Golkach, Zhob Valley, Wana, and Tank) and from a report by Stewart et al, 1972, entitled "Flora of West Pakistan, An Annotated Catalogue of the Vascular Plant of W. Pakistan and Kashmir". Vegetation communities are listed according to geographical consideration: Downstream Valley of Gomal River, South Waziristan, and Zhob Valley. The vegetation is mainly represented by xerophytic communities, including for example different species of Acacia.

According to the flora study and figure 2 of the 1961 Energoprojekt report, no forest is located within the limits of the reservoir nor within command areas.

b) Wild Lands and Wetlands

It is noted that the catchment of Gomal Zam dam is characterized by marked erosion of the land, cutting for fuel wood and heavy grazing, especially by sheep and goats.

According to a 1990 IUCN report of south Asian protected areas (quoted in Annex G, Section 2.3.7 of the Preliminary EIA report), nine wetlands are designated as wetlands of international importance especially as waterfowl habitat (Ramsar sites) in Pakistan. None of these wetlands are located within or in the immediate vicinity of the project sites (i.e., catchment, dam site, and command area).

Ten wetland species have nevertheless been observed in Gomal river bed, downstream of the Gomal dam site, including Tamarix dioica, Juncus maritima, etc.

c) Endangered and Threatened Species

During the preliminary EIA study, four plant species were classified by the flora team as endangered and threatened. Vegetation Communities: Salvadoran oleoides, Eleergnus sp., Vitex negundo and Prosopis cineraria. Salvadora oleoides is presented as included in the IUCN Red Data Book.

d) Aquatic/Benthic Communities

The only aquatic and waster dependant plant communities listed in the study area are located in the downstream valley of Gomal River. These are: Psammogetion canescens, Ranuncultus aquatalis, Oxalis sp. and Juncus maritima.

4.2.2. Fauna

a) Habitat

The watershed of Gomal dam is located in the hilly and semi-arid areas of South Waziristan Agency, Balochistan, and Afghanistan. The Sulaiman Range represents the transition between this mountainous region and the Gomal plain, which belongs to the right bank of the Indus plain.

As mentioned above, vegetation is mainly composed of scrubs, dispersed in the all area, with specific species in the river beds.

According to the gazetteer of the D. I. Khan district of 1883-84, the disappearance of wildlife (tiger, hog deer, wild boar, and wild ass) began at the end of the 19th century, owing to the increase of cultivation in the D. I. Khan district. Wolves, foxes, jackals, hyenas and few leopards were nevertheless always present at that time. The tendency towards disappearance of wildlife and their habitat has gone on the present time. It is specified in a 1994 WAPDA report, as regards environmental considerations of the project, that the reservoir and catchment areas are now practically devoid of wild animals. The increase of access and activities of human beings can be expected to further tax any surviving specimens of local species (WAPDA, 1994 (?), pages 6-7).

No protected area has been identified in the watershed of Gomal Dam or in the region to be irrigated. Only one Game Reserve (Zarkani, 12,800 ha) is located in the downstream valley of Gomal, south of Sawan river and North of Daraban, but outside the proposed command area (Coyne et Beiller, 1995, 2, Annex G, Section 2.3.6.).

b) Wildlife Species

No detailed survey of the fauna was carried out during the preliminary EIA. As far as the watershed of Gomal dam and the command area, animals listed in

the fauna study have been taken from Robert, 1991, and some field observations. It consists of 18 species of mammals (fox, black bear, hyena, hare, etc.), 30 species of birds including aquatic species (Houbara and Great Indian bustard, Saker and peregrine falcon, Shrike etc.), and one species of reptile (lizards). Some wildlife species were also reported by the local tribal Malik (Raghzai village), including jackal, snakes, etc. (Coyne et Beiller, 1995, 2, Annex G, Section 2.2.4 and Page 34).

Indus river system constitutes an important flyway for migrating birds traveling from the breeding grounds of Russia to winter in the arid zones of Pakistan, Iran and North West India. Large numbers of the endangered species Houbara Bustard (Chlamydotis unulata) migrate from the Kazakh steppes to the Indus plain. All along their routes in Pakistan, migrating birds are shot, trapped and poisoned. Since 1968, the Houbara bustard has been hunted by visiting falconers, and up to several thousand birds are killed every year (Coyne et Beiller, 1995, 2, Annex G, Section 4.8).

c) Aquatic Species

Aquatic species recorded in the project area include aquatic birds (Spot bill duck, White headed duck, Cotton tail, India pea fowl) and fish.

Some studies have identified 17 fish species in Zhob river. It is considered that most of these may also be inhabiting Gomal, including the food fish like Tor zhobensis or Nazirtor zhobensis) and Tor putitora (Robert, 1991, quoted in Annex G, section 3.1 of the Preliminary EIA). These two species, endemic to Zhob river, migrate along the river, between the upper section (cold water) and lower section (warm water) (Coyne et Beiller, 1995, 2, Annex G, Section 4.5). Methods of fishing developed recently, e.g. by hand grenades and dynamite, have nevertheless reduced fish population to a very low level.

d) Rare and Threatened Species

The number and location of the rare and threatened species in Pakistan and in the Project area has not been studied in detail.

Among the 32 species of animals listed as" endangered" in Annex G, Section 2.3.5 of the Preliminary EIA, seven are presented as "endangered species in the Project Area and its surroundings". Among these seven species, six are listed as endangered species in Pakistan in the 1983 IUCN Red List of Threatened Animals: one mammal as endangered species (Markhor); three mammals as vulnerable (Black Buck, Chinkara, and Punjab Urial); one bird as Vulnerable (Houbara Bustard); and one reptile as Vulnerable (Python).

Moreover, 49 species are listed as present in the Gomal watershed and in the downstream valley (Coyne et Beiller, 1995, 2, Annex G. Section 2.2.4). Among these animals, ten are recorded in the 1994 IUCN Red List: six mammals including two endangered species (Black Bear and Sulaiman Markhor); two suspected to be threatened species (Fishing Cat, Sand Cat); two vulnerable (Chinkara, Urial), and four birds as vulnerable species (Houbara Bustard, Indian Bustard, Siberian Crane, and White headed Duck).

4.3. Socioeconomic Environment

The following sections deal in turn the administrative division, population, community facilities and services, economic activities and culture resources. Information is given in each section, as far as it is possible, for the future reservoir area and for the command area (Project's area of influence).

The discussion is taken, expect where otherwise mentioned, from the preliminary socio-economic study provided in Annex-I of the Preliminary EIA report. **Figure 4.1** presents a map of the area showing settlements.

4.3.1. Administrative Division

The reservoir area is located partly in the South Waziristan Agency, and partly in Zhob Agency of Balochistan. The command area lies in the D. I. Khan.

The D. I. Khan division comprises two districts: D. I. Khan and Tank. The D. I. Khan district is subdivided into two Tehsils: D. I. Khan and Kulachi, whereas Tank has only one Tehsil.

The union council is the basic rural unit comprising 2 to 7 villages which may have several Mouzahs (main villages), Kots (villages) and Abadies (small villages or hamlets) in the area. Electoral wards correspond to sub division of union Councils.

The summary of Union Councils in the three Tehsils of Tank, Kulachi and D. I. Khan is presented in **Table 4.2**. The data of the different administrative divisions which are in the Command Area is given in **Table 4.3**. The list of these villages is given in Annex I of the Preliminary EIA report.

4.3.2. Population

a) Demography [22]

According to census data from 1998, FATA is home to a population of roughly 3.18 million. Annual population growth in the inter-censal period of 1981 to 1998 is calculated to be 2.19 per cent but certain agencies and FRs refute this

[22] Source: Government of FATA website (http://fata.gov.pk/), accessed on 11 October 2010.

trend, showing a decline during the same period. Population density for 1998 stands at 117 persons per square kilometer in FATA as a whole, with wide variations between individual agencies and FRs. In D. I. Khan FR, for example, the population is thinly scattered with 19 persons per square kilometer, while population density in Bajaur Agency reaches 461 persons per square kilometer.

The average annual population growth for FATA is slightly lower than the provincial average of 2.8 per cent and the national average of 2.7 per cent (GoP, 1998a). The average household in FATA consists of 9.3 persons, compared to 8 persons in the NWFP and 6.8 persons in the country as a whole.

The gender ratio of 108 males for every 100 females is somewhat perplexing, since some 126,577 persons, most of whom are likely to be men, are recorded as migrants from FATA in other parts of Pakistan during the 1998 census. This should in theory leave a higher proportion of females in the local population. Census reporting in FATA is likely to have been distorted by problems in gathering data, since tribal custom forbids the disclosure of information about women to outsiders.

b) Ethnic Features

Although South Waziristan is also inhabited by Suleiman Khel, Bhittanis and Urmars, these tribes are smaller in this agency compared to the Wazirs and the Mahsoods who dominate it and have been responsible for much of its inaccessibility, and its warlike history.

The Wazirs and Mahsoods have a common ancient ancestral lineage. They are nevertheless at present quite distinct and separate tribes and have been often been hostile to each other, mainly for economic reasons arising out of the scarcity of land. Wazir is subdivided into two main sub tribes: Zali Khel and Amazai.

The area to be flooded by the reservoir is under the responsibility of Zali Khel tribe. Suleiman khel tribe occupies the west are of the catchment are partly in South Waziristan and partly in Balochistan. Dottanis are in Balochistan between Gomal Zam and Zhob Zam. Mahsoods are located in the area comprised between the dam site and Command Area, whereas Bhittanis are in the North of Jandola town.

The Mahsoods, Wazirs and Bhittanis are doing bushiness in timber, dry fruits, cloths and other merchandise in Tank. The transport business in this area is also exclusively in their hands.

Several documents describe the following tribes in the Command Area:

- Jats have been present since the beginning of the 15th century. They belong to the main sub tribes Awans, Siyars, Khokhars, Chinas and Bhatti. They are spread throughout the D. I. Khan division and numerous in Tank Tehsil,
- Balochs immigrated after Jats, mainly during the 19th century. The main sub tribes are Gumanis, Sarganis, Mamdanis, Magassis, Laskanis, Kulachis, Korais, etc. Like jats, the Baloch are also scattered throughout the area. Though, they are generally more educated than Jats. They are mainly farmers.
- Pathans. The principal Pathan tribes in the Command Area are Gandapuri, Kundis, Main Khels, Durranis, Marwats, Tators, Daulat Khel, Bhittanis, Gorazais, Babar, shermis, Masuds, Wazirs and ustranas, Gadapuris are spred over almost all of the division but they originated from Tehsil Kulachi. The villages Takwara, Kulachi, Luni, Rori and maddi are considered to be the centres of Gandaouri tribe. Kundis belong to Powindah tribe, settled in the area. Their villages of origin are Pal and Amana Khel but at present the village of Gul Imam is inhabited by this tribe. The peaceful Pathans of Main Khel tribe are the descendants of richest Powindah tribes named as "Lohani". The durranis mostly live in town areas; while Marwat tribe lives in Paniala and Tank.
- Mughal, Syed and Kamins.

The principal mother tongue of the area is Punjabi (Saraiki) in D. I. Khan and Pushto in Tank. The other important languages spoken in the area are Hindko and Urdu.

Islam is the religion of more than ninety present of the people. Sunnis and Shias are the two main sets Muslims. Christians are in fractional percentage.

c) Housing

There were some signs of some old houses, currently abandoned, in the region of the reservoir reported in the Preliminary EIA (however, these houses are not included in the list of protected sites). At the time of the Energoprojket study (1963), an agreement that there would be no settlement in the reservoir area was concluded between the government and the tribal chiefs (Maliks). Some years ago, some families tried to establish temporary dwellings and farms at the confluence of Gomal Zam and Zhob Zam, but the local authorities demolished the settlement. During summer, the people of south Waziristan carries on their normal life in the hilly areas while during winter, the majority of

them move down to the milder parts of Tank and D. I. Khan district, bringing with them their families and herds.

At the confluence the two rivers, there is a cemetery with about one hundred graves. According to local authorities, the persons buried there are nomadic people who have no links with local tribes.

As far as the command area is concerned, two different situations can be seen: in rural areas people generally live in mud huts with flat roofs (kacha house), while in big villages or Mouzas and in towns, the houses are made of bricks and cement (pacca house).

4.3.3. Community Facilities and Services

This section summarizes the community facilities and services of the reservoir and the command area: education, roads water and sewerage, health facilities, police, electricity, postal and telecommunication services. A more detailed description is provided in Annex I, Section 3 of the Preliminary EIA report.

a) Education

In South Waziristan Agency, according to important Agency-wise socio-economic indicators of FATA 1992 and FATA Development Statistics 1992 (Bureau of Statistics, Planning, Environment and Development Department-government of NWFP), the literacy ratio of population (ten years and above) in FATA 1980-81 census are very low, 7.04 for both sexes and 11.76 for men and only 0.6 for women. (According to the 1998 census, the literacy in South Waziristan was 19.84 %.)[23]

The total number of primary schools is 250 (191 for boys and 59 for girls) i.e. one school for 1,776 inhabitants. In addition there are 46 mosque primary schools. The number of middle schools is 39, among them only two middle schools for girls. There are 20 High Schools, one of which for girls. In addition there are two inter/degree colleges and one vocational institute for men (see Table 30, Section 3, Annex I of the Preliminary EIA report.

The numbers of girls studying is very low especially from the middle level up. In addition, all these schools are often far from the living place of the people. The nomadic or semi nomadic way of life of a large part of the population is South Waziristan Agency is also an obstacle to a permanent participation of the children on the training courses.

The literacy rate in 1981 was very low in NFWP (now KP): 16.7% (35.41 according to the 1998 census). The literacy ratio for males was 25.9% while it

[23] Source: http://www.nps.edu/programs/ccs/Docs/Pakistan/Maps/FATA_Literacy.pdf.

was only 6.5% for female. For the District of D. I. Khan, the literacy ratio was only 15%: 35.5% in urban areas and 10% in rural areas. The male literacy ratio was 22.8% compared to 5.8% for female.

The Education department tries to improve this situation. It follows a set of criteria for the establishment of new schools. Each village of at least 1,000 people is supposed to have a primary school for boys and one for girls. A second criterion is distance: the nearest primary school should be no further than 1.5 miles from the population centre. At the time of the study, 20.317 primary schools were located in NWFP: 78% are male and only 22% are female.

The Gomal University is located 10 miles from D. I. Khan, and has faculties of agriculture, art, sciences, pharmacy, English and computing.

Table 4.4 gives the number of schools by level and by Tehsils in the command area. The list of schools and their location are presented in Section 31.1 of Annex I of the Preliminary EIA. Only primary, middle and high schools are located in this region. Among primary schools, some are mosque/mohallah schools. These schools have the same grades as primary schools, but they place greater emphasis on Islamic instruction (Islamayat or Islamic Studies), and the training of teachers is less formal and more heavily based on Islamic subject matter. In Command Area no school of this kind exists for girls.

Often in the villages of the Command Area, the population complained during the socio-economic survey about the condition of their schools. The approximate percentage of schools without building amounts to 20%, Moreover, 62% need immediate repairs of different magnitude (see Table 19 in Annex I, Section, 311.1 of the Preliminary EIA - Coyne et Beilier, 1995).

b) Road Network

D. I. Khan, located at a distance of 40 miles from Tank and 32 mile from Kulachi, has link with Peshawar (Provincial Capital), Lahore (Punjab Provincial Capital), and Zhob in the Balochistan Province. By road, it is linked with Punjab through Dera Ghazi Khan to Faisalabad and Lahore. It has also a link with Zhob in the Balochistan province through Tank and Wana while it has a good connection with Peshawar via Bannu and Kohat.

Tank has road connections with D. I. Khan, Kulachi, Zhob via Wana, Bannu via Pezu while the Kulachi Tehsil headquarters has a link with D. I. Khan, Tank, and Daraban through black top roads.

According to statistics in socio-economic indicators, there was a total 996 km of roads (686 lm black top and 310 km shingle) within the boundary of D. I. Khan

division in 1992. The communication and works department is mainly working to repair the parts of the roads which have been destroyed by floods.

c) Water and Sewerage

In 1992, a total of 57 water supply schemes were completed in South Waziristan Agency, serving about 143, 558 people, i.e. 31.5% of the total population.

According to the Public Health Engineering Department officials of D. I. Khan and Tank Districts, since 1952 it has completed 114 water supply schemes in the rural area of D. I. Khan District, which serve a population of 143,109 people. In the mean time, this department has also completed 29 schemes in the Tank District serving a population of 118,565 people.

Tank officials said that at present 8 scheme are in operation which benefit almost all the villages located in the command Area. The total of population served 9with the exception of Kulachi) is of about 42,897 people out of a total of roughly 100,000 inhabitants without the part of Kulachi concerned by the project. So the percentage of the population served would be between 40 and 50 percent.

It was stated that tube wells run for 8 to 10 hours daily except for Dabbara scheme, where due to closing the account of Afghan refugees, the electricity bills are not paid and pumping lasts for only one hour a day.

During the socio-economic survey, 31 villages were studied. It was observed that about 20% of the villages do not have fresh water supply. Some of them use water from the running watercourses while other have been provided by the Public Health Engineering Department through pipes from their tube wells to reservoirs constructed outside the villages. Villages are not allowed to tap the water from the reservoirs to their homes.

The need for water supplies was emphasized by all the people interviewed in the villages, both men and women. Indeed, when no drinking water is available in the village; women and girls are in charge of supplying the family.

In the rural area, the sewerage system is not properly laid. Open drains dispose of the used water in the home. No flush system exists in the rural areas of the command area nor in the reservoir region. However, in the urban localities of Tank, Kulachi and D. I. Khan such a facility is available but to a limited population.

d) Health Facilities

This section is based on the report on Water Quality and health, Annex H-2 of the Preliminary EIA report (Coyne et Beilier, 1995).

Common diseases affecting children include gastroenteritis, dysentery, diarrhea, malaria and typhoid. Common diseases among adults include malaria, dysentery, diarrhea typhoid, cholera, hepatitis, and skin diseases. These diseases are due to use or unhygienic water from ponds and unsuitable well water. The adult mortality rate is less than 1%. It seems that Gomal area has less water borne diseases than the Tank Zam area.

Guinea worm is also mentioned for the Gomal area, but, according to the Deputy Director, Communicable Disease Control of Health Department, Peshawar, only two cases were recorded in 1993 and none in 1994 for the D. I. Khan division (see Annex H-2, Minutes of Meeting, Preliminary EIA report - Coyne et Beilier, 1995).

According to the FATA Development Statistics, the health facilities provided in South Waziristan Agency in 1992 were 6 hospitals (135 beds), 33 dispensaries, 12 Basic Health Units and 2 maternal and Child Health Centers. The total population per hospital bed was 3,192 i.e. nearly twice the population per bed in D. I. Khan Division. There was government staff of 30 doctors, 3 dental surgeons, 2 nurses and 12 midwives. The number of nurses is particularly low. No private medical practitioners are available.

According the Department of Health of D. I. Khan division and 1994 NWFP Development Statistics, health facilities available in D. I. Khan division consisted of 13 Hospital (555 beds), 50 Dispensaries, (20 beds), 7 Rural Health Centre (32 beds), 8 Maternal and Child Health Centers, 4 Sub Health Centers and 47 Basic Health Units. Population per hospital and dispensary bed was approximately 1,714. Detailed description is provided in Section 3.2 of Annex-I of the Preliminary EIA report.

Health facilities were less developed in the command area with one Hospital (at Kulachi), 4 Dispensaries (in Kulachi and Tank Tehsil), 1 Rural Health Center (in Tank Tehsil), 1 Sub Health Centre (in Kulachi Tehsil) and 15 Basic Health units. The level of health facilities was considered as insufficient by the population, especially in the monsoon season when communication is difficult. It seems also that the staff of Basic Health Units (BHUs) is not always sufficiently trained. So people often prefer going to the town hospitals.

e) Police

In FATA, the political agent acts as coordinator between Government and tribes but the Frontier Corps and Scouts are the enforcing agencies.

In the Command Area, law and order is controlled by the police headed by Inspector Generals of Police at the provincial level, by Deputy Inspector Generals and Senior Superintendents of Police at Divisional and District level respectively.

f) Electricity

At the time of conducting the Preliminary EIA, a total of 57 villages included in the Command Area were electrified: 5 in D. I. Khan Tehsil, 15 in Kulachi Tehsil and 37 in Tank Tehsil. The list is presented in Table 34 in Annex I, Section 3.6 of the Preliminary EIA report.

In most of the electrified villages, it was seen that some houses were connected illegality, so the total number of connected families must be more than the 5,500 calculated.

g) Postal and Telecommunication Services

According to the FATA Development Statistics, the total number of post offices in South Waziristan Agency was 26 in 1990-91. Telecommunication services were little developed with 5 telephone exchanges and 285 manual connections.

The list of the villages of the Command Area which have some kind of post office is presented in table 35, section 37.1.1 of Annex l of the Preliminary EIA report. No General Post office is available, but one is located at Tank, where it is also possible to use private call offices at any time in the day. The facilities available in this Command Area are 2 Sub Offices, 2 Extra Departmental Sub Offices and 7 Extra Departmental Branch Offices. It seems that command area has more postal services than the other parts of the Tehsils of Tank and Kulachi, the level of fulfillment of the needs is low.

The total number of villages having a telecommunication facility is 25 for the whole Tehsils of Tank and Kulachi. No information was obtained during the socio-economic survey on the situation in D. I. Khan Tehsil. Table 36 in Annex l of the Preliminary EIA report (Coyne et Beilier, 1995) shows the list of these villages.

4.3.4. Economic Activities

The economy of the reservoir region and the Command Area is predominantly agrarian. In South Waziristan, people generally rear animal and lead a nomadic life since they migrate to the plains of D. I. Khan and Tank during winters.

Agriculture, including perennial and flood irrigation and live stock rearing, dominates the economy of D. I. Khan division. Chapter 2 of Annex l of the Preliminary EIA report describes these rural activities. The present section is a summary for the findings.

a) Land Tenure

We first deal with the area of the future reservoir. Apart from some interviews of Maliks (tribe chiefs) in Wana and a rapid survey of the area which will be flooded by the reservoir, the following data have mainly been collected from books published by the bureau of Statistics – Government of NWFP- 1992 (see section 21.7 of Annex l).

According to the Bureau of Statistics, tenure classification of farms in South Waziristan Agency in 1980 was as follow:

Owner:	16,385 (85%)
Owner cum tenant:	2,825 (15%)
Tenant:	10

The collective property rights of the tribe are very strict. Nobody has the right to settle in an area belonging to a tribe without its authorization.

The **Table 4.5** represents the tenurial system in D. I. Khan division, as it was in 1980. According to the socio-economic study during the Preliminary EIA, there have been not many tenurial changes in the project area, even though for D. I. Khan Tehsil, the Chashma Right Bank Canal Project has brought considerable modifications (see Section 21.1. of Annex l of the Preliminary EIA report).

The **Table 4.5** shows that while 45.1 % of the farms in the D. I. Khan division are cultivated by the owners, 30.2% and 24.7% are cropped by owners cum tenants and tenants respectively.

In the Kulachi Tehsil ownership is dominated by the Gandapuri tribe.

It has been noticed during the field survey that tenants are often managed by the land owner (except if he is an absentee land owner). Cropping patterns, agricultural calendar, investments etc, are sent by the owner for all farm. It was concluded from the discussions with the farming community that the land owners would prefer to rent out land rather than hire permanent labor, to reduce the effect of crop failures.

Different tenurial arrangements were found during the survey (see end of section 21.1 in Annex l of the Preliminary EIA report). Generally, the owner and tenants share 50:50 in the produce where the tenant provides the seed. In other areas, for example, the share is 2/3:1/3, in which case seed is provided

by the owner himself. In some cases, the expenditures (tractor for example) for bund making either divert water or to store it in the field in the responsibility of landlord while the manpower needed to repair embankments after the draining of excessive water from the field is the liability of the tenant.

b) Land Revenue and Taxes

Land revenue, levied by the Government of Pakistan, was first one of such taxes being paid by the landlords depending upon their size of holding, irrespective of their land utilization or mode of cultivation.

With the implementation of Usher and Zakat ordinance, the payment of land revenue was discontinued. Usher is paid at the rate of 5% of produce from irrigated land and 10% of that of rain fed or barani (rain-fed) cultivation. This is collected after giving due allowance of 25% for production costs, estimated by the revenue officials. Small farmers having a farm size less than 12.5 acres are nevertheless not charged the usher. In the Command Area, in the case of tenancy firmly, Usher is generally paid by the owner.

Zakat is the obligatory religious bindings on the Muslims of every sphere of life having assets/liabilities above the specified limits. An amount equivalent to 2.5% of the assets such as cash and jewelry held for one year in excess of the prescribed limits is to be paid annually. It may be paid to institutions or needy persons.

c) Agriculture

As far as South Waziristan is concerned, the total cultivated area in the Agency was 15,000 ha in 1990-1991, including 6,000 hectares irrigated, i.e. 40% of the total cultivated area.

The agriculture in the D. I. Khan division is presented in Chapter 2.7 of the Updated Feasibility Study of the irrigation system of Gomal Zam, main Report (Coyne et Beilier, 1995, 1).

The total area of the D. I. Khan division is approximately 9,000 km^2. The cultivated area represents 2,000 km^2, i.e. 32% of the total area.

The present Cultivable Area (CA) in the Command Area is around 64,000 hectares, i.e. approximately 60% of the total area (Ibid). It is characterized by two kinds of agriculture (see section 4.3.4.f. below for description of irrigation system):

- Perennial irrigation, which represent 12,500 hectares ,
- Flood irrigation, with 51,500 hectares, including 43,500 ha upstream the First Lift Canal project and 8,000 ha downstream.

According to the Revenue office from kharif 1989 to Rabi 1993/94 (kharif corresponds to summer and rabi to winter cropping season), the cropping intensity in the perennial rights area was in average 50%. It is calculated for a culturable area of 15,800 hectares, which includes perennial rights areas from Tank river. The different rabi crops are wheat and barley (36.5% of the CA), fodder, gram and the kharif crops are millet sorghum, maize, rice, and sugar cane. Good performances are observed in Gomal with a cropping intensity higher than 50% good yields and a noticeable proportion of water consumption crops such as sugar cane and rice. This is due to a sufficient and regular water supply from the Gomal river, fertile soils and favorable topography. Conditions are quite different in the Jattatar Chak, with a large proportion of soils subject to salinization and possible alkalinization, and uncertain water supply (Coyne et Beilier, 1995, 1 Chapter 2, Section 2.7.1.1. and Table 2.7.2).

Cropping intensity for the floods rights area is very low 8.7%. For the purpose of the Preliminary EIA, only data from the Kulachi Tehsil have been used to describe existing crops: wheat, barley, gram, oil seeds for rabi crops, and millet, sorghum, melon for kharif crops.

The use of inputs in the Command Area, particularly fertilizer, is almost non existent as the soils are in nutrients brought with the silt during the flood season, However, the use of mechanical power particularly for bund making for the diversion of water, needs a huge amount of money which is beyond the financial means of the inhabitants (bunds are fields surrounded by earthen embankment). To fulfill their requirements, the farmers generally approach the agriculture Development Bank of Pakistan which advances short, medium or long term loans (Section 3.8 in Annex I, Preliminary EIA report). Two branches of the D. I. Khan Agricultural Development Bank of Pakistan are located in the Gomal Plain, one at Tank and the other at Kulachi (Coyne et Beilier, 1995, 1, Chapter 2, Section 2.7.4.3.).

d) Livestock

According to the publications of the Bureau of Statistics of NWFP (now KP), a large number of animals are present in South Waziristan Agency.

According to the 1986 census, there were some 310 goats, 300,000 sheep and 120,000 cattle in South Waziristan Agency, as well as 13,000 buffaloes and 8,000 camels.

At the time of the Preliminary EIA study, South Waziristan had two industrial units based on sub products of livestock: one tannery (93 workers, production of 244,500 hides and skins in 1982) and one footwear and leather goods

factory (202 workers, production of 300,000 pairs of shoes and 400,000 pairs of soles in 1985).

The economy of the Command Area is dependent on agriculture. To supplement their income, these people also rear herds of cattle, goat and sheep. Herd can be sold in case of necessity, particularly for major family events. A large part of the land is covered with thorny bushes, plants and fibrous trees that are used for grazing for the herds of goats and sheep. Area of ranges in D. I. Khan division is 1.3x 10^6 acres (5.260 km^2), i.e. 58% of the total area.

4.3.5. Cultural Resources

This section is based on the archaeological report prepared by Professor Farid Khan, Chairman of the Pakistan Heritage Society (Annex J of the Preliminary EIA report - Coyne et Beilier, 1995).

The Gomal valley is described as an important pass linking the sub-continent with the Iranian Plateau and central Asia through Indus plain, Balochistan, and Afghanistan. It used to occupy a strategic position in terms of caravan trade.

The first systematic and proper archaeological survey in Gomal plain began in the beginning of the 20th century (1927-29), then in the end of the 60's and during the 70's , following by some excavations up to 1990.

The investigation, completed by a field survey for the study, have revealed that no archaeological sites worth investigations exist in the area to be flooded by the reservoir, except a Powinda graveyard, which is located at the junction of the Gomal and the Zhob rivers. It consists of modern Muslim graves, belonging to Afghan nomads, with Persian engraved on the white marble head.

In the Gomal valley downstream from the dam, 21 archaeological sites are described in the archaeological report. The earliest evidence of human occupation in the Gomal valley dates from the 5th millennium Before Christ.

Among these 21 identified archaeological sites, 8 to 10 are located within or the border of the proposed area to be irrigated. These are the following sites: Dabbara, Gomal Bazard, Karam Shah, Kot Allah Dad, Gridavi, Hathala, Shah Zaman Dheri, Kot Kat Dheri ann Laki Kot mounds, and Mian Noor Shrine. The collections observed at these mounds are represented by a large variety of pottery, shell or terracotta bangles, sometimes covered by modern Muslim graves, with spurs of wall, etc. The Mian Noor Shrine seems to be only building of these 10 identified archaeological sites. It is a late 19th century building, frequently visited by people.

None of the above sites/buildings are included in the list of protected sites.

4.3.6. Flood Damages

Gomal Zam flood damages have been studied in the Updated Feasibility study of the irrigation system (Coyne et Beilier, 1995, 1, section 4.6). They are of two types.

- Private property: House, livestock, land, crops and, sometimes, human lives.
- State-owned property: public building, roads and bridges.

Information has been collected on the following floods: 16/07/1973 (18.07 feet), 07/07/1978 (20.70 feet), 02/08/1985 (16.90 feet), 20/04/1992 (18.50 feet), and 01/07/1994 (18 feet). The main sources of information were the offices of the local government (tehsildars of Kulachi, Tank and D. I. Khan), plus different administrations.

According to the collected data, it appears that the importance of the damage and the area concerned are not always in proportion of the levels. For similar heights or water, the losses for the later years are greater than for 1973 and 1978 floods. The heads of Tehsils offices explained that Rod Kohi system was more efficiently working before and "there were not so many diversion as there are now causing silting in the channels, which the over flow of flood water".

Aggregate damage for each of the selected flood has been worked out from different cost estimates: cost of materials and time needed to build of repair constructions, animals price given by farmers, cost directly estimated by the local administration, etc, It has finally been chosen to consider only damages due to two floods (1992 and 1994), of which cost estimates are more comprehensive and representative of the present hazard. Their cost has been averaged at Rs 260 million, which was considered representative of an 18 feet flood.

Moreover, according to officials, farmers and chiefs of the concerned areas, flood lower than 12 feet do not cause any damage. Linear relationship was assumed between 12 and 18 feet with no damage and Rs 260 million damage respectively. Estimated cost of damages has thus been calculated using this relation and the floods above 12 feet recorded by WAPDA from 1956 to 1994. Based on that procedure, the average annual cost of Gomal Zam flood damages was finally evaluated at Rs 80 million.

Floods of July/August 2010

The heavy monsoon rains and resulting floods during July/August 2010 devastated vast areas across the entire Country, and the D. I. Khan as well as its adjacent areas were also affected by the overflowing rivers and streams.

Though accurate estimates and nature of the damages in the area are not known, however, it is highly unlikely that the Gomal Zam river caused any significant flooding, since substantial amount of water was stored in the Gomal Zam reservoir and was gradually released through the diversion tunnel.

4.3.7. Attitude and Wishes of People Concerning Project

Attitude and wishes of the people concerning the project are summarized in this section for the reservoir region and the Command Area respectively. More complete information is available in section 5 of Annex I, Preliminary EIA report.

During the Preliminary EIA, discussions were held with the chiefs of tribes (Maliks) of Mahsood in Tank, Wazir and Sulaiman Khel in South Waziristan Agency.

The tribes of the reservoir region acknowledged that the dam would not be directly beneficial for them as they could not use the water of the reservoir, contrary to the people living in the Command Area. They believe that this project could be unfavorable to them for the following reasons:

- A part of the land they use for the animals, especially in winter, will be flooded. In the Command Area, where some of them move to winter pastures, the quantity of pasture land will also decrease.
- The gorges of the Gomal Zam, which are a route from Afghanistan to D. I. Khan Division, will also be flooded. At present they can buy animals at a good price as well as dry and they are able to sell their own produce to passing caravans.

The Government and tribes have nevertheless a general agreement for the building of any equipment in the tribal area. The main lines of this agreement are:

- Government will pay to the tribes whose land is used a commission of 6.25% of the amount of the project concerning the tribal area. This commission is called Qoumi commission.
- Government will give compensation for land on which the project is built, especially if this land is good for cultivation.
- Contractors will be chosen preferably among who already exist in the tribal area. Even with contractor from outside, he will preferentially employ people of the tribal area for the work they are able to do.

The project could therefore have favorable indirect financial impacts; this money could be used to control some of their main problem, emphasized by the tribe chiefs.

According to the maliks, a rural integrated development project could be implemented with help of international funder. The components of the project could include education, employment, agriculture, livestock, forest management, agro-industries, tanneries, and handicraft workshops. Maliks also requested reinforcement of the existing facilities: water supply, health, all-weather roads, credit system for small farmers and herders.

4.4. Changes in Site Conditions/Observations Made during Site Visit

This Section presents the observations made and changes identified at the Project sites (primarily dam site, powerhouse site, the reservoir area in the vicinity of the dam, and the area along the road leading to the dam site from Tank), during the site visit as part of the current assignment. No obvious evidence was observed of any changes in the environmental media since the EIA study in 1995 – other than the aspect discussed below, however, detailed studies are needed to determine this aspect in definite terms. The Site photographs are presented in **Appendix E** to further elaborate the description below.

4.4.1. Environmental Aspects at the Dam Site

The only changes which have been identified in the area during the site visit are associated with the project's temporary as well as permanent facilities. These include:

- Contractors' site facilities including offices, workshop, warehouse, temporary powerhouse (diesel generators to provide power for the construction activities and site facilities), batching plant, stone crushers, residences, and associated facilities.
- Contamination of soil and water caused by improper waste disposal (work shop, temporary powerhouse, offices, and residences). Most of the sewage from the temporary facilities is discharged into the river through buried pipes as well as open channels, without adequate treatment. This not only contaminates the soil, but also the river water (the sewage is released in the river upstream of the water intake for the construction works and temporary facilities). Similarly, there exists no proper system at the temporary powerhouse and its diesel storage to capture the leaked/spilled diesel and oils. As a result, soil has been

contaminated with diesel/oils at and around these facilities. In addition, no proper system exists at the site for the collection and disposal of solid waste. Mostly, the solid waste is dumped openly, or thrown in the ravines and river.

- Permanent works, including dam itself, powerhouse, and associated facilities/structures.

Most of the temporary facilities will be removed at the end of the construction phase. Appropriate site restoration will need to be carried out once these facilities are removed – this aspect is included in the EMMP presented later in the document.

The soil contamination caused by improper sewage disposal and diesel/oil handling will need to be cleaned. This activity can be undertaken as soon as appropriate sewage treatment and disposal system, as well as appropriate oil/diesel handling/storage arrangements are made at the site.

In addition to the above, the project-related traffic may have deteriorated the condition of the road which passes through the project area, and links the dam site with Tank and D. I. Khan. Currently, this road is in very bad condition, and it can be argued that the project-related traffic is one of the main reasons for its current state, though the pre-project road condition is not known.

Drinking Water

Safe drinking water is not available for the site staff and workers except for some of supervision staff. The water settling tanks are constructed near river side (downstream of the dam) which provides water for construction, drinking, and other domestic purposes. The system has two stages: first stage having two chambers where river water is stored and sedimentation takes place and then it is pumped to the second stage settling tank, which is located along the road near the site facilities. These chambers act as sedimentation tanks as they can only removes sediments to some extent but cannot removes pathogens and bacteria. Sedimentation tanks are kept open where dust easily settled due to vehicular movement as third chamber is along the road. No security is provided to the facility as it's exists in threatened area. The water is suitable for construction and other domestic purposes but not for drinking uses. No water quality monitoring is carried out at the site.

4.4.2. Social Aspects

A diverse range of people were interviewed and consulted representing Wazir and Mahsood tribes, the people from command area, nomads (Pawindas), the

work force on site, WAPDA and FWO officials, and Chinese contractors. The following points summarize the consultations:

- The local population generally supports the Project, and they consider early completion very positive for their prosperity.
- The local people consider that through this project they will be able to get good road communication network.
- There will be better security environment.
- The nearby communities have profound demand for electric power supply, but they are skeptical about obtaining electricity connections after the powerhouse completion.
- The nomadic people feel that their grazing area will reduce but are optimistic that on river side due to regular flow there will be more vegetation that will meet their grazing requirements.
- There will be more job opportunities and will be more economic activity that will improve livelihood of the local population.
- All of the personals related directly to the construction of the project emphasized on release of funds and early completion of the project.
- The daily wagers complained about low wages not compatible with the market and of high fines for smaller offences.
- The local communities interviewed during the visit held positive views about the Project and were of the view that it will improve underground water table and they will be able to have agriculture activity and will have secure drinking water facility.

Conditions in Catchment Area

The catchment area was not studied during the present assignment, however, in view of its remoteness, it is highly unlikely that any major changes had taken place since the time feasibility studies and preliminary EIA were conducted. During the preparation of watershed management plan (discussed later in the document), the catchment/watershed area will need to be studied in detail. As part of that study, a detailed profile of the watershed should be prepared.

Recommendations

The following recommendations have been formulated on the basis of the consultations held at the site:

- It is strongly recommended that an integrated development project with strong component of watershed management is designed and executed in a

participatory manner with active involvement of political authority and the representative of the communities.

- It is observed that presently the pawindas are free to use the land for grazing. However, once there is more vegetation in the nearby areas, conflicts between the tribes may surface over the grazing rights. This situations needs to be monitored, and dialogue between the tribes/communities need to be initiated under the supervision/guidance of the office of the Political Agent.
- Suppressing of militancy and creating negotiating spaces among the tribal groups is vital for peace and prosperity.
- The graveyard in the reservoir area is abandoned as it belongs to Pawindas
- The mausoleum of Mian Noor in command area is not under threat due to realignment of irrigation system.
- The three houses in the reservoir area are of temporary nature and seasonally occupied. Once the reservoir is filled they may move to upper grounds.
- Hunting activity around the reservoir should be banned from the start, as the reservoir falls in the route of migratory birds and should be substituted by other recreational and cultural activities.

4.4.3. EPA Visits

According to information provided by the Project officials during the site visit, no EPA personnel have ever visited the Project site.

Table 4.1: Meteorological Data for D. I. Khan

Mean FOR THE PERIOD 1961 - 2009

Station Name: DERA ISMAIL KHAN WMO Number: 41624 ICAO Identity: OPDI Elevation: 0173 m
Latitude: 31° 49' N Longitude: 70° 55' E Established in 1866

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Maximum Temperature (°C)													
Mean	20.0	22.3	27.1	33.6	39.0	41.2	38.5	37.4	36.5	33.4	27.8	22.2	25.7
Highest	30.4	33.2	37.2	44.0	49.0	50.0	47.4	44.5	42.4	40.5	35.0	30.6	50.0
Date	7/1996	10/1993	12/1969	29/2006	20/2004	5/1978	3/2002	2/1983	7/1988	1/1985	1/1996	13/1970	5/ 6/1978
Minimum Temperature (°C)													
Mean	4.4	7.6	13.0	18.6	23.3	26.4	26.7	26.2	23.7	17.4	10.5	5.5	13.7
Lowest	-2.2	-2.0	3.5	8.5	12.5	17.5	16.2	19.0	15.8	8.0	2.0	-2.8	-2.8
Date	23/1964	6/1980	4/2003	7/1994	1/2004	13/1987	8/1993	21/2003	24/1984	20/1985	29/2003	26/1984	26/12/1984
Rainfall (mm)													
Mean	11.0	20.3	33.2	23.1	14.4	19.2	64.3	57.4	25.7	5.8	2.5	8.4	225.9
Wettest	64.4	120.2	101.7	106.5	106.8	90.9	180.6	178.6	128.0	41.9	32.1	63.8	497.0
Year	2005	2007	1978	1983	1982	2001	1973	1983	1992	1997	2006	1967	2005
Driest	0.0	0.0	1.8	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.0	139.5
Year	8 yrs	1988	2 yrs	4 yrs	4 yrs	7 yrs	1985	1987	8 yrs	25 yrs	22 yrs	14 yrs	1985
24 hours													
Heaviest	50.1	44.3	75.0	28.5	57.3	53.8	116.0	112.5	70.0	29.5	14.5	40.4	116.0
Date	1/2005	10/2007	5/1978	2/1991	31/1986	30/1975	4/1994	23/1989	16/2004	4/2009	17/2006	27/1967	4/ 7/1994
Relative Humidity (%)													
at 00 UTC	79.4	77.6	78.5	69.4	59.1	66.0	81.1	85.3	82.1	78.1	80.1	80.1	60.2
at 12 UTC	46.2	41.4	40.2	32.5	26.7	31.5	49.0	53.5	46.1	41.4	46.9	50.3	32.8
Wind Speed (Knots)													
at 00 UTC	1.3	1.5	1.5	1.6	1.8	1.8	1.7	1.6	1.2	1.0	0.9	0.9	1.2
at 12 UTC	1.1	1.5	1.8	1.9	2.3	2.5	2.6	2.2	1.6	0.9	0.6	0.7	1.4

Data compiled at Climate Data Processing Centre (CDPC), Pakistan Meteorological Department, Karachi.
Data may not be used without acknowledgement.

UTC = Universal Time Coordinated {Pakistan Standard Time (PST) = 5 hours + UTC)
* = Event occured more than one time.

Figure 4.1: Settlements in the Area

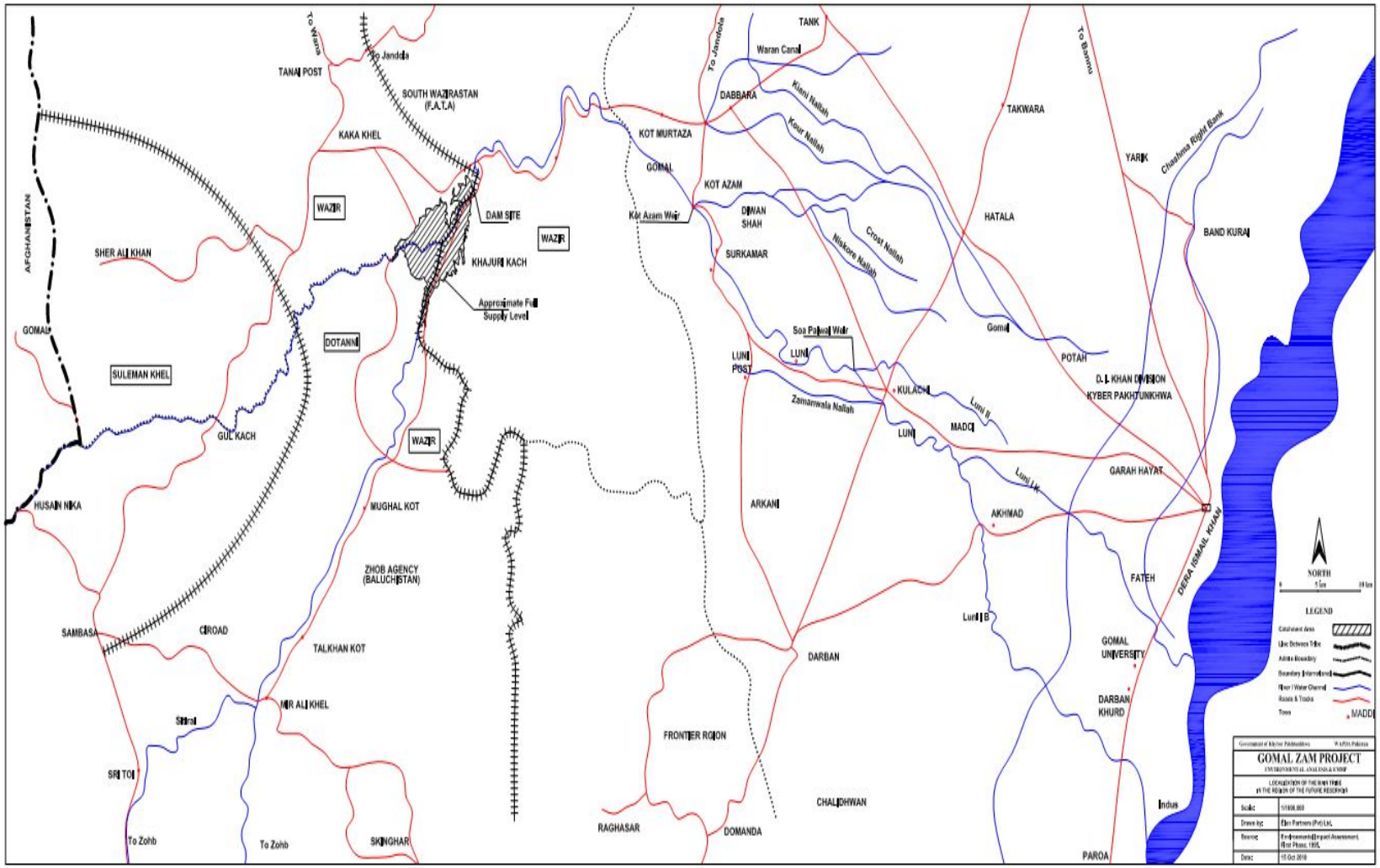

Table 4.2: Administrative Units in D. I. Khan

District	Tehsil	Union Councils Nos.	Electoral Wards Nos.	Mouzas or main villages Nos.	Villages Nos.	Total Area (Ha)
Tank	Tank	9	63	101	540	165,574
D.I. Khan	Kulachi	8	46	93	145	282,281
	D.I. Khan	26	161	263	654	449,000
D.I Khan		43	270	457	1.339	896,855

Source: Office of the Assistant Director, Local Government, D.I Khan, see Annex I

Table 4.3: Administrative Units in Command Area

District	Tehsil	Union Council		Electoral Wards		Mouzas		Villages	
		Nos.	%	Nos.	%	Nos.	%	Nos.	%
Tank	Tank	6	67	24	38	44	44	100	19
D. I. Khan	Kulachi	3	38	19	22	22	24	28	19
	D. I. Khan	3	12	4	2	11	4	12	2
D. I. Khan		12	28	38	14	78	17	140	10

Table 4.4: Educational Institutions in Command Area (School Year 1993-94)

Tehsil	Primary School		Middle School		High School		Total	
	M	F	M	F	M	F	M	F
Tank	55	21	3	1	4	0	62	22
Kulachi	43	15	2	0	5	1	50	16
D. I. Khan	7	2	0	1	1	0	8	3
Total	105	38	5	2	10	1	120	41

Source: District/Subdivision Education Officers (male and female) Tank, Kulachi and D. I. Khan and Primary Schools census profile in NWFP by District 1993-094: District 05 D. I. Khan; Male and Female, District 20 Tank, Male and Female.

Table 4.5: Tenurial Classification by Size of Farm in D. I. Khan

Size of farm by class (acres)	Number of farms					Farm area				
	Total		Tnurial classification			Average farm size		According tenurial classification		
	Nos.	%	Owner	Owner cum tenants	Tenant	Acres	Kanals	%	%	%
Less than 12.5	17.433	43	54.6	16.3	29.1	6	48	48.0	20.0	32.0
12.5 to 25.0	8.734	22	38.9	32.6	28.5	17	136	37.4	34.9	27.7
25.0 to 50.0	7.444	18	33.6	43.3	23.1	33	264	32.4	45.4	22.2
50.0 and above	6842	17	41.6	48.0	10.4	115	920	44.9	47.4	7.7
Overall	40.453	100	45.1	30.2	24.7	32	256	41.9	43.3	14.8
NWFP (Now KP)			68.3	13.6	18.1	8		58.3	26.9	14.8

Source: Pakistan Census of Agriculture 1980 – NWFP

5. Rapid Environmental and Social Assessment

This Chapter discusses the potentially negative and positive impacts that may be caused by the Project on environment and people. Also included in this Chapter is the state of environmental management at the site as observed during the recent visit to the Project site.

5.1. Impact Assessment Methodology

During the present assignment, the potentially significant environmental and social impacts of the Project were characterized according to the aspects tabulated below.

Categories	Characteristics
Nature	**Direct:** The environmental parameter is directly changed by the project. **Indirect:** The environmental parameter changes as a result of change in another parameter
Duration of impact	**Short-term**: lasting only for the duration of the project such as noise from the construction activities. **Medium-term**: lasting for a period of few months to a year after the project before naturally reverting to the original condition such as loss of vegetation due to clearing of campsite, contamination of soil or water by fuels or oil. **Long-term**: lasting for a period much greater than medium term impact before naturally reverting to the original condition such as loss of soil due to soil erosion.
Geographical extent	**Local, regional (spatial dimension)**
Timing	**Construction** and **Operation**
Magnitude	**Large scale** or **small scale**.
Reversibility of impact	**Reversible**: when a receptor resumes its pre-project condition **Irreversible**: when a receptor does not or cannot resume its pre-project condition
Likelihood of the impact	**Almost Certain:** Impact expected to occur under most circumstances **Likely:** Impact will probably occur under most circumstances **Possibly:** Impact may possibly occur at some time **Unlikely:** Impact could occur at some time **Rare:** Impact may occur but only under exceptional circumstances
Impact consequence severity	**Major**: When an activity causes irreversible damage to a unique environmental feature; causes a decline in abundance or change in distribution over more than one generation of an entire population of species of flora or fauna; has long-term effects (period of years) on socioeconomic activities of significance on regional level. **Moderate**: When an activity causes long-term (period of years), reversible damage to a unique environmental feature; causes

Categories	Characteristics
	reversible damage or change in abundance or distribution over one generation of a population of flora or fauna; has short-term effects (period of months) on socioeconomic activities of significance on regional level. **Minor**: When an activity causes short-term (period of a few months) reversible damage to an environmental feature; slight reversible damage to a few species of flora or fauna within a population over a short period; has short term (period of months) effects on socioeconomic activities of local significance. **Negligible**: When no measurable damage to physical, socioeconomic, or biological environment above the existing level of impact occurs.
Significance of impact	Categorized as **High, Medium**, or **Low** Based on the consequence, likelihood, reversibility, geographical extent, and duration; level of public concern; and conformance with legislative of statutory requirements.

Subsequent to the impact characterization discussed above, each of the potentially significant impacts of the Project was assessed according the risk assessment methodology presented below.

Likelihood of Impact	Impact Intensity – Severity of Consequence		
	Severe	**Moderate**	**Mild**
Certain	High Significance	High Significance	Medium Significance
Likely	High Significance	Medium Significance	Low Significance
Unlikely	Medium Significance	Low Significance	Low Significance

The characteristics and significance of the Project's potentially negative impacts as well as the mitigation and control measures to minimize if not totally eliminate these impacts are discussed in the sections below, and summarized in **Table 5.1**.

5.2. Impacts Identified in Preliminary EIA [24]

The Preliminary EIA identifies potentially significant adverse impacts associated with project activities, location and design aspects. These include land slide in reservoir area, soil erosion and siltation in reservoir, erosion of river bed downstream of the dam, decreased soil fertility caused by decreased silt load in the irrigation water, increased soil salinity caused by irrigation with the saline water from the reservoir, loss of natural vegetation in the project

[24] The Preliminary EIA report identified these impacts, but did not characterize or assess these impacts, as has been done in the present document.

area, habitat modification for the key wildlife species, increased risk of diseases caused by vectors such as mosquitoes, conflict between communities linked with unequal availability of irrigation water, in-migration of people in the area because of increased availability of irrigation water, and loss of grazing area because of the reservoir impounding. Significance of the above impacts and the associated mitigation measures is discussed in the sections below.

5.2.1. Land Sliding in Reservoir Area

Land sliding in the reservoir is expected in limited area, up to 1.5 km from the dam, the volume of material involved in sliding is small, and the process will be slow. On the basis of these characteristics, the impact significance has been determined as follows:

Nature:	direct
Duration of impact:	long term
Geographical extent:	local
Timing:	after reservoir impoundment
Magnitude:	small
Reversibility:	irreversible
Probability:	likely
Impact severity:	moderate
Significance:	medium.

Mitigation Measures: The water level in the reservoir to be kept some meters below the left bank saddle, area which is most prone to slides. Furthermore, land sliding to be monitored during the initial filling of the reservoir and afterwards.

5.2.2. Soil Erosion and Siltation in Reservoir

Soil erosion within the reservoir, likely to be caused by washing away of decomposed, semi-consolidated, and loosely cemented formations, as well as solid load in Gomal River, will cause siltation in the reservoir, and reduction in the water storage capacity. Significance of this impact has been determined as follows:

Nature:	direct
Duration of impact:	long term
Geographical extent:	local (reservoir and catchment area)
Timing:	after reservoir impoundment

Magnitude:	large
Reversibility:	irreversible
Probability:	likely
Impact intensity:	moderate to severe
Significance:	medium to high.

Mitigation: Flushing of sediments through the dam will reduce the reservoir siltation; appropriate provisions have been made in the design of the dam (de-silting sluices – see **Section 3.4.4**). Riverbed and watershed management upstream of the dam can reduce the slit load in the water inflows in the reservoir. A comprehensive watershed management and afforestation plan needs to be developed, for which detailed studies will need to be conducted to determine the nature and extent of soil erosion in the catchment area, and to identify and design various types of structural measures (such as gabions, check dams) and non-structural measures (such as plantation) – as well as combination of structural and non-structural measures through techniques such as bio-engineering[25] - to control the soil erosion in the area. WAPDA has previous experiences of developing and implementing such plans for the Mangla and Tarbela dam catchment areas.

5.2.3. Erosion of River Bed Downstream of Dam

The siltation in reservoir will result into clear water releases through the dam. This clear water seeks to replenish its sediment load, causing riverbed erosion. The river stretch between the dam and diversion barrage is likely to be impacted the most, since at the barrage, a major portion of water releases from the dam will be diverted to the irrigation canal - about 400 x 10^6 m^3 of water, out of total releases from the dam of 511 x 10^6 m^3; see **Section 4.1.2b**. This reduced flow in the river will minimize the riverbed erosion downstream of the barrage. The riverbed erosion can potentially affect the physical structures built across the river, such as bridges and culverts, though there are very few such structures on the Gomal river. The Significance of this impact has been determined as follows:

Nature:	indirect
Duration of impact:	long term
Geographical extent:	local (riverbed downstream of dam)
Timing:	after reservoir impoundment

[25] The bio-engineering techniques have recently been piloted during a highway rehabilitation project in KP and AJK by the National Highway Authority, with some encouraging results.

Magnitude:	small
Reversibility:	irreversible (during the life of the project)
Probability:	likely
Impact intensity:	mild to moderate
Significance:	low to medium

Mitigation. The Gomal River downstream of the dam will be surveyed to identify the at-risk structures, and to determine reinforcement needs. After the commissioning of the Project, the erosion in the riverbed downstream of the dam will be monitored on a regular basis, particularly near the bridges and other structures. Repairs will be carried out where necessary.

5.2.4. Decreased Soil Fertility in Command Area

The decreased silt load in the irrigation water may also reduce the natural fertilization of the soils. However, this impact will be partially compensated because of the increased water availability, and can further be mitigated with rational use of fertilizers. Significance of this potential impact has been determined as follows:

Nature:	indirect
Duration of impact:	long term
Geographical extent:	local (command area)
Timing:	after reservoir impoundment
Magnitude:	small to medium
Reversibility:	irreversible (during the life of the Project)
Probability:	likely
Impact intensity:	mild to moderate
Significance:	low to medium

Mitigation. Growers will be encouraged to use fertilizers to counter reduced natural fertilization of the soils. Capacity building and awareness raising of the growers would be needed to promote techniques such as organic farming and Integrated Pest Management (IPM), as well as rational use of fertilizers. Soil fertility will be monitored through regular soil analyses.

5.2.5. Increased Soil Salinity in Command Area

Regular irrigation with saline water will lead to a progressive salinization of non-saline lands and a possible worsening of salinity and sodicity problem in the

already salt-affected lands in the command area. Significance of this potential impact has been determined as follows:

Nature:	indirect
Duration of impact:	long term
Geographical extent:	local (command area)
Timing:	after reservoir impoundment
Magnitude:	small to medium
Reversibility:	reversible (at least in the medium to long term)
Probability:	likely
Impact intensity:	moderate
Significance:	medium

Mitigation. Growers will be encouraged and educated to use appropriate cultivation practices such as over irrigation and pre-sowing flooding for non- or slightly-saline soils. Capacity building of growers would be needed in this regard. Reclamation of coarse to medium textured saline soils will need to be carried out. Further studies would need to be carried out particularly for saline, moderately fine to fine soils. Soil salinity will be monitored on a regular basis.

5.2.6. Loss of Natural Vegetation in the Project Area

Natural vegetation will be submerged as a result of the reservoir impoundment (though very few large trees exist in the reservoir area, a quick survey will be conducted to determine any large trees which would be submerged in the reservoir. Such large tress will be cut and removed from the area). Establishment of the project's temporary and permanent facilities would also have caused some de-vegetation. However none of this vegetation is significant. This impact has been assessed as follows.

Nature:	direct
Duration of impact:	long term
Geographical extent:	local (reservoir area, dam and powerhouse sites, site facilities)
Timing:	during construction; at the time of reservoir impoundment
Magnitude:	small
Reversibility:	reversible (at least in the medium to long term)

Probability:	likely
Impact intensity:	mild
Significance:	low

Mitigation. Compensation will be paid to the owners for cutting of trees on privately owned land. Despite the low significance of the impact, re-vegetation and tree plantation will be carried out in the catchment area as well as at other project sites, such as at the site facilities near the dam, and along the canals in the command area. A tree-plantation plan will be developed for this purpose. The salt-tolerant species will be used in the saline areas.

5.2.7. Habitat Modification for Key Wildlife Species

Among the endangered species, only houbara bustard may be negatively impacted caused by the habitat modification. On the other hand, the water reservoir will provide habitat for water foul and aquatic fauna. The impacts on the faunal resources of the area are assessed as follows.

Nature:	indirect
Duration of impact:	long term
Geographical extent:	local (reservoir area, dam and powerhouse sites, site facilities)
Timing:	during construction and O&M
Magnitude:	small
Reversibility:	irreversible
Probability:	likely
Impact intensity:	mild
Significance:	low

Mitigation. Further investigations will be carried out to determine any negative impacts on the key species of the area, such as houbara bustard. During the study, the natural vegetation of the area will also be studied to identify any species of significance. Appropriate, non-invasive fish species (eg, Labeo sp.) will be introduced in the reservoir in a controlled and planned manner (for further details, see Annex G, Section 4.5, of the Preliminary EIA of the Project). Measures such as controlled hunting and appropriate waste disposal to be implemented to safeguard water foul in the reservoir area.

5.2.8. Increased Risk of Diseases Caused by Vectors

The water reservoir and increased/regular water availability may cause proliferation of disease vectors, such as mosquitoes, causing diseases such as malaria and dengue fever. This potential impact is assessed as follows.

Nature:	indirect
Duration of impact:	long term
Geographical extent:	local (reservoir area, dam and powerhouse sites, site facilities)
Timing:	after reservoir impoundment
Magnitude:	small
Reversibility:	reversible
Probability:	likely
Impact intensity:	mild to moderate
Significance:	low to medium

Mitigation. Any vector breeding in the reservoir area is likely to affect primarily the dam/powerhouse staff. (The communities will also be exposed to this risk in the command area, however this aspect needs to be addressed in detail during the environmental assessment of the irrigation network.) An integrated approach involving preventive as well as curative measures needs to be designed and implemented to address this potential problem. Preventive measures include vaccination (where applicable), rational use of permissible insecticides, promoting use of mosquito nets in the windows, and awareness raising. The curative measures include increasing the number, capacity, and outreach of the healthcare facilities in the area.

5.2.9. Conflict between Communities

Increased irrigation water availability for some communities and loss of grazing area in the reservoir region may lead to conflict and tension between tribes. Similarly, the increased availability of irrigation water and subsequent enhanced/faster development of the area may induce in-migration from other parts of the province – a situation which may cause conflict between communities. Significance of this potential impact has been determined as follows:

Nature:	indirect
Duration of impact:	long term
Geographical extent:	local (reservoir area, command area)

Timing:	after reservoir impoundment/project completion
Magnitude:	small to medium
Reversibility:	reversible
Probability:	likely
Impact intensity:	moderate
Significance:	medium

Mitigation. Formal and informal agreements between the two major tribes in the area (Mahsoods and Wazirs) must be facilitated, and the office of the Political Agent should be approached for this purpose. Benefits of the Project including development of physical as well as social infrastructure should be uniformly distributed among the communities in the area. Local non-governmental organizations (NGOs) should be mobilized to facilitate dialog and agreements among the tribes, and to determine the development needs of the area.

5.2.10. Loss of Grazing Area

The reservoir impounding will reduce the grazing area, particularly for the nomads. This impact will be somewhat compensated through increased availability of irrigation water and hence increased production of fodder in the command area. Significance of this potential impact has been determined as follows:

Nature:	direct
Duration of impact:	long term
Geographical extent:	local (reservoir area, dam and powerhouse sites, site facilities)
Timing:	after reservoir impoundment/project completion
Magnitude:	small
Reversibility:	irreversible
Probability:	likely
Impact intensity:	low to moderate
Significance:	low to medium

Mitigation. Formal and informal agreements between the two major tribes in the area must be facilitated, as recommended earlier as well. Increased production of fodder in command area needs to be promoted. Area

development plan should be prepared and implemented. Local non-governmental organizations (NGOs) should be mobilized to facilitate dialog and agreements among the tribes, and to determine the development needs of the area, as mentioned earlier.

5.3. Additional Impacts Associated with Project Siting/Design

The potentially negative impacts associated with the Project Design/Siting not covered under the EIA are discussed in this section.

5.3.1. Dam Collapse

The collapsing of the dam can have catastrophic impacts downstream, particularly in the command area communities, infrastructures such as Chashma Right Bank Canal, and the D. I. Khan city. This could be caused by a number of factors, including earthquakes, extreme flooding, vibrations caused by any damaged gate, or other similar events/situations. This aspect is assessed as follows.

Nature:	direct
Duration of impact:	long term
Geographical extent:	local (river stretch downstream of dam, powerhouse, command area)
Timing:	during operation
Magnitude:	large
Reversibility:	irreversible
Probability:	unlikely
Impact intensity:	severe
Significance:	medium.

Mitigation. Geotechnical investigations have been carried out and the dam design has been prepared in accordance with their findings. Similarly, frequency and intensity of floods have also been studied as part of the Project feasibility and the dam can withstand floods with return periods of up to 5,000 years (see **Section 3.4.2**). The safe operation of dam and its auxiliaries will be adequately covered in the Project Operational Manual, which will include an Emergency Response Plan also. Capacity building of the O&M staff will be ensured. The reservoir induced seismicity will be studied to determine any remedial measures (further discussed later in the Chapter).

5.3.2. Water Flow Regime Changes /Water Availability

The Project will alter the current water flow regime in the Gomal river, particularly downstream of the barrage. In terms of the flood control and availability of regular irrigation water, this change will be beneficial. Though no information is available on any possible changes in the Gomal river releases in the Indus river, however owing to the fact that the annual average flow in Gomal River are small (0.414 MAF, compared to 48 MAF in Indus River – less than 1 %), its overall impact on Indus River flow is likely to be nominal.

The Project will not adversely affect the existing water users of Gomal river; rather, they will be benefited with the availability of the regulated irrigation water supply throughout the year.

No information is currently available on the river habitat downstream of the dam and its state after the Project completion. This aspect as well as the effects of possibly modified Gomal river releases in the Indus River mentioned above should be studied during the proposed environmental study for the irrigation network.

This impact has been assessed as follows.

Nature:	direct
Duration of impact:	long term
Geographical extent:	local (river stretch downstream of the barrage)
Timing:	after the project completion
Magnitude:	medium
Reversibility:	irreversible (during the life of the Project)
Probability:	likely
Impact intensity:	mild
Significance:	low.

Mitigation. The drainage network, which is part of the irrigation network in the command area, needs to be maintained properly, so that the excess water can find its way back to the river. Other aspects of the flow regime modification need to be studied as part of the environmental study for the irrigation network, as stated above, and the associated mitigation measures need to be identified.

WAPDA will install a meteorological station at the dam site to record the key meteorological data including temperature, precipitation, humidity, and wind speed/direction. WAPDA will also monitor the water inflow in the reservoir,

water releases from the reservoir, irrigation water diverted in the canal, water released in the river downstream of diversion barrage, and water reaching the Indus river.

5.3.3. Water Availability in Gomal and Zhob Rivers

The Gomal and Zhob rivers originate in Afghanistan and Balochistan, respectively, as mentioned earlier (**Section 4.1.2**). Any water resource development works on these rivers upstream of the dam can adversely affect the Project. This aspect is assessed as follows.

Nature:	indirect (impact on Project)
Duration of impact:	long term
Geographical extent:	regional (Afghanistan, Balochistan)
Timing:	after the project completion
Magnitude:	medium to large
Reversibility:	irreversible
Probability:	unlikely
Impact intensity:	severe
Significance:	medium.

Mitigation. Any water resource development works (such as dams/barrages) upstream of the Gomal Zam dam need to be monitored. The feasibility studies and EIA/IEE of such projects should evaluate the potential impacts on the water availability for the Gomal Zam Project. In addition and more importantly, an agreement should be reached with the Government of Afghanistan ensuring water availability for the Gomal Zam Project.

5.3.4. Reservoir-induced Seismicity

Once the reservoir is filled with water, it may induce seismicity in the area. The mass of water in a reservoir alters the pressure in the rock below, which can trigger earthquakes. Reservoir-induced seismic events can be relatively large compared to other forms of induced seismicity. Unfortunately, understanding of reservoir induced seismic activity is very limited. However, it has been noted that seismicity appears to occur on dams with heights larger than 100 meters. The extra water pressure created by vast reservoirs is the most accepted explanation for the seismic activity. Once the reservoirs are filled, induced seismicity could occur immediately or with a small time lag. This potential impact is assessed as follows.

Nature:	indirect

Duration of impact:	long term
Geographical extent:	regional
Timing:	after the reservoir impoundment
Magnitude:	medium to large
Reversibility:	irreversible
Probability:	likely
Impact intensity:	moderate to severe
Significance:	medium to high.

Mitigation. Further studies are needed at the Gomal Zam dam to determine the likelihood, consequence severity, and other aspects of this issue. A seismic risk analysis should also be included in this study. Appropriate instruments to be installed to monitor the seismicity at the site.

5.3.5. Slope Stabilization

Though geotechnical studies have been carried out for the Project in the past, the recent land slide at the switchyard site necessitates further investigations to be carried out on urgent basis. This aspect is assessed as follows.

Nature:	-
Duration of impact:	long term
Geographical extent:	local
Timing:	construction and operation
Magnitude:	medium to large
Reversibility:	irreversible
Probability:	likely
Impact intensity:	moderate to severe
Significance:	medium to high.

Mitigation. Mitigation measures such as slope reinforcements, grouting, or bracing need to be designed and implemented after carrying out detailed investigations.

5.3.6. Eutrophication of Reservoir

Eutrophication of reservoir can be caused by the presence of excessive vegetation in the reservoir, and inflow of nutrients from natural and/or anthropogenic sources, and it can adversely affect the water quality. Since the catchment area of the reservoir is sparsely populated with very little cultivation activities, the nutrients flow from the anthropogenic source would be nominal.

Owing to the barren nature of the area, the natural nutrients inflow is also likely to be nominal. This aspect is assessed as follows.

Nature:	indirect
Duration of impact:	long term
Geographical extent:	local
Timing:	after reservoir impoundment
Magnitude:	medium
Reversibility:	reversible
Probability:	unlikely
Impact intensity:	moderate
Significance:	low.

Mitigation. Large trees if present in the reservoir area need to be cut before impounding. Separate studies are needed to investigate this aspect in a greater depth. This aspect can also be covered under the watershed management studies, proposed earlier.

5.3.7. PCB in Transformer Oil

Poly chlorinated biphenyl (PCB) is a persistent organic pollutant (POP), and its usage in the transformer oil prohibited in most of the countries. However, the old transformers in the WAPDA (and DISCOs) system may still have PCB-containing transformer oil. This aspect is assessed as follows.

Nature:	indirect
Duration of impact:	long term
Geographical extent:	local
Timing:	construction and operation
Magnitude:	medium
Reversibility:	reversible
Probability:	unlikely
Impact intensity:	high
Significance:	medium.

Mitigation. It will be ensured that the new transformers are PCB-free. Also, extreme care will be employed to ensure that PCB-containing transformer oil does not fond its way in the powerhouse.

5.3.8. Climate Change

The climate change can potentially impact the rainfall and temperature patterns in the area, thus affecting the Project's operational characteristics, such as water availability, intensity and frequency of storms and extreme events, and changed cropping patterns. This aspect is assessed as follows.

Nature:	indirect
Duration of impact:	long term
Geographical extent:	local
Timing:	operation
Magnitude:	unknown
Reversibility:	unknown
Probability:	likely
Impact intensity:	unknown (could be moderate to severe)
Significance:	unknown (could be medium to high)

Mitigation. The affects of climate change are not fully known on Projects such as dams and reservoirs. Further studies are needed to address this concern, and to frame any mitigation or adaptation measures for the Project.

5.4. Impacts/Issues Observed during Site Visit

The key issues identified during the field visit as part of the present assignment include soil and water contamination caused by improper and inadequate waste disposal arrangements, unavailability of safe drinking water for the site staff, and dust emissions caused by the construction activities and vehicular traffic. These are discussed below.

5.4.1. Soil and Water Contamination

Most of the sewage from the temporary facility is discharged into the river through buried pipes as well as open channels, without adequate treatment. This not only contaminates the soil, but also the river water (the sewage is released in the river upstream of the water intake for the construction works and temporary facilities). Similarly, there exists no proper system at the temporary powerhouse and its diesel storage to capture the leaked/spilled diesel and oils. As a result, soil has been contaminated with diesel/oils at and around these facilities. In addition, no proper system exists at the site for the collection and disposal of solid waste. Mostly, the solid waste is dumped openly, or thrown in the ravines and river. Significance of these impacts has been assessed as follows.

Nature:	direct
Duration of impact:	short to medium term
Geographical extent:	local (site facilities)
Timing:	during construction
Magnitude:	small
Reversibility:	reversible
Probability:	Certain
Impact intensity:	severe
Significance:	high.

Mitigation. Appropriate sewage treatment arrangements such as properly designed and sized septic tanks should be made at site on an urgent basis. Arrangement to collect oils, and fuels in the workshop and temporary powerhouse should be made. Contaminated soil should be removed and appropriately disposed. Solid waste collection and its safe disposal system should be established at site.

The effluents released from the camps/offices/workshops should comply with NEQS (**Table 2.1**).

5.4.2. Unavailability of Safe Drinking Water

Currently safe drinking water is not available for the site staff and workers. The water treatment arrangements available at site are not adequate. This impact has been assessed as follows.

Nature:	direct
Duration of impact:	short term
Geographical extent:	local (site facilities)
Timing:	during construction
Magnitude:	medium
Reversibility:	reversible
Probability:	certain
Impact intensity:	severe
Significance:	high.

Mitigation. Appropriate arrangements must be made to treat the drinking water adequately. The effectiveness of this system should be regularly verified through laboratory analysis of drinking water.

5.4.3. Dust Emissions

Construction activities and vehicular traffic cause dust emissions which affects the site workers as well as the travelers passing through the site. This impact has been assessed as follows.

Nature:	direct
Duration of impact:	short term
Geographical extent:	local (dam and powerhouse sites, site facilities)
Timing:	during construction
Magnitude:	medium
Reversibility:	reversible
Probability:	likely
Impact intensity:	mild
Significance:	low.

Mitigation. Appropriate arrangements such as water sprinkling should be made to minimize the dust emissions in the area. In addition, tree plantation plan should be developed and implemented to reduce dust emissions in the area.

5.5. Impacts Related to Construction Activities

The construction works at the dam site and powerhouse are nearing completion. However the transmission line laying works are yet to be started. The potential impacts relating to the remaining works at the dam/powerhouse site, transmission line laying, and other remaining construction activities have been discussed below. Most of these impacts are temporary in nature and can easily be addressed through adopting appropriate mitigation/control measures.

5.5.1. Soil Erosion and Degradation

Soil erosion is likely to be caused by the vehicular traffic on unpaved roads, land clearing for construction camps and other site facilities (for transmission line works), construction of roads and excavation for transmission line tower foundations. These impacts have been characterized below.

Nature:	direct and indirect
Duration of impact:	long term
Geographical extent:	local
Timing:	construction

Magnitude:	small to medium
Reversibility:	irreversible
Probability:	likely
Impact intensity:	moderate
Significance:	medium.

Mitigation Measures; It is unlikely that the fill material will need to be obtained from any cultivation fields (during the transmission line works). However if this is unavoidable, the top 30 cm soil layer will be removed and stockpiled for redressing the land after removal of the borrow material. The excavation in such areas will be limited to 50 cm depth. The fill material will not be obtained from any cultivation fields or orchards, without the permission of the land owner/cultivator.

Areas from where the fill material is obtained or surplus soil deposited, will be landscaped to minimize erosion and hazard for people and livestock.

Temporary embankments will be constructed where necessary to avoid any soil erosion.

Operation of vehicles close to the river/stream/channel banks will be minimized to the extent possible, to minimize soil erosion.

Excavated soil will be protected against erosion caused by rain or wind.

Photographic record will be maintained for pre-project, during-construction and post-construction condition of the site.

5.5.2. Soil and Water Contamination

Soil and water may be contaminated as a result of fuel/oils/chemicals spillage and leakage, and inappropriate waste (solid as well as liquid) disposal. These impacts have been characterized below.

Nature:	direct and indirect
Duration of impact:	medium term
Geographical extent:	local
Timing:	construction
Magnitude:	small to medium
Reversibility:	reversible
Probability:	likely
Impact intensity:	severe
Significance:	high.

Mitigation Measures. Vehicles and construction equipment will not be repaired in the field. If unavoidable, impervious sheathing will be used to avoid soil and water contamination.

For the domestic sewage from the construction camps, appropriate treatment and disposal system, such as septic tanks and soaking pits, will be constructed having adequate capacity, and after determining the soil percolation capacity (such arrangements should be incorporated /improved in the existing site facilities. For the camps for the transmission line works, these arrangements should be included in the design of the temporary facilities). For the transmission line works, the contractor(s) will submit to the MC the plans for the camp layout and waste disposal system, and obtain approval.

Waste oils will be collected in drums and sold to the recycling contractors.

The inert recyclable waste from the site (such as card board, drums, broken/used parts, etc.) will be sold to recycling contractors. The hazardous waste will be kept separate and handled according to the nature of the waste.

Domestic solid waste from the construction camp will be disposed in a manner that does not cause soil contamination. The waste disposal plan submitted by the contractor(s) will also address the solid waste.

The effluents released from the camps/offices/workshops should comply with NEQS (**Table 2.1**).

5.5.3. Air Quality Deterioration

Construction machinery, diesel generators and project vehicles will release exhaust emissions, containing carbon monoxide (CO), sulfur dioxide (SO_2), oxides of nitrogen (NO_X), and particulate matter (PM). These emissions can deteriorate the ambient air quality in the immediate vicinity of the project site and along the road leading to it. Furthermore, construction activities such as excavation, leveling, filling and vehicular movement on unpaved tracks may also cause fugitive dust emissions. The unmitigated impacts related to air quality deterioration have been characterized below.

Nature:	direct and indirect
Duration of impact:	short term
Geographical extent:	local
Timing:	construction
Magnitude:	small to medium
Reversibility:	reversible

Probability:	likely
Impact intensity:	mild
Significance:	medium.

Mitigation Measures. Construction machinery, generators and vehicles will be kept in good working condition and properly tuned, in order to minimize the exhaust emissions. The exhaust emissions will comply with the NEQS (**Table 2.2**). Fugitive dust emissions will be minimized by appropriate methods, such as spraying water on soil, where required and appropriate. The waste water from kitchen and washing area of the construction camp may be used for water spraying. Project vehicles will follow safe driving practice while passing through/near the communities/construction camps, including reduced speed, which will minimize dust emissions as well.

5.5.4. Loss of Natural Vegetation/Threat to Wildlife

Land may need to be cleared of natural vegetation for constructing the permanent facilities at the Project site (no information is available for the type, size or location of any permanent facilities at the site), or for the construction camp for the transmission line works (though the Tank grid station may be used for this purpose). However the area is generally sparsely vegetated and no tree cutting is envisaged. No wildlife species of concern are present in the vicinity of the site/transmission line route either. Furthermore, no protected areas exist at or in the immediate vicinity of the Project sites. The unmitigated impacts of the proposed activities on the biological resources of the area are characterized below.

Nature:	direct and indirect
Duration of impact:	medium term
Geographical extent:	local
Timing:	construction
Magnitude:	small
Reversibility:	reversible (at least in medium to long term)
Probability:	unlikely
Impact intensity:	mild
Significance:	low.

Mitigation Measures. Tree plantation plan will be developed and implemented for the project site. Expert advice will be obtained for this purpose. Indigenous tree species will be selected for plantation; eucalyptus trees will not be used in

any case. Garbage will not be left in the open. The project staff will not be allowed to indulge in any hunting, trapping or fishing activities.

5.5.5. Involuntary Resettlement and Damage to Crops

No permanent land acquisition is envisaged for the remaining works of the projects on the dam site and the transmission line laying. The old houses in the reservoir area are abandoned and are not likely to result in any resettlement issues. The land under the transmission line is generally not purchased, and the right of way along the transmission line is only temporarily acquired during the construction works. Furthermore, the transmission line route will be finalized in a manner to avoid the cultivation fields as much as possible. The potential impact of the remaining works on the land and agricultural assets has been assessed as follows.

Nature:	direct and indirect
Duration of impact:	medium term
Geographical extent:	local
Timing:	construction
Magnitude:	small
Reversibility:	irreversible
Probability:	unlikely
Impact intensity:	moderate
Significance:	low.

Mitigation. Full compensation will be paid in the unlikely event of any land acquisition or loss of agriculture during the transmission line works.

5.5.6. Damage to infrastructure

The road leading to the Project site is currently in a poor condition, which is likely to be the result of Project-related vehicular traffic. Public infrastructure may also be damaged during the transmission line works. These impacts have been assessed as follows.

Nature:	direct and indirect
Duration of impact:	medium to long term
Geographical extent:	local
Timing:	construction
Magnitude:	medium to large
Reversibility:	reversible

Probability:	likely
Impact intensity:	moderate to severe
Significance:	medium to high.

Mitigation. Damage to the public infrastructure will be avoided and minimized to the extent possible. For the infrastructure damaged by the Project activities, WAPDA will ensure that adequate repairs are carried out to restore the infrastructure to the original or better condition.

5.5.7. Blocked Access

The road leading to the dam site is a public road leading to border town of Wana and beyond. The construction activities and Project-related vehicular traffic cause hindrance to the traffic on this road. Similarly, the transmission line works may also block the local roads, routes and accesses. This impact has been assessed as follows.

Nature:	direct and indirect
Duration of impact:	short term
Geographical extent:	local
Timing:	construction
Magnitude:	medium to large
Reversibility:	reversible
Probability:	likely
Impact intensity:	moderate
Significance:	medium.

Mitigation. By-pass should be built near the dam site, so that the construction activities (and dam operational activities afterwards) do not hinder the traffic on the public road. During the transmission line works, blockage of local roads and routes will be minimized. If unavoidable, consultation with the affected communities will be carried out and alternate routes identified. Furthermore, the duration of such blockage will be minimized.

5.5.8. Noise and Vibration

The dam site is away from any local community; therefore the noise generated by the construction machinery/vehicles/generators only affects the site staff. However, the transmission line works near the communities may generate noise, affecting the nearby population. This impact is assessed as follows:

Nature:	direct
Duration of impact:	short term
Geographical extent:	local
Timing:	construction
Magnitude:	medium
Reversibility:	reversible
Probability:	likely
Impact intensity:	moderate
Significance:	medium.

Mitigation. Speed of the project vehicle be kept low, and horns will not be used, while passing through or near the communities. Vehicles will have exhaust silencers to minimize noise generation. The vehicles noise will comply with the NEQS (**Table 2.2**). Nighttime traffic will be avoided near the communities, as far as possible. Liaison with the community will be maintained. Grievance Redressal Mechanism will be put in place to address the community complaints, as stated earlier.

5.5.9. Safety Hazard

The construction activities involve operation of heavy construction machinery, vehicular traffic, excavation, filling operations, works on heights, high voltage (in powerhouse, switchyard, and on transmission line). In addition, the project traffic on the local roads leading to the site poses safety risks to the nearby communities. The transmission line works near the communities may also pose safety risk to the population. This impact has been assessed below.

Nature:	direct
Duration of impact:	short term
Geographical extent:	local
Timing:	construction
Magnitude:	medium to large
Reversibility:	reversible
Probability:	likely
Impact intensity:	severe
Significance:	high.

Mitigation. The standard Environment, Health, and Safety (EHS) guidelines (e.g., the IFC's EHS guidelines discussed in **Section 2.3.2**) will be strictly

followed. The construction sites will have protective fencing to avoid any unauthorized entry.

The transmission line will be routed in a manner to avoid settlements as far as possible. If unavoidable, minimum required distance of 8 m will be maintained between the transmission line conductor and the structure underneath. Safety net will be installed between the conductor and any settlements underneath, where necessary.

Road signage will be fixed at appropriate locations to reduce safety hazard associated with project-related vehicular traffic. The project drivers will be trained for safe driving skills. Vehicular speeds near/within communities will be kept low to minimize safety hazards.

Firefighting equipment will be made available at the site and camps; fire extinguishers will be provided in the project vehicles. The camp staff will be provided fire fighting training.

All safety precautions will be taken to transport, handle and store hazardous substances, such as fuel.

Liaison with the community will be maintained while working near the settlements.

5.5.10. Public Health

The public health concerns related to the safe disposal of wastes have been covered under the soil and water contamination (see **Section 5.5.2**). Other health concerns during the Project relate to the availability of safe drinking water and protection against communicable diseases. These concerns are assessed as given below.

Nature:	indirect
Duration of impact:	short term
Geographical extent:	local
Timing:	construction
Magnitude:	medium to large
Reversibility:	reversible
Probability:	likely
Impact intensity:	severe
Significance:	high.

Mitigation. The construction camps and site offices will have first-aid kits. The construction crew will be provided awareness for the transmissible diseases (such as HIV/AIDS, hepatitis B and C).

5.5.11. Gender and Social Issues

No communities exist near the dam/powerhouse site, hence no gender or social issues are likely to arise there. No information is available on the camp location for the transmission line works. To avoid any gender or social issues, it will be located well outside the community. The vehicular traffic on the local roads can potentially pose low level of adverse impact on the women of the area. This impact is assessed as follows.

Nature:	indirect
Duration of impact:	short term
Geographical extent:	local
Timing:	construction
Magnitude:	small
Reversibility:	reversible
Probability:	unlikely
Impact intensity:	severe
Significance:	medium.

Mitigation. Construction crew will avoid entering villages and settlements. Communities will be informed and consulted before commencing the site works. Strict code of conduct will be maintained by the construction crew. Local norms will be respected. Employment opportunities to be offered to locals.

5.5.12. Impacts on Archeological, Cultural, Historical or Religious Significance

No archeological or cultural heritage sites have been reported at the dam site and its vicinity. The EIA report mentions some such sites in the command area (see **Section 4.3.5**), the transmission line route is however unlikely to cross these sites. The potential impact on the archeological and/or cultural heritage sites has been assessed as given below.

Nature:	direct and indirect
Duration of impact:	long term
Geographical extent:	local
Timing:	construction

Magnitude:	small to medium
Reversibility:	irreversible (though repairs/restoration can be done on damaged assets)
Probability:	unlikely
Impact intensity:	severe
Significance:	medium.

Mitigation Measures. The sites identified in the EIA report (Dabbara mound, Gomal Bazar mound, and Girdavi mound)[26] will be avoided during the construction works. Similarly, sanctity of mosques, graveyards, and shrines will be respected during the transmission line laying works. In case of chance discovery of any sites or artifacts of historical, cultural, archeological or religious significance, the work will be stopped at that site. The provincial and federal archeological departments will be notified immediately, and their advice will be sought before resumption of the construction activities at such sites.

5.5.13. Child Labor

Although the use of child labor is not prevalent in the construction works such as those involved in the Project, however, it will be explicitly prohibited at the site, and the provisions of the Child Labor Act (see **Section 2.1.9**) will be made part of the construction contracts, in order to ensure that no child labor is employed at the project sites or campsites.

5.6. Impacts Related to Operation and Maintenance Activities

The activities related to the operation and maintenance (O&M) of dam, powerhouse, and transmission line are mostly environmentally benign. The few impacts which are expected can readily be addressed with the help of appropriate mitigation measures. These impacts and associated mitigation actions are discussed below.

5.6.1. Soil and Water Contamination

The O&M activities of the Project facilities (powerhouse, offices, and residences) may generate several types of wastes, which can cause soil as well as water contamination. These include domestic solid waste from the offices and residences at the powerhouse, sewage from the offices and residences, and wastes from the repair and maintenance activities, workshop, and warehouse (discarded equipment and parts, packing materials, cardboards, used oils and chemicals, cotton rags and the likes). In addition,

[26] For details, please the EIA report (C. Bellier, 1995. *Environmental Impact Assessment (First Phase), Gomal Zam Additional Studies*.)

leakage and spillage of transformer oil can contaminate soil and ultimately water. These unmitigated impacts are characterized below.

Nature:	direct and indirect
Duration of impact:	medium term
Geographical extent:	local
Timing:	O&M
Magnitude:	small to medium
Reversibility:	reversible
Probability:	likely
Impact intensity:	severe
Significance:	high.

Mitigation Measures

The standard EHS guidelines (eg, the IFC's EHS guidelines discussed in **Section 2.3.2**) will be strictly followed, as described earlier.

The dam site, powerhouse, and associated facilities will have appropriate solid waste collection and disposal arrangements. No waste effluents will be released into the river water directly. No solid waste will be thrown into the river water or left in the open.

The dam site, powerhouse, and associated facilities will have appropriate sewage handling, treatment and safe disposal system. The waste effluent releases from the facilities will comply with the NEQS (**Table 2.1**).

Waste oils and chemicals will be disposed in accordance with their respective Material Safety Data Sheet (MSDS). MSDS will be made available at the power plant.

Non-toxic recyclable waste (such as cardboard) will be given away for recycling. Toxic waste will be stored separately, and incinerated at an appropriate double chamber incinerator.

The powerhouse and switch yard will have channels and drainage pits to collect any leaked oil from the transformers. This oil will be sent back to the workshop for recycling.

Any soil contaminated by the oil/chemical spillage will be removed and disposed off appropriately in accordance with the MSDS of the spilled oil/chemical.

5.6.2. Safety Hazard

The dam, if not operated according to the relevant standards (operations, maintenance, repairs, instrumentation, others), may pose significant risk to the downstream communities. The powerhouse and transmission line operation and maintenance activities pose a low level of safety hazards to the nearby population, in view of the remoteness of the Project site and transmission line route. However, the project traffic on the local roads leading to the site poses safety risks to the nearby communities. These impacts have been assessed as follows.

Nature:	direct
Duration of impact:	short term
Geographical extent:	local
Timing:	O&M
Magnitude:	medium to large
Reversibility:	reversible
Probability:	likely
Impact intensity:	severe (for dam); moderate (for other components)
Significance:	high (for dam); medium (for other components).

Mitigation Measures

The dam safety risk assessment will be carried out (if not already done) by an independent panel of experts. The standard operating procedures (SOPs) for dam and powerhouse O&M will be prepared and strictly implemented. The standard EHS Guidelines will be made part of the SOPs mentioned above, and will be strictly followed. The Emergency Response Plan (ERP) will be made available at the Project sites. Its salient points will be displayed at prominent places. The O&M staff will be given training on the ERP.

The O&M staff will be provided essential protective gears and equipment. The O&M staff will be provided safety training. Refresher courses will be arranged on regular basis.

The Project sites will have protective fencing to avoid any unauthorized entry.

The project drivers will be trained for defensive driving skills. Vehicular speeds near/within communities will be kept low to minimize safety hazards.

Firefighting equipment will be made available at the site; fire extinguishers will be provided in the project vehicles. The powerhouse staff will be provided safety training, including fire fighting.

All safety precautions will be taken to transport, handle and store hazardous substances, such as fuel.

Liaison with the community will be maintained for the transmission line maintenance works, where necessary. The communities near the grid stations and transmission lines will be educated on the risk of electrocution, and how to avoid accidents.

The trees under the transmission lines will be regularly trimmed in order to maintain 8 m clearance.

5.6.3. Loss of Agriculture

During the repair and maintenance activities on the transmission lines, the nearby crops can potentially be damaged. This impact has been assessed as follows.

Nature:	direct and indirect
Duration of impact:	short term
Geographical extent:	local
Timing:	O&M
Magnitude:	small to medium
Reversibility:	reversible
Probability:	unlikely
Impact intensity:	moderate
Significance:	low.

Mitigation. The crop damage will be minimized during the O&M activities of the transmission line. Community liaison will be maintained during such operations. Compensation will be paid to the grower for damage to crops or any other asset.

5.6.4. Safe Drinking Water

The canal water after the Project completion is likely to be sued for drinking purposes also. However, if it is unfit for human consumption, it is likely to have adverse health impacts. This aspect is assessed as follows.

Nature:	indirect
Duration of impact:	long term

Geographical extent:	local
Timing:	O&M
Magnitude:	medium
Reversibility:	reversible
Probability:	likely
Impact intensity:	moderate
Significance:	medium.

Mitigation. The water analysis should be carried out on a regular basis. If needed, appropriate treatment would also be carried out. Awareness raising and capacity building of the communities would also be carried out.

5.7. Beneficial Environmental and Social Impacts

5.7.1. Environmental Benefits

The beneficial environmental impacts associated with the Project include i) reduction in green house gas production associated with the hydropower generation (more than 57,000 tons of CO_2 annually, based upon 91GWh of electricity generation per year from the powerhouse);[27] ii) implementation of water shed management activities; iii) creation of a wetland which is likely to attract water fouls; and iv) increase in the aquatic fauna including fish in the reservoir.

5.7.2. Social Benefits

The social benefits of the Project are numerous and far reaching. Salient among them are i) reduced losses caused by the frequent floods; ii) increased cultivation in the command area, resulting in improved economic conditions of the farmers and poverty reduction; iii) increased domestic and drinking water[28] availability and possibly improved sanitation facilities; iv) increased electricity supply in the area thus reduction in the use of fuels such as cow dung and wood/biomass; v) employment opportunities for the local population; vi) and the development induced by all these factors. All these benefits, coupled with the likely development of physical and social infrastructure in the area being recommended in this report, can have a major impact on the socioeconomic landscape of the Project's area of influence, and can also become role model for other such areas needing developmental interventions.

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27 WAPDA should explore the possibility of obtaining carbon credits for this project.

28 Drinking water supply is not included in the Project objectives as such. However, use of canal water for domestic and drinking purposes cannot be ruled out. Further, groundwater availability may also improve with increased irrigation water availability in the area. However, water quality would need to be monitored on a regular basis. Appropriate treatment would need to be carried out if needed.

Gender Aspects

Country overview: Although[29] the proportion of population living below the poverty line in Pakistan fell sharply between 2001 and 2005, women have not benefited from economic growth to the same extent as men. Low social indicators coupled with limited access to income-generating opportunities have left women considerably more vulnerable to poverty than men. The gender and development index (GDI) remains lower than the human development index (HDI). When access to economic opportunities is added to United Nations (UN) HDI indexes, Pakistan is ranked 112 out of 115 countries in the 2006 (and 126 out of 128 in the 2007) World Economic Forum Gender Gap Index. Full economic growth is impeded by women's exclusion from employment and other income-generating opportunities.

The socio-cultural constraint on the mobility of girls and women is a significant factor limiting their access to development opportunities. Socially driven constraints do change over time and there are considerable differences in how social constraints are manifested between regions in Pakistan. For example, gender parity indexes for both primary and secondary education (Millennium Development Goal 3) have improved slowly over recent years (from 0.73 for primary education in 1991 to 0.85 in 2004–2005) as attitudes toward girls' education have changed. But aggregated national figures mask stark regional differences. Yet additional education does not necessarily translate into employment for women because of other constraints, such as discrimination in the workplace and physical insecurity. A considerably higher proportion of unemployed women 25–34 years old hold a degree certificate compared to their male counterparts, and female labor force participation increases have been almost entirely among illiterate populations. With slow increases, the labor force participation rates of women at only 19% in Pakistan remain the lowest in the region. The maternal mortality rate (MMR) is also a reflection of the poor status of women's health. Ratios have worsened over the past 5 years despite significant investments in primary health and emergency obstetric and neonatal care facilities and services and the MMR has contributed to imbalanced sex ratio of 105 men to every 100 women in 2004.

In rural areas, women make vital contributions to livelihoods. In 2005–2006, 54% of women in the workforce were engaged in agriculture (up from 48% in 2003–2004). The significance of this contribution from women is not fully acknowledged. Women, as paid or unpaid laborers, are usually relegated tasks

[29] ADB 2008. *Releasing* Women's *Potential Contribution to Inclusive Economic Growth: Country Gender Assessment – Pakistan.* Asian Development Bank, September 2008.

with low productivity and little investment in technology or extension efforts by government. In the urban context, an increasing proportion of women are working in the informal sector (74.2% in 2006 compared to 66.0% in 2003–2004), in manufacturing and service-based activities. In the formal sector, some well-educated women are gradually moving into responsible positions in banks and other private sector offices. A quota of 10% for women in government service has been established, but progress on filling this quota, especially in senior categories, is uneven and varies across regions.

Government policies and mechanisms have evolved to address gender imbalances, most recently in 2002 through the National Policy for Development of Women. The policy identifies gender mainstreaming across line ministries and departments as the mechanism to address women's needs in policy and program formulation, implementation, and monitoring. In 2004, cabinets in almost all provinces and the federal government adopted Gender Reform Action Plans (GRAPs) to facilitate institutionalizing the process of gender mainstreaming. These government commitments have been given further emphasis in Poverty Reduction Strategy Paper (PRSP) I and II and the Medium-Term Development Framework (2005–2010).

All ministries are required to be responsible for gender mainstreaming, but with limited capacities and a need to garner more support from male civil servants amid massive decentralization reforms. Institutionalizing this approach so far has been less than effective. The lead role in advocating for and guiding this process is taken by the Ministry of Women Development, but is hampered by resource and capacity constraints. In 2000, the National Commission on the Status of Women (NCSW) was created to provide greater impetus to the implementation of gender policy commitments.

Gender aspects specific to the Project: Women[30] are generally disadvantaged across the social and economic spectrum. Over the last decade, international funding agencies attempted to inform large dam projects of gender issues. For several large dam projects, increasing the availability of and access to social and economic resources of critical importance to women (fresh water, farmlands through irrigation, return migration of men, etc.) has been one of their objectives.

[30] Excerpts from *Thematic Review - Social Impacts of Large Dams Equity and Distributional Issues, Scoping Paper* (World Commission on Dams, 1999).

The World Bank's OED assessment[31] has concluded that rural populations receive a large share of direct and positive impacts from large dams. Dam related benefits included jobs generated for unskilled rural workers at the construction stage, the mitigation measures accompanying resettlement programs, community water supply, and irrigated agriculture which strongly benefits the rural economy. As a result large dam projects - especially irrigation dams - are perceived as a powerful instrument of rural poverty reduction.

The increased availability of domestic and drinking water, improved sanitation, and easier access to electricity are among the key benefits of the Gomal Zam Project. These benefits are likely to impact the women and children most.

Fetching water for the domestic and drinking purposes is generally the responsibility of the women of the family in the rural areas of the Country. In water scarce regions such as the proposed command area, women have to walk long distances to fetch water on a daily basis. With increased availability of water, the ordeal of women of the area will be greatly reduced.

The poor sanitation conditions affect the children most, in turn increasing the burden on the mothers and other women in the family. Increased water supply is likely to improve the sanitation conditions in the command area. Approximately 90 percent of typhoid and diarrheal illness in Pakistan is attributable to inadequate drinking water, sanitation and hygiene. Up to 83,500 deaths a year are linked to these causes. Morbidity linked with waterborne diseases amounts to 74.5 million cases per year.[32]

Indoor air pollution – caused by the use of poor quality fuels such as cow dung and bio mass - accounts for over 28,000 deaths a year and 40 million cases of acute respiratory illness, particularly in children under the age of 5 years.[33] The improved electricity supply in the area is likely to reduce reliance on such fuels, thus improving the indoor air quality, in turn decreasing the respiratory diseases prevalence in the area.

5.8. Current EHS Mitigation and Monitoring, and Supervision on Site

Currently, the Chinese contractor has established a safety system at site, and a safety incharge has been appointed. Safety trainings are regularly arranged for the site staff, and their reports prepared. The safety adherence at site is

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31 WB 1998; 1998,4: Operations Evaluation Department. 1998. Recent Experience With Involuntary Resettlement. Overview. Document of the World Bank. Report No. 17538, June.

32 The World Bank (2008). Environmental Health and Child Survival, Epidemiology, Economics, Experiences.

33 Ibid.

however not very strict, and many workers can be seen without appropriate personal protective equipment (PPE) or safety gear. Therefore the safety system and its implementation at the site need to be reviewed and upgraded.

For environmental management, no system currently exists at the site. The EIA prepared in 1995 does not include any EMMP, nor has any such plan later been prepared. As a result, no environmental mitigation and monitoring are carried out at site, nor has any environmental focal pointed been appointed/designated at the site.

Table 5.1: Impact Significance

Impacts	Significance
Project Siting/Design	
Land sliding in reservoir	Medium
Soil erosion and siltation of reservoir	Medium to high
Erosion of river bed downstream	Low to medium
Decreased soil fertility	Low to medium
Increased soil salinity	Medium
Loss of natural vegetation	Low
Habitat modification	Low
Increased risk of vectors	Low to medium
Conflict between communities	Medium
Loss of grazing area	Low to medium
Soil and water contamination	High
Unavailability of safe drinking water	High
Dust emissions	Low
Dam collapse	Medium
Changed water flow regime	Low
Reservoir induced seismicity	Medium to high
Slope stabilization	Medium to high
Reservoir eutrophication	Low
PCB in transformer oil	Medium
Climate change	Unknown
Construction activities	
Soil erosion/degradation	Medium
Soil and water contamination	High
Air quality deterioration	Medium
Loss of natural vegetation and threat to wildlife	Low
Involuntary resettlement	Low
Damage to infrastructure	Medium to high
Blocked access	Medium
Noise and vibration	Medium
Safety hazards	High
Public health	High
Gender and social issues	Medium
Impacts on cultural heritage	Medium
O&M Phase	
Soil and water contamination	High
Safety hazards	High to medium
Loss of agriculture	Low
Safe drinking water	Medium

6. Environmental Mitigation and Monitoring Plan

This Chapter presents the environmental mitigation and monitoring plan (EMMP) proposed for the remaining construction activities at the dam/powerhouse site, and the O&M phase. Also provided in this Chapter are the institutional strengthening needs and cost estimates for environmental and social management of the Project. The present EMMP focuses the Project components being considered for the USG funding including the dam and its ancillaries, and powerhouse; the irrigation system is however not covered in this Plan.

6.1. Institutional Strengthening

6.1.1. Remaining Construction Works

Appropriate institutional arrangements will need to be made to ensure environmental and social management of the remaining works. The construction contractor for the dam and powerhouse construction should re-designate the existing Safety Supervisor as the EHS Supervisor. The transmission line construction contractor should also designate/appoint a suitable site staff as EHS Supervisor. Similarly, the Management Consultants (MC) should also designate a suitable site staff as EHS Engineer. The EHS Supervisors will be responsible for implementing the mitigation measures discussed in **Chapter 5** (and further elaborated in the Section below), and other aspects of EMMP. The EHS Engineer will maintain day-to-day coordination with the EHS Supervisors, and ensure that the EMMP is adequately implemented. The EHS Engineer will also liaise with the Pak-EPA and KP EPA for matters related to environmental management and compliance of the Project.

The contractors and MC should prepare and implement an EHS training plan. The key fey features of such training plans are provided in **Table 6.1**.

6.1.2. O&M Phase

During the Project's O&M phase as well, EHS responsibilities will be well defined and included in the SOP of the facility. An EHS Engineer will be appointed at the Project site to implement various aspects of the EMMP. WAPDA Environmental Cell (WEC) will maintain top supervision of the EMMP implementation at the site.

The EHS Engineer will also prepare and implement an EHS training plan at the Project Site. In addition, the EHS Engineer will maintain liaison with outside

agencies including the national and provincial EPAs for matters concerning the environmental management and compliance of the Project operations.

6.2. Environmental Mitigation and Monitoring Plan Construction and Operation

The mitigation and monitoring plan (EMMP) lists all the potentially significant effects of each activity of the project and their associated mitigation measures discussed in **Chapter 5** of the present document. EMMP present the following information for each Project activity/aspect:

- A listing of the potential impact associated with that Project activity,
- A comprehensive listing of mitigation measures (actions),
- The person(s)/entities responsible for ensuring the full implementation of the action,
- A listing of the monitoring requirements,
- The person(s)/entities responsible for monitoring the action,

The EMMP for the Project is presented in **Table 6.2**. The EMMP broadly covers the overall Project aspects, and specifically addresses the Project components being considered for USG funding. The EMMP Also includes the transmission line, though it would be reviewed and updated by the transmission line contractor once the route is finalized.

6.3. Environmental Monitoring

6.3.1. Monitoring Parameters

The following parameters need be monitored on a regular basis:

- Water inflow in the reservoir; outflow from the dam, releases in the canal, releases in the river downstream of diversion barrage, and water discharges in the Indus river.
- Stored water volume in the reservoir
- Meteorological data
- Suspended solids (sediment) analysis of the river water at the inlet of the reservoir, and at the outlet of the dam.
- volume of sediment transported into the reservoir
- Water quality at the reservoir inlet and in the reservoir. The parameters may include salinity, pH, temperature, electrical conductivity, turbidity, dissolved

oxygen, suspended solids, phosphates, nitrates, and biochemical oxygen demand

- Sampling of microflora, microfauna, aquatic weeds and benthic organisms
- Wildlife (species, distribution, numbers)
- Vegetation changes (cover, species composition, growth rates, biomass, etc.) in the upper watershed, head pond drawdown zone, and downstream areas
- Increases in erosion in the watershed
- Impacts on wildlands, species or plant communities of special ecological significance
- Public health and disease vectors.

The Monitoring Plan is provided in **Table 6.3**.

6.3.2. Biological Resources

Due to the scarcity of base line data on the ecology of the area including its terrestrial and aquatic ecosystem and bio-diversity, a composite monitoring plan for wildlife, fisheries and bio-diversity is recommended. It is suggested that this should be carried out initially for a period of one year after commencement of the project operation. The personnel required for this task will include a biologist (Forestry or Wildlife) and a chemist. The chemist will be responsible for chemical analysis of water resources while the biologist will collect local data on animal and plant life including data on the distribution pattern, age distribution, feeding and breeding areas, parasites and pests.

6.4. Environmental and Social Audit

After the completion of construction works, a detailed environmental and social audit of the Project should be carried out, in order to determine any outstanding issue and to identify remedial measures. This audit will also provide post-construction bench mark for the environmental and social aspects of the Project area.

6.5. Budget for Environmental Mitigation, Monitoring and Institutional Strengthening

The cost of EMMP implementation has been estimated to be Rs. 28.78 million (about US$ 339,000)[34]. This includes Rs.28.10 million as one time cost, and Rs. 0.68 million as recurrent costs on annual basis. However, these estimates

[34] US $ 1 = Pak Rupees 85.

do not include the implementation costs of various plans such as watershed management and afforestation plan, eutrophication control plan, and landscaping and plantation plan.

The details are provided in the table below.

Environmental Management Cost

Description	Cost Estimates (Pak Rupees)	Basis
Construction Phase		
EHS Supervisor and EHS Engineer	0	The existing site personnel will be re-designated.
Water quality analysis	2,400,000	10 samples per month; Rs. 20,000 per analysis; 12 months
Trainings	500,000	Master trainer to provide training to EHS Supervisor and EHS Engineer. Rs. 30,000 x 10 days; plus miscellaneous expenses.
Environmental and social audit	2,500,000	1 environmental + 1 social specialist x 30,000 per day x 30 days; miscellaneous expenses
Meteorological Station	1,200,000	-
O&M Phase	0	
EHS Engineer	0	The existing site personnel will be re-designated.
Water laboratory analysis (annual cost estimates)	480,000	2 samples per month; Rs. 20,000 per analysis; 12 months
Trainings (annual cost estimates)	200,000	One training course per year in Lahore or Islamabad
Additional Studies	0	

Description	Cost Estimates (Pak Rupees)	Basis
Study to evaluate soil erosion and siltation in reservoir; development of watershed management and afforestation plan	5,900,000	2 specialists (geotechnical and forester) x 90 days x 30,000 per day; plus miscellaneous expenses
Study to evaluate soil salinity in command area	1,200,000	1 agricultural scientist x 30 days x 30,000; laboratory analyses; miscellaneous expenses.
Study to evaluate reservoir induced seismicity	2,000,000	1 geotechnical specialist x 60 days x 30,000; miscellaneous expenses.
Study to evaluate slope stabilization	2,000,000	1 geotechnical specialist x 60 days x 30,000; miscellaneous expenses.
Study to evaluate reservoir eutrophication	1,000,000	1 biologist x 30 days x 30,000; miscellaneous expenses.
Development of site landscaping and plantation plan	2,700,000	1 landscaping specialist x 45 days; 1 horticulturist x 45 days x 30,000; miscellaneous expenses.
Monitoring of biological resources	5,200,000	1 biologist x 240 days; 1 chemist x 240 days x 10,000; miscellaneous expenses
Study to evaluate climate change impacts on the Project, particularly water availability.	1,500,000	1 specialist x 45 days x 30,000; miscellaneous expenses.
Total	**28,780,000**	

Table 6.1: Environmental and Social Trainings

Contents	Participants	Responsibility
General environmental and socioeconomic awareness; Environmental and social sensitivity of the project area; Key findings of the EIA; Mitigation measures; EMMP; Social and cultural values of the area.	Selected project management staff	EHS Engineer (MC)
General environmental and socioeconomic awareness; Environmental and social sensitivity of the project area; Mitigation measures; Community issues; Safety issues; Awareness of transmissible diseases Social and cultural values.	All site personnel	EHS Engineer (MC); EHS Supervisor
EMMP; Safety issues; Waste disposal	Construction crew	EHS Supervisor
Road safety; Defensive driving; Waste disposal; Cultural values and social sensitivity.	Drivers	EHS Supervisor
Camp operation; Waste disposal; Natural resource conservation; Safety Housekeeping.	Camp staff	EHS Supervisor
Restoration requirements; Waste disposal	Restoration teams	EHS Engineer; EHS Supervisor

Table 6.2: Environmental Mitigation and Monitoring Plan

Aspects/Impacts	Mitigation		Monitoring	
	Action	Responsibility	Action	Responsibility
Impacts Associated with Project Design and Site				
Positive Impacts Reduction of floods frequency in Gomal River/Gomal Zam	-	-	The reservoir inlet and water release data from the dam to be recorded on a regular basis.	WAPDA
Regulated supply of irrigation water from the reservoir, and hence increased cultivation in the command area.	Capacity building and awareness raising of farmers on efficient irrigation techniques; appropriate use of fertilizers and pesticides; promotion of organic farming and integrated pest management (IPM) practices; protection against water logging and soil salinity.	WAPDA; Provincial Agriculture and Irrigation Departments	-	-
Electricity generation from the project	Availability of electricity to the local population. Spending a portion of the proceeds from the electricity generation on the area development.	WAPDA; Office of Political Agent; Provincial line departments (Local Government and Rural Development, Education, Health, and others)	-	-

Aspects/Impacts	Mitigation		Monitoring	
	Action	Responsibility	Action	Responsibility
Negative Impacts				
Land slides in reservoir area	Keep the water level in the reservoir lower than the left bank saddle (for details, please refer to Section 2.1 of Annex D, EIA report of the Project)	Operations Staff (WAPDA)	The land slides need to be monitored during the initial filling of the reservoir and afterwards.	Operations and Supervisory Staff (WAPDA)
Soil erosion and siltation in reservoir, thus reducing the reservoir capacity	Flushing sediments through the dam. Further studies to determine the extent of soil erosion in the catchment area, and to identify remedial measures; develop and implement watershed management and afforestation plan (structures such as check dams and gabions; terracing; bio-engineering; plantation of trees, shrubs and grasses; controlled grazing; others.)	Operations Staff (WAPDA) EHS Engineer (WAPDA)	Monitor the reservoir siltation and silt releases from the dam; Monitor the implementation and effectiveness of the watershed management plan.	Operations and Supervisory Staff (WAPDA) WAPDA (GM Hydro); WAPDA Environmental Cell (WEC)
Erosion of riverbed downstream of dam (caused by release of silt-free water from reservoir)	Survey of river bed downstream of dam to identify potentially at-risk structures. Reinforcement of bridges, culverts, and other structures where needed	WAPDA in SWA; Provincial Works and Communication Department in KP	Monitor the river bed erosion, particularly near the bridges, culverts and other structures.	EHS Engineer (WAPDA)
Decreased soil fertility because of decreased silt in irrigation water	Use of fertilizer by the growers. Encourage using organic farming and IPM techniques. Capacity building and awareness raising needed.	Provincial Agriculture Department	Monitor the soil fertility and fertilizer usage practice in the command area.	Provincial Agriculture Department

Aspects/Impacts	Mitigation		Monitoring	
	Action	Responsibility	Action	Responsibility
Increased soil salinity	Use appropriate cultivation practices such as over irrigation and pre-sowing flooding for non- or slightly-saline soils. Capacity building of growers. Reclamation of coarse to medium textured saline soils. Carry out further studies for saline, moderately fine to fine soils.	Provincial Agriculture Department	Monitor soil salinity for different soil types; monitor cultivation practices	Provincial Agriculture Department
Loss of natural vegetation in the project area	Compensation to be paid to the owners for cutting of trees on privately owned land. Re-plantation with local species; use salt resistant species for the saline areas; prepare re-plantation plan.	EHS Engineer (WAPDA)	Monitor the implementation and effectiveness of the re-plantation.	WEC
Habitat destruction	Conduct field investigations for key wildlife species including houbara bustard. Measures such as controlled hunting and appropriate waste disposal to be implemented to safeguard water foul in the reservoir area.	EHS Engineer (WAPDA)	-	-
Increased fish population in reservoir	Planned and controlled introduction of appropriate non-invasive species.	EHS Engineer (WAPDA)	-	-
Increased risk of diseases caused by vectors such as mosquitoes	Integrated approach involving preventive as well as curative measures. Use of approved and non-toxic insecticides; use of mosquito nets in buildings, vaccination	Health Departments in SWA and KP	Monitor the vector breeding; monitor the disease incidence/outbreak and	EHS Engineer (WAPDA)

Aspects/Impacts	Mitigation		Monitoring	
	Action	Responsibility	Action	Responsibility
	(where applicable), and awareness raising. Strengthen the health care facilities in the command area.		key health parameters of the population.	
Conflicts caused by unavailability of irrigation water to some communities in the area	Agreements between different communities/tribes. Uniform development of the area. Local non-governmental organizations (NGOs) should be mobilized to facilitate dialog and agreements among the tribes, and to determine the development needs of the area.	Office of Political Agent, SWA	-	-
Influx of people in the area, potentially causing conflicts	Agreements between different communities/tribes.	Office of Political Agent, SWA	-	EHS Engineer (WAPDA)
Loss of grazing area because of reservoir impounding	Payment of Qaumi commission; seeding for grasses as part of watershed management; increased fodder production in command area; rural development (social and physical infrastructure) in the area based upon the needs and preferences of the local population.	WAPDA Hyrdo	Monitor the negative impacts on the local herders/others.	EHS Engineer (WAPDA); WEC
Dam collapse	Preparation of Operational Manual including Emergency Response Plan; operation of dam according to Operational Manual; capacity building of O&M staff.	WAPDA Hyrdo	Compliance monitoring	GM - Hydro, WAPDA

Aspects/Impacts	Mitigation		Monitoring	
	Action	Responsibility	Action	Responsibility
Modified water flow regime in Gomal River	Regular maintenance of drainage network; Conduct further studies to identify impacts of flow regime changes; Install meteorological station at the dam site to record the key meteorological data including temperature, precipitation, humidity, and wind speed/direction. Agreement with the Government of Afghanistan to ensure water availability for the Project.	KP Irrigation Department WAPDA GoP	Monitoring of river flow at different locations (reservoir inlet, dam, barrage, canals, confluence with Indus River)	Dam Operations (WAPDA); EHS Engineer
Reservoir induced seismicity	Conduct further studies for reservoir-induced seismicity; Conduct seismic risk analysis. Appropriate instruments to be installed to monitor the seismicity at the site.	WAPDA Hydro	-	-
Slope stabilization	Mitigation measures such as slope reinforcements, grouting, or bracing need to be designed and implemented after carrying out detailed investigations	WAPDA Hydro		
Eutrophication of Reservoir	Large trees if present in the reservoir area need to be cut before impounding. Conduct detailed study to investigate this aspect in a greater depth. This aspect can also be covered under the watershed management studies, proposed earlier.	WAPDA Hydro WEC	-	-

Aspects/Impacts	Mitigation		Monitoring	
	Action	Responsibility	Action	Responsibility
PCB in Transformer Oil	Ensure that new transformers are PCB free (Obtain certificates from manufacturers). Ensure that transformer oil brought to site is PCB free	EHS Engineer	Compliance	WEC
Climate change	Conduct studies to address concerns related to climate change (such as increased frequency and intensity of extreme events), and to frame any mitigation or adaptation measures for the Project.	WAPDA Hydro WEC	Compliance	WEC

Construction Phase Impacts – Remaining Works at Dam/Powerhouse

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
1	Contractor Demobilization	1.1	Soil Erosion and Contamination	o Vehicular traffic on unpaved roads will be avoided as far as possible. o Vehicles and equipment will not be repaired in the field. If unavoidable, impervious sheathing will be used to avoid soil and water contamination.	Contractors	EHS Supervisor; EHS Engineer	After construction (AC)
		1.2	Air Quality Deterioration	o Construction machinery and vehicles will be kept in good working condition and properly tunned, in order to minimize the exhaust emissions.	Contractors	EHS Supervisor	AC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				o Fugitive dust emissions will be minimized by appropriate methods, such as spraying water on soil, where required and appropriate.			
		1.3	Noise	o Vehicles will have exhaust mufflers (silencers) to minimize noise generation. o Nighttime traffic will be avoided near the communities. Local population will be taken in confidence if such work is unavoidable. o Vehicular traffic through the communities will be avoided as far as possible. Vehicle speeds will be kept low, and horns will not be used while passing through or near the communities.	Contractors	EHS Supervisor	AC
		1.4	Safety Hazards	o Road signage will be fixed at appropriate locations to reduce safety hazard associated with project-related vehicular traffic. o Project drivers will be trained on defensive driving. o Vehicle speeds near / within the	Contractors	EHS Supervisor	AC

[35] IFC 2007. *Environmental, Health,* and *Safety (EHS)* Guidelines. International Finance Corporation, The World Bank Group. April 2007.

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				communities will be kept low, to avoid safety hazard and dust emissions. o EHS plan will be strictly followed (The IFC's EHS Guidelines[35] can be used for this purpose).			
		1.5	Damage to Infrastructure	o All damaged infrastructure will be restored to original or better condition.	Contractors/ WAPDA	EHS Supervisor; EHS Engineer	AC
2	Construction Camp Operation	2.1	Soil Erosion / Contamination; water contamination	o Contractors will prepare a waste disposal plan and submit to MC/EHS Engineer for approval. o For the domestic sewage, appropriate treatment and disposal system will be constructed having adequate capacity, in accordance with NEQS (**Table 2.1**). o Waste oils will be collected in drums and sold to the recycling contractors in Tank/D. I. Khan. o The inert recyclable waste from the site (such as card board, drums, broken/used parts, etc.) will be sold to recycling contractors in Tank/D. I. Khan. The hazardous waste will be kept separate and handled according to the nature of the waste.	Contractors	EHS Supervisor	During construction (DC); AC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				o Domestic solid waste from the construction camp will be disposed in a manner that does not cause soil contamination. o The camp sites will be completely restored after the completion of the construction works. All temporary structures will be demolished, land leveled and re-contoured to the original condition or better. All debris and any other material will be removed from the site. The photographs if taken prior to the camp establishment will be used to restore the area.			
		2.2	Air Quality Deterioration	o Generators and vehicles will be kept in good working condition and properly tunned, in order to minimize the exhaust emissions. o Fugitive dust emissions will be minimized by appropriate methods, such as spraying water on soil, where required and appropriate. Waste water from kitchen and washing area of the construction camp may be used for water spraying.	Contractors	EHS Supervisor	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
		2.3	Loss of Vegetation	o The construction crew will be provided with LPG as cooking (and heating, if required) fuel. Use of fuel wood will not be allowed.	Contractors	EHS Supervisor	DC
		2.4	Noise	o Generators and vehicles will have exhaust mufflers (silencers) to minimize noise generation. Compliance with NEQS will be ensured.	Contractors	EHS Supervisor	DC
		2.5	Safety Hazards	o Protective fencing to be installed around the Camp to avoid any accidents. o Firefighting equipment will be made available at the camps. o The camp staff will be provided fire fighting training. o All safety precautions will be taken to transport, handle and store hazardous substances, such as fuel. o EHS Plan to be followed.	Contractors	EHS Supervisor	DC
		2.6	Public Health	o The construction camps and site offices will have first-aid kits. o The construction crew will be provided awareness for the transmissible diseases (such as HIV/AIDS, hepatitis B and C).	Contractors	EHS Supervisor	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
		2.7	Social and Gender Issues	o Employment to locals will be maximized. o No child labor will be employed.	Contractors	EHS Supervisor	DC
3	Transportation of Equipment and Construction Materials	3.1	Soil Erosion and Contamination	o Vehicular traffic on unpaved roads will be avoided as far as possible. o Vehicles and equipment will not be repaired in the field. If unavoidable, impervious sheathing will be used to avoid soil and water contamination.	Contractors	EHS Supervisor	DC
		3.2	Air Quality Deterioration	o Vehicular traffic on unpaved roads will be avoided as far as possible. Operation of vehicles and machinery close to the water channels, water reservoir will be minimized. o Vehicles will be kept in good working condition and properly tunned, in order to minimize the exhaust emissions.	Contractors	EHS Supervisor	DC
		3.3	Noise	o Vehicles will have exhaust mufflers (silencers) to minimize noise generation. o Nighttime traffic will be avoided near the communities. Local population will be taken in confidence if such work is unavoidable.	Contractors	EHS Supervisor	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
		3.4	Safety Hazards	o Road signage will be fixed at appropriate locations to reduce safety hazard associated with project-related vehicular traffic. o Project drivers will be trained on defensive driving. o Vehicle speeds near / within the communities will be kept low, to avoid safety hazard and dust emissions. o EHS Plan to be strictly followed.	Contractors	EHS Supervisor	DC
		3.5	Damage to Infrastructure	o All damaged infrastructure will be restored to original or better condition.	Contractors/ WAPDA	EHS Supervisor; EHS Engineer	DC
4	Construction works	4.1	Blocked Access	o A bypass route should be constructed at the project site to divert the through traffic, thus avoiding the public traffic passing through the site.	Contractors/ WAPDA	EHS Supervisor	DC
		4.2	Noise and Vibration	o Construction machinery will be appropriate noise muffling arrangement. NEQS will be followed.	Contractors	EHS Supervisor	DC
		4.3	Safety Hazards	o The construction sites will have protective fencing to avoid any unauthorized entry. o The EHS plan will be strictly followed.	Contractors	EHS Supervisor	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
		4.4	Damage to Infrastructure	o All damaged infrastructure will be restored to original or better condition.	Contractors	EHS Supervisor	DC
		4.5	Social Issues	o Employment to locals will be maximized. o No child labor will be employed.	Contractors	EHS Supervisor	DC
		4.6	Sites of Historical, Cultural, Archeological or Religious Significance	o In case of chance find of any sites or artifacts of historical, cultural, archeological or religious significance, the work will be stopped at that site. The provincial and federal archeological departments will be notified immediately, and their advice will be sought before resumption of the construction activities at such sites.	Contractors	EHS Supervisor; EHS Engineer	DC
		4.7	Soil Erosion	o After the completion of the construction works, campsites and other construction sites will be completely restored. No debris, surplus construction material or any garbage will be left behind. o Photographic record if maintained for pre-project conditions will be used to restore the area.	Contractors	EHS Supervisor	DC
		4.8	Soil Contamination	o Vehicles and equipment will not be repaired in the field. If unavoidable,	Contractors	EHS Supervisor	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				impervious sheathing will be used to avoid soil and water contamination. o Waste oils will be collected in drums and sold to the recycling contractors. o The inert recyclable waste from the site (such as card board, drums, broken/used parts, etc.) will be sold to recycling contractors. The hazardous waste will be kept separate and handled according to the nature of the waste. o Leaked oil collection arrangement (such as a channel and a drain pit below the transformers) will be incorporated in the design of the transformer foundations at the powerhouse and switchyard.			
		4.9	Air Quality Deterioration	o Construction machinery, generators and vehicles will be kept in good working condition and properly tunned, in order to minimize the exhaust emissions. o Fugitive dust emissions will be minimized by appropriate methods, such as spraying water on soil, where	Contractors	EHS Supervisor	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				required and appropriate.			
		4.10	Loss of natural vegetation / Aesthetic Value	o Tree plantation will be carried out at the site.	Contractors	EHS Supervisor	DC

Construction of Transmission Line

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
1	Contractor Mobilization and Demobilization	1.1	Soil Erosion and Contamination	o Vehicular traffic on unpaved roads will be avoided as far as possible. o Vehicles and equipment will not be repaired in the field. If unavoidable, impervious sheathing will be used to avoid soil and water contamination.	Contractors	EHS Supervisor;	Before Construction (BC); After construction (AC)
		1.2	Air Quality Deterioration	o Construction machinery and vehicles will be kept in good working condition and properly tuned in order to minimize the exhaust emissions. o Fugitive dust emissions will be minimized by appropriate methods, such as spraying water on soil, where required and appropriate.	Contractors	EHS Supervisor	AC
		1.3	Noise	o Vehicles will have exhaust mufflers (silencers) to minimize noise	Contractors	EHS Supervisor	AC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				generation. o Nighttime traffic will be avoided near the communities. Local population will be taken in confidence if such work is unavoidable. o Vehicular traffic through the communities will be avoided as far as possible. Vehicle speeds will be kept low, and horns will not be used while passing through or near the communities.			
		1.4	Safety Hazards	o Road signage will be fixed at appropriate locations to reduce safety hazard associated with project-related vehicular traffic. o Project drivers will be trained on defensive driving. o Vehicle speeds near / within the communities will be kept low, to avoid safety hazard and dust emissions. o EHS plan will be strictly followed (The IFC's EHS Guidelines can be used for this purpose).	Contractors	EHS Supervisor	AC
		1.5	Damage to Infrastructure	o All damaged infrastructure will be restored to original or better condition.	Contractors/ WAPDA	EHS Supervisor;	AC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
						EHS Engineer	
2	Construction Camp Operation	2.1	Soil Erosion / Contamination; water contamination	o Contractors will prepare a waste disposal plan and submit to MC/EHS Engineer for approval. o For the domestic sewage, appropriate treatment and disposal system will be constructed having adequate capacity, in accordance with NEQS (**Table 2.1**). o Waste oils will be collected in drums and sold to the recycling contractors in Tank/D. I. Khan. o The inert recyclable waste from the site (such as card board, drums, broken/used parts, etc.) will be sold to recycling contractors in Tank/D. I. Khan. The hazardous waste will be kept separate and handled according to the nature of the waste. o Domestic solid waste from the construction camp will be disposed in a manner that does not cause soil contamination. o The camp sites will be completely restored after the completion of the construction works. All temporary	Contractors	EHS Supervisor	During construction (DC); AC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				structures will be demolished, land leveled and re-contoured to the original condition or better. All debris and any other material will be removed from the site. The photographs if taken prior to the camp establishment will be used to restore the area.			
		2.2	Air Quality Deterioration	o Generators and vehicles will be kept in good working condition and properly tuned, in order to minimize the exhaust emissions. o Fugitive dust emissions will be minimized by appropriate methods, such as spraying water on soil, where required and appropriate. Waste water from kitchen and washing area of the construction camp may be used for water spraying.	Contractors	EHS Supervisor	DC
		2.3	Loss of Vegetation	o The construction crew will be provided with LPG as cooking (and heating, if required) fuel. Use of fuel wood will not be allowed.	Contractors	EHS Supervisor	DC
		2.4	Noise	o Generators and vehicles will have exhaust mufflers (silencers) to minimize noise generation. Compliance with NEQS will be ensured.	Contractors	EHS Supervisor	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
		2.5	Safety Hazards	o Protective fencing to be installed around the Camp to avoid any accidents. o Firefighting equipment will be made available at the camps. o The camp staff will be provided fire fighting training. o All safety precautions will be taken to transport, handle and store hazardous substances, such as fuel. o EHS Plan to be followed.	Contractors	EHS Supervisor	DC
		2.6	Public Health	o The construction camps and site offices will have first-aid kits. o The construction crew will be provided awareness for the transmissible diseases (such as HIV/AIDS, hepatitis B and C).	Contractors	EHS Supervisor	DC
		2.7	Social and Gender Issues	o Employment to locals will be maximized. o No child labor will be employed.	Contractors	EHS Supervisor	DC
3	Transportation of Equipment and Construction Materials	3.1	Soil Erosion and Contamination	o Vehicular traffic on unpaved roads will be avoided as far as possible. o Vehicles and equipment will not be repaired in the field. If unavoidable, impervious sheathing will be used to	Contractors	EHS Supervisor	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				avoid soil and water contamination.			
		3.2	Air Quality Deterioration	o Vehicular traffic on unpaved roads will be avoided as far as possible. Operation of vehicles and machinery close to the water channels, water reservoir will be minimized. o Vehicles will be kept in good working condition and properly tuned, in order to minimize the exhaust emissions.	Contractors	EHS Supervisor	DC
		3.3	Noise	o Vehicles will have exhaust mufflers (silencers) to minimize noise generation. o Nighttime traffic will be avoided near the communities. Local population will be taken in confidence if such work is unavoidable.	Contractors	EHS Supervisor	DC
		3.4	Safety Hazards	o Road signage will be fixed at appropriate locations to reduce safety hazard associated with project-related vehicular traffic. o Project drivers will be trained on defensive driving. o Vehicle speeds near / within the communities will be kept low, to avoid	Contractors	EHS Supervisor	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				safety hazard and dust emissions. o EHS Plan to be strictly followed.			
		3.5	Damage to Infrastructure	o All damaged infrastructure will be restored to original or better condition.	Contractors/ WAPDA	EHS Supervisor; EHS Engineer	DC
4	Route selection	4.1	Damage to agriculture, safety hazards for local population	o Alternate routes will be identified, the one with least environmental and social issues will be preferred. o The route will be selected avoiding cultivation fields and settlements as far as possible. o The archeological sites mentioned in **Section 4.3.5** will be avoided.	Contractors	EHS Supervisor; EHS Engineer	BC
5	Construction of Transmission Line	5.1	Loss of Agriculture	o Temporary RoW will be used along the proposed transmission lines, and for access routes to the transmission line corridor. o Cultivation fields will be avoided as far as possible. o Compensation will be paid for any crops damaged as a result of the construction activities. The compensation will be paid to the cultivator, and absence of the land title will not be a bar to receiving the	Contractors	EHS Supervisor	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				compensation. o Complete record will be maintained for the determination and payment of the compensation. o It will be ensured that the land under the 132-KV transmission line tower remains available for cultivation. o In case the above is not possible, the land under the tower will be acquired in accordance with the LAA procedures (Section 17.4 of the LAA will not be used). o Operation of project vehicles and construction machinery outside the RoW will be avoided. Attempts will be made to use existing tracks/roads to access the transmission line corridor/tower locations. In case new access routes are necessary, the cultivated land will be avoided as far as possible. Damage to crops will be compensated. o Grievance redressal mechanism will be put in place to address the community complaints.			

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
		5.2	Damage to irrigation network	o Operation of construction machinery or project vehicles near the existing water courses/canals will be avoided. o All damages to the water courses or canals caused by the project activities will be completely repaired.	Contractors	EHS Supervisor	DC
		5.3	Blocked Access	o In case of the blockage of the existing routes, alternate routes will be identified in consultation with affected communities.	Contractors	EHS Supervisor	DC
		5.4	Noise and Vibration	o Vehicular traffic through the communities will be avoided as far as possible. Project routes will be authorized by MC. o Vehicle speeds will be kept low, and horns will not be used while passing through or near the communities. o Vehicles will have exhaust silencers to minimize noise generation. o Nighttime traffic will be avoided near the communities. o Movement of all project vehicles and personnel will be restricted to within	Contractors	EHS Supervisor	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				work areas, to avoid noise disturbance. o Working hours for construction activities within the communities will be limited to between 8 am and 6 pm.			
		5.5	Safety Hazards	o The communities near the transmission line routes will be informed about the construction activities. Protective fencing will be installed where required. o Before commencing the testing commissioning of the system, the nearby communities will be informed. Protective fencing will be used where appropriate/possible. o EHS Plan will be strictly followed. IFC's EHS Guidelines can be used to develop the Plan.	Contractors	EHS Supervisor	DC
		5.6	Damage to Infrastructure	o All damaged infrastructure will be restored to original or better condition.	Contractors	EHS Supervisor	DC
		5.7	Gender Issues	o Bypass routes to be identified, if required, especially along routes frequented by women, such as route to the local well or water source.	Contractors	EHS Supervisor	DC
		5.8	Social Issues	o Construction crew will avoid entering villages and settlements.	Contractors	EHS Supervisor	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				o Employment of locals will be maximized. o No child labor will be employed at the project sites.			
		5.9	Sites of Historical, Cultural, Archeological or Religious Significance	o Extreme care will be employed while working through the graveyards that may exist on the transmission line routes. No graves will be damaged. Construction activities will be carried out after consultation with the nearby/relevant community. o The archeological sites mentioned in **Section 4.3.5** will be avoided during the construction works.	Contractors	EHS Supervisor	DC
				o In case of discovery of any sites or artifacts of historical, cultural, archeological or religious significance, the work will be stopped at that site. The provincial and federal archeological departments will be notified immediately, and their advice will be sought before resumption of the construction activities at such sites.	Contractors	EHS Supervisor; EHS Engineer	DC
		5.10	Soil Erosion	o Embankments and excavated slopes will not be left untreated/unattended for long	Contractors	EHS Supervisor	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				durations. o Vehicular traffic on unpaved roads will be avoided as far as possible. Operation of vehicles and machinery close to the water bodies will be minimized. o After the completion of the construction works, the transmission line routes and other construction sites will be completely restored. No debris, surplus construction material or any garbage will be left behind. o Photographic record will be maintained for pre-project, during-construction and post-construction condition of the sites.			
		5.11	Soil Contamination	o Vehicles and equipment will not be repaired in the field. If unavoidable, impervious sheathing will be used to avoid soil and water contamination.	Contractors	EHS Supervisor	DC
		5.12	Air Quality Deterioration	o Construction machinery, generators and vehicles will be kept in good working condition and properly tunned, in order to minimize the exhaust emissions. o Fugitive dust emissions will be	Contractors	EHS Supervisor	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				minimized by appropriate methods, such as spraying water on soil, where required and appropriate. o Project vehicles will avoid passing through the communities and cultivation fields as far as possible. If unavoidable, speed will be reduced to 15 km/h to avoid excessive dust emissions. o While working within the communities for works such as transmission line laying, coordination with the communities will be maintained to minimize any detrimental impacts on the crops and settlements.			
		5.13	Loss of Natural Vegetation	o Clearing of natural vegetation will be minimized as far as possible during the transmission line works. o Herbicides will not be used to clear vegetation along the transmission line route (or at other project locations). o For each transmission line route, a tree cutting plan will be prepared and submitted to WAPDA for approval. A complete record will be maintained for any tree cutting or trimming. The record will include: the number,	Contractors	EHS Supervisor	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				species, type, size, age, condition and photograph of the trees to be cut/trimmed. o Tree plantation will be carried out to compensate the tree cutting mentioned above. o The construction crew will be provided with LPG as cooking (and heating, if required) fuel. Use of fuel wood will not be allowed.			
		5.14	Damage to Wildlife	o Garbage will not be left in the open. o The project staff will not be allowed to indulge in any hunting or trapping activities.	Contractors	EHS Supervisor	DC

O&M Activities

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
1	Operation and maintenance of Project Facilities	1.1	Soil and water contamination	o For the domestic sewage, appropriate treatment and disposal system will be constructed having adequate capacity, in accordance with NEQS (**Table 2.1**). o Waste oils will be collected in drums and sold to the recycling	Facilities Maintenance department	EHS Engineer	During O&M

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				contractors in Tank/D. I. Khan. o The inert recyclable waste from the site (such as card board, drums, broken/used parts, etc.) will be sold to recycling contractors in Tank/D. I. Khan. The hazardous waste will be kept separate and handled according to the nature of the waste. o Domestic solid waste from the site facilities will be disposed in a manner that does not cause soil contamination.			
		1.2	Safety hazards	o The dam safety risk assessment will be carried out (if not already done) by an independent panel of experts. o The standard operating procedures (SOPs) for dam and powerhouse O&M will be prepared and strictly implemented. o The standard EHS Guidelines will be made part of the SOPs mentioned above, and will be strictly followed. o The Emergency Response Plan (ERP) will be made available at the Project sites. Its salient points will be displayed at prominent places. The O&M staff will be given training on the	ESH Engineer		During O&M

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				ERP. o The O&M staff will be provided essential protective gears and equipment. o The O&M staff will be provided safety training. Refresher courses will be arranged on regular basis. o The Project sites will have protective fencing to avoid any unauthorized entry. o The project drivers will be trained for defensive driving skills. Vehicular speeds near/within communities will be kept low to minimize safety hazards. o Firefighting equipment will be made available at the site; fire extinguishers will be provided in the project vehicles. The powerhouse staff will be provided safety training, including fire fighting. o All safety precautions will be taken to transport, handle and store hazardous substances, such as fuel. o Liaison with the community will be maintained for the transmission line maintenance works, where necessary. The communities near the grid stations			

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				and transmission lines will be educated on the risk of electrocution, and how to avoid accidents. o The trees under the transmission lines will be regularly trimmed in order to maintain 8 m clearance.			
		1.3	Loss of agriculture	o The crop damage will be minimized during the O&M activities of the transmission line. o Community liaison will be maintained during such operations. o Compensation will be paid to the grower for damage to crops or any other asset.	EHS Engineer		During O&M

Table 6.3: Environmental Monitoring Plan

	Monitoring Parameter	Monitoring Location	Frequency	Responsibility	Resource Requirements	Documentation
1	Water inflow in the reservoir	Upstream of reservoir	Continuous	WAPDA	Rim station(s)	Rim station readings
2	Water outflow from the reservoir	Outlet structures	Continuous	WAPDA	Record gauge	Record gauge readings
3	Water flow through the spill way	Spillway	Continuous	WAPDA	Record gauge	Record gauge readings
4	Water flow through the powerhouse	Powerhouse	Continuous	WAPDA	Record gauge	Record gauge readings
5	Water diversion in the canal	Diversion barrage	Continuous	WAPDA	Record gauge	Record gauge readings
6	Water releases in Gomal river downstream of diversion barrage	Downstream of diversion barrage	Continuous	WAPDA	Rim station(s)	Rim station readings
7	Gomal river water releases in Indus river	At the confluence of Gomal and Indus rivers	Continuous	WAPDA	Rim station(s)	Rim station readings
8	Sediment load in entering the reservoir	Upstream of reservoir	Continuous	WAPDA	Sediment meter	Meter readings
9	Sediment load in water releases	Downstream of dam	Continuous	WAPDA	Sediment meter	Meter readings
10	Volume of sediments in reservoir (to be calculated based upon data recorded for item 8 and 9 above)	-	Continuous	WAPDA	-	Calculation results

	Monitoring Parameter	Monitoring Location	Frequency	Responsibility	Resource Requirements	Documentation
11	Water quality (BOD, E. coli, pH, TSS, TDS, Sulfates, etc.)	Reservoir	Once a month	WAPDA	Sampling bottles (and access to laboratory)	Analysis results
12	Meteorological data (temperature, wind, precipitation, humidity, etc.)	At the dam site	Continuous	WAPDA	Met station	Complete readings of the station
13	Water level in reservoir	Reservoir	Daily	WAPDA	Level gauge	Measurement record
14	Vegetation cover changes	In the watershed area	Regularly	WAPDA	Survey by biologists	Survey findings
15	Wildlife (aquatic flora and fauna, key avian species, key terrestrial species, etc.)	In the watershed, around the lake, and downstream of dam	Regularly	WAPDA	Survey by biologists	Survey findings
16	Erosion and land sliding	In the watershed area	Regularly	WAPDA	Surveys by field staff	Survey findings
17	Disease vectors	Near the dam and in command area	Regularly	Health Department	Surveys by Department staff	Survey findings
18	Soil fertility	In command area	Once in six months	Agriculture Department	Laboratory analysis	Analysis results
19	Soil salinity	In command area	Once in six months	Agriculture Department	Laboratory analysis	Analysis results
20	Groundwater table	In command area	Once in six months	Agriculture Department	-	Measurement record

[a] Frequency may be adjusted based upon the previous results.

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Useful Links for environmental and social management of dams and hydroelectric projects

http://www.fema.gov/

http://www.icold-cigb.net/

http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2008/12/03/000334955_20081203035112/Rendered/PDF/E20170EA0P09651LIC100EAP1EA1P096532.pdf

http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2009/02/05/000333038_20090205234636/Rendered/PDF/E17360v10repla1LIC10Huai0EA1English.pdf

http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2008/11/13/000333038_20081113031725/Rendered/PDF/E20070v40EA0Bo1LIC10XFWMP0EA0Report.pdf

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Appendix A: Terms of Reference

Scope of Work

Technical Assistance on Environmental Assessment (IEE/EIA) of Gomal Zam and Satpara Multipurpose Dams

Background

The U.S. Government's Quick Impact Energy program started in October 2009 to address Pakistan's severe electricity shortages that have created an energy crisis threatening the country's political and economic stability. As part of Phase-II of the Energy Program, the USG through USAID is considering Satpara and Gomal Zam multi-purpose projects for USG funding at the request of Government of Pakistan. Both projects are under different phases of construction and USAID is assessing the remaining work required for completion. For the purpose of projects' evaluation, USAID would want to ensure that the environmental assessments for both the projects are compliant with the local and US environmental regulations.

The Initial Environmental Examination (IEE) for Satpara dam project was conducted by WAPDA environmental specialists in 2002. The report was reviewed by the Northern Areas (NA) Planning and Development Department in 2004 since there was no provisional Environmental Protection Agency (EPA) in the NA. In the case of the Gomal Zam project, Coyne-et-Bellier, a French consulting firm, completed the Environmental Impact Assessment in 1995. The EIA was not formally approved by the Federal EPA since the Pakistan EPA was not established till 1997.

In the above context, USAID through its contractor, Advanced Engineering Associates International, is seeking quick assistance from local engineering/environmental firms to carry out the following environmental assessment tasks in 1-1.5 months upon award:

Tasks:

1. Review the environmental reports for both Satpara and Gomal Zam Dams, and prepare a summary for each project of the environmental issues, positive or negative impacts and proposed mitigations & monitoring (in tabular form) for the scope of activities under both projects in their area of influence. Highlight any changes in the environmental conditions & issues since the existing (original) reports and start-up of construction.

2. Describe the areas as they currently exist with the onoging construction of the dam, hydro-power plant, transmission line in Gomal Zam and of the dam, hydropower plant and irrigation system in Satpara. This task will require onsite assessment in the field and should cover different areas impacting the environment such as physical, biological, climate, water resources, geology and socio-economic. Construction and operation practices, on-going supervision as well as implementation of environmental mitigation and monitoring measures (and Contractor's capabilities) as proposed in the original IEE/EA shall be reviewed and documented. Determine the significance of existing and potential adverse environmental and social impacts due to construction and operation of the dams and associated infrastructure, and update or develop an Environmental Monitoring and Mitigation Plan (EMMP) for each project.
3. Review the comments of USAID Environmental Officers and address all concerns.
4. For the remaining scope of work on both Satpara and Gomal Zam dams to be implemented under USG funding, conduct a quick environmental analysis and develop a comprehensive and detailed EMMP with budget and responsibilities that should comply with GOP and USAID/ USG environmental regulations and best international practice. The remaining works to be completed in Gomal Zam include dam, hydropower plant and transmission line; and in Satpara include dam, hydropower plant and irrigation system.

Appendix B: List of Specialists involved in Present Assignment

The following specialists participated in the present assignment:

- Mohammad Omar Khalid – Environmental and Social Assessment Specialist and team leader
- Shazia Shahid – Environmental Specialist
- Shaukat Sharar – Social Assessment Specialist
- Jamshaid Iqbal – Environment Engineer
- Muhammad Ziauddin – Advisor

Appendix C: Initial Environmental Examination (IEE)

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PART B - INITIAL ENVIRONMENTAL EXAMINATION FOR GOMAL ZAM DAM

PROGRAM/ACTIVITY DATA:

Country: Pakistan

Objective: To provide access to reliable source of electricity and to provide economic opportunities to the underdeveloped areas of South Waziristan that is vulnerable extremism by completing the dam, hydropower plant and transmission line of WAPDA's high priority project at Gomal Zam Dam.

Activity Name: Gomal Zam Dam Construction Completion.

Funding Begins: FY 2010 **Funding Ends**: FY 2011 **LOP Amount:** $ 40 million

IEE Prepared By: Rosario Calderon **Date:** August 17, 2010

IEE Amendment (Y/N): No If "yes", File name & date of original

ENVIRONMENTAL ACTION RECOMMENDED: (Place X where applicable)

Categorical Exclusion	[ ]	Deferral	[ ]
Positive Determination	[ ]	Negative Determination	[X]
With Conditions	[X]	Exemption	[ ]

1.0 BACKGROUND AND PROGRAM DESCRIPTION

1.1 Purpose and Scope of IEE

The purpose of this initial environmental examination (IEE), in accordance with 22 CFR 216, is to provide a specific review for USAID of the reasonably foreseeable effects on the environment as well as recommend threshold decisions for construction completion of the Gomal Zam Dam as a part of Pakistan Signature Energy Program. This IEE provides a brief statement of the factual basis for a threshold decision based on available GOP documents.

1.2 Background

Gomal Zam Dam is a multi-purpose hydro project that would provide energy, irrigation, and water storage benefits to the local residents of South Waziristan. The project site is located at in an isolated area near Gomal River about 60 km west of Tank and D.I. Khan in the South Waziristan Agency of the Federally Administered Tribal Areas (FATA). This river is basically dry during nine months of the year and has water during the summer monsoon months.

The basic objectives of USG support are: (1) Reduce the electricity supply/demand gap and provide economic opportunity in underdeveloped that are vulnerable to extremism - South Waziristan in FATA (2) Add power generation capacity and energy to the national power transmission grid; (3) Store water for the companion down stream irrigation projects; (4) Provide flood control for areas below the dam; and (5) Provide water for domestic use.

The completion of the Gomal Zam Dam would build on our counter-insurgency (COIN) efforts in the Federally-Administered Tribal Areas. A $40 million investment would complete the dam, hydroelectric plant and power transmission lines, providing 17.5 megawatts of power and electrifying 25,000 households in South Waziristan, Tank and D.I. Khan. It would also control flooding, which by GOP estimates costs $2.6 million in damages annually.

The dam will store 1.14 million acre feet of water, sufficient to provide downstream irrigation for 191,000 acres in Tank and D.I. Khan, benefitting 30,000 farming households. Indeed, the $68 million downstream irrigation project would provide economic incentives to over 20,000 Masoud and Wazir tribal members – a population susceptible to militant recruitment -- to settle in regions under government control.

The main dam and powerhouse are estimated to be 81% complete and the and transmission line is about 15% complete. It is estimated that all will be completed in 15-18 months. The USAID Office of Agriculture is conducting the due diligence necessary to evaluate the funding of the irrigation network which is at this stage only 12% developed. It is estimated that the irrigation component may take 2-3 years to complete.

A detailed feasibility study for the project was completed by Coyne et Bellier, France in 1983 and later revised in 1995. The main dam and water storage area was gifted by the 'Maliks' (elders) of South Waziristan to WAPDA free of cost where construction of the main dam is already near completion. The project is thus considered to have the support of local FATA elders.

1.3 Prior Environmental Reports & Description of Activities

In Pakistan the Water & Power Development Authority's (WAPDA) environmental unit is responsible for finalizing environmental reports. In some cases the feasibility study consultant also completes an EIA for the project. Under the Pakistan Environmental Protection Act no project involving construction activities or any change in the physical environment can commence unless the fulfillment of prerequisite to conduct an IEE or EIA and submittal of a report to the Federal or Provincial EPA. In case of Gomal Zam, Coyne-et-Bellier the feasibility

study consultant completed an EIA in 1995 and the study was included in the PC-1. Attached is a copy. The PC-1 was eventually approved in August 2001 by the Executive Committee of the National Economic Council (ECNEC) of Pakistan. Unfortunately, there was no GOP agency that approved the EIA. In response to USAID's concerns, WAPDA is presently preparing to obtain a No Objection Certificate from the Provincial Environmental Agency for the Project.

The construction of the project was discontinued in 2004 because of security reasons. A contract for the dam, including hydropower generation and the irrigation facilities just near the FATA boundary and the canal/distributaries was later awarded to the Frontier Works Authority (FWO) in 2007. The two sub-contractors are Sino`-Hydro which is responsible for the dam and hydropower component and Tekser is responsible for the irrigation component of the contract.

The main dam, hydropower plant and other associated works are at advanced stages of construction at about 87% complete. A 132 Kv double circuit 55 km transmission line from the dam site to the Tank grid station is being constructed by the Peshawar Electric Supply Company (PESCO), a subcontractor to WAPDA.

The progress of this project is summarized below:

No.	Description of Work	Completion Status (As of July 1, 2010)	Outstanding Works
1.	Dam and Power House (FWO/Sino-Hydro)	87.3%	12.7%
2.	132 kV Power Transmission Line	15.0 % (50% Advance paid to PESCO)	85.0 %

Based on the above the remaining construction activities at the project site, the following describe the construction activities remaining:

A. Civil Works/ Dam & Spillways

The outstanding work on the main dam, intake structure, intake tunnel and access roads are 87% complete and other major civil works are already completed. Presently only 8 meters of the dam height needs to be completed to reach its maximum height of 135 meters. The intake structure and the intake tunnel are complete except for installation of gates and some finishing works.

B. Power Generation House

Powerhouse Unit 1 and Unit 2 are at an advanced stage of construction at 87 % complete. All equipment is on-site and erection of the equipment is in progress. The

switchyard equipment is on site and is being installed. Testing and commissioning of both units is dependent on the impounding reservoir and level of water stored.

C. Transmission Line

The 55 km 132 kV transmission line from Gomal Zam to Tank is under construction and presently about 15% complete. The transmission line will be placed on towers constructed in an isolated barren area following existing main road right of way. However, no villages or homes are located close to the towers.

2.0 COUNTRY AND ENVIRONMENTAL INFORMATION (BASELINE INFORMATION)

Studies conducted by the Government and donor agencies[1,2,3] in Pakistan have highlighted a number of environmental issues. Broadly, the areas of concern identified include water, energy, pollution and waste management, irrigated agriculture, and biodiversity. Overall, these studies reveal deterioration in all these areas. The increasing pollution of water, air, and land continues to have an enormous impact on people's health, especially that of vulnerable groups such as children. The quality and quantity of renewable natural resources such as water, forests and other vegetation, and key biological habitats have declined. The Government, private sector, and civil society have not responded adequately to meet these challenges, although there have been some exceptions, such as the switchover to cleaner fuels in the transport subsector.

3.0 NATIONAL ENVIRONMENTAL LEGISLATION[4,5]

3.1 Pakistan Environmental Protection Act 1997

The Pakistan Environmental Protection Act, 1997 is the basic legislative tool empowering the government to frame regulations for the protection of the environment. This Act broadly applies to air, water, soil and noise pollution, as well as the handling of hazardous waste. Penalties have been prescribed for those who contravene the Act's provisions. The powers of the Federal and Provincial Environmental Protection Agencies (EPAs) were also considerably enhanced under this legislation and they have the power to conduct inquiries into possible breaches of environmental laws either of their own accord, or upon the registration of a complaint.

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[1] **Pakistan Infrastructure Implementation Capacity Assessment (PIICA)** World Bank Report No. 41630-PK at: http://siteresources.worldbank.org/SOUTHASIAEXT/Resources/Publications/448813-1202436185914/PIICfull.pdf

[2] **Pakistan Strategic Country Environmental Assessment (in two volumes)** World Bank Report No. 36946-PK at: http://siteresources.worldbank.org/SOUTHASIAEXT/Resources/Publications/448813-1188777211460/pakceavolume1.pdf and http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/SOUTHASIAEXT/0,,contentMDK:21459418

[3] **Pakistan's Water Economy Running Dry** at: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2008/06/25/000333037_20080625013311/Rendered/PDF/443750PUB0PK0W1Box0327398B01PUBLIC1.pdf

[4] http://www.environment.gov.pk/

[5] http://www.lexadin.nl/wlg/legis/nofr/oeur/lxwepak.htm

Under this Act, no project involving construction activities or any change in the physical environment can commence unless the fulfillment of prerequisite to conduct an IEE or EIA and submittal of a report to the Federal or Provincial EPA.

3.2 Pakistan Environmental Protection Agency (Review of IEE and EIA) Regulations 2000

The PEPA review of the 2000 IEE and EIA regulations (the 'regulations') provides the necessary details on the preparation, submission and review of the IEE and the EIA reports. The regulation classifies projects on the basis of expected degree of adverse environmental impacts and lists them in two separate schedules. Schedule-I lists projects that may not have significant environmental impacts and therefore require an IEE. Schedule-II lists projects of potentially significant environmental impacts requiring preparation of an EIA. However, it may be noted that this regulation does not have any other category for equipment procurement projects.

3.3 National Environmental Quality Standards (NEQS) 2000

First promulgated in 1993, the NEQS were last amended in 2000. These constitute the basic guidelines with which municipal and industrial origin liquid effluent and gaseous emissions must comply. These standards present the maximum allowable concentration for liquid effluent before its discharge into sea, inland water and sewage (total 32 parameters with which to comply) and gaseous emissions in the ambient air from industrial sources (total 16 parameters with which to comply).

4.0 EVALUATION OF PROJECT ISSUES WITH RESPECT TO ENVIRONMENTAL IMPACT POTENTIAL

All of the activities under Section 1.3 were identified and addressed by an Environmental Impact Assessment (EIA) finalized by Coyne-et-Bellier in 1995. The purpose was to evaluate any environmental impacts during the construction and operation phase of the project and to prepare a mitigation program to minimize adverse affects.

The content of the 1995 EIA was designed to meet the standard guidelines of the Pakistan Environmental Protection Agency (PEPA), the World Bank and the Asian Development Bank.

The Coyne-et-Bellier EIA report concluded the following:

(i) No major resettlement issues; as there is no inhabitation within the vicinity of the Dam, reservoir and power house.

(ii) No significant loss of any rare flora is foreseen since the dam is located in Rocky Mountains with no vegetation.

(iii) No significant reduction in fish production or population is expected. The dam could stop the migration of few species along the Zhob river e.g., Tor Putitora, Naziritor Zhobensis. However, due to large reservoir area the fish population is expected to increase. New fish species could be introduced and commercial fishing could be initiated.

(iv) Minor probability of land slide occurring within a 1.5 km radius of the dam site.

(v) No significant loss of any rare and endangered species as the dam is located in a barren area. Among endangered species, only population of the migrant bird Houbara Bustard could be affected due to destruction of some its habitat by irrigation system.

(vi) There will be a minor impact on natural fertilization of the downstream soil due to sediment patterns. This could be mitigated using a suitable fertilization program.

(vii) As far as socio-economic impacts of the projects are concerned, the most important affect will be saving of flood damages in the form of wastage of agricultural land, houses, livestock, infrastructure, roads and human lives (estimated annual damage ~ $2.6 million).

(viii) The erection of 55 km long 132 Kv transmission line will be build along existing road right-of-way with no significant impact on community since almost 90% of the route has neither any residential vicinity nor agricultural area. About 10% of the transmission line passes through thinly populated area where PESCO will ensure safe clearances as specified in WAPDA's standard rules and regulations to avoid any adverse impact on the living beings.

Overall 80% of the construction, dam and power house has been completed by the Frontier Works Organization (FWO), which was responsible for the safety and environmental standards during construction. FWO is supervised by consortium of consultants: National Development Consultants, Lahmeyer International, ECIL, EPSILON and BAK. The underground construction activities of the diversion tunnel, power tunnel and foundation works for the dam, roads, power house have been completed.

4.1 Environmental Assessment Guideline Reference Documentation

If required, provided below is a list of references for preparation of an Environmental Mitigation & Monitoring Plan (EMMP).

1. Environmental Guidelines for Small-Scale Activities: (http://www.usaid.gov/locations/latin_america_caribbean/environment/docs/epiq/epiq.html and http://www.encapafrica.org/egssaa.htm)
2. World Bank Environmental Assessment Handbook and Updates: (http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/ENVIRONMENT/EXTENVASS/0,,contentMDK:20282864~pagePK:148956~piPK:216618~theSitePK:407988,00.html)
3. World Bank Pollution Prevention and Abatement Handbook: (http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/p_ppah/$FILE/PPAH.pdf)
4. IFC Environmental, Health and Safety Guideline (http://www.ifc.org/ifcext/sustainability.nsf/Content/EnvironmentalGuidelines.)
5. ERBD Sub-Sectoral Environmental and Social Guidelines at: http://www.ebrd.com/about/policies/enviro/sectoral/
6. Environmental Handbook, German BMZ at: http://ces.iisc.ernet.in/energy/HC270799/HDL/ENV/enven/begin2.htm#Volume%20II:%20Agriculture,%20mining-energy,%20trade-industry http://ces.iisc.ernet.in/energy/HC270799/HDL/ENV/enven/begin1.htm#Volume%20I, http://ces.iisc.ernet.in/energy/HC270799/HDL/ENV/enven/begin2.htm#Volume%20II:%20Agriculture,%20mining-energy,%20trade-industry

5.0 RECOMMENDED THRESHOLD DECISIONS AND MITIGATION ACTIONS (INCLUDING MONITORING AND EVALUATION)

5.1 The ongoing construction activity will result in a *Negative Determination with Conditions* for completion of the Gomal Zam multipurpose project. The conditions will include the use of environmentally sound materials and safe construction practices, monitoring and evaluation, and preparation of specific Environmental Mitigation and Monitoring Plan for the Activity. The Bureau Environmental Officer/ Asia will have to approve this IEE. Furthermore, obligations will not occur until the EMMP is approved by the. Bureau Environmental Officer/ Asia.

5.2 USAID/Pakistan is hiring an environmental consulting firm to conduct the following tasks that have been approved by the MEO/DMEO.

a. Review the environmental reports for Gomal Zam Dam, and prepare a summary for each project of the environmental issues, positive or negative impacts and proposed mitigations & monitoring (in tabular form) for the scope of activities under both projects in their area of influence. Highlight any changes in the environmental conditions & issues since the existing (original) reports and start-up of construction.

b. Describe the areas as they currently exist with the ongoing construction of the dam, hydro-power plant, transmission line in Gomal Zam dam area of influence., This task will require onsite assessment in the field and should cover different areas impacting the environment such as physical, biological, climate, water resources, geology and socio-economic. Construction and operation practices, on-going supervision as well as implementation of environmental mitigation and monitoring measures (and Contractor's capabilities) as proposed in the original IEE/EA shall be reviewed and documented. Determine the significance of existing and potential adverse environmental and social impacts due to construction and operation of the dams and associated infrastructure, and update or develop an Environmental Monitoring and Mitigation Plan (EMMP.).

c. Review the comments of USAID Environmental Officers and address all concerns.

d. For the remaining scope of work on both Satpara and Gomal Zam dams to be implemented under USG funding, conduct a quick environmental analysis and develop a single/integrated comprehensive and detailed Gomal Zam dam EMMP with budget and responsibilities that should comply with GOP and USAID/USG environmental regulations and best international practice.

5.3 The following table presents the summary of activities, environmental impacts and recommended threshold decisions.

5.3 Summary of recommended threshold decisions.

Activities	Environmental Impact	Recommended Determination
Completion of civil works for dam and spillway	Minor to Moderate. 87% construction has been completed	**Negative Determination with Conditions** per 22 CFR 216.3 (a) (2) (iii), the Conditions (with reference to the Pakistani laws and guidance in1-6 under Section 4) being use of environmentally sound materials, monitoring and evaluation (M&E), and good international industry practices acceptable to USAID. An EMMP shall be prepared which will elaborate environmentally safe and waste management and ensure compliance with all OHS requirements acceptable to USAID. EMMP will be approved by the BEO/Asia.
Construction of 17.4 MW power house	Minor to Moderate. 87% of the work has been completed	**Negative Determination with Conditions** per 22 CFR 216.3 (a) (2) (iii), the Conditions (with reference to the Pakistani laws and guidance in1-6 under Section 4) being use of environmentally sound materials, monitoring and evaluation (M&E), and good international industry practices acceptable to USAID. An EMMP shall be prepared which will elaborate environmentally safe and waste management and ensure compliance with all OHS requirements acceptable to USAID. EMMP will be approved by the BEO/Asia .
Construction of a 132	Minor to moderate.	**Negative Determination**

KV transmission line	About 15% of the work has been completed.	**with Conditions** per 22 CFR 216.3 (a) (2) (iii), the Conditions (with reference to the Pakistani laws and guidance in1-6 under Section 4) being use of environmentally sound materials, monitoring and evaluation (M&E), and good international industry practices acceptable to USAID. An EMMP shall be prepared which will elaborate environmentally safe and waste management and ensure compliance with all OHS requirements acceptable to USAID. EMMP will be approved by the BEO/Asia

5.3 Limitations

This assistance doesn't cover activities involving:

1. Assistance, procurement or use of pesticides and of genetically modified organisms (GMOs).

2. DCA or GDA programs.

3. Procurement or use of Asbestos Containing Materials (ACM) or other toxic/hazardous materials prohibited by US EPA as provided at: http://www.epa.gov/asbestos and/or under international environmental agreements and conventions, e.g. Stockholm Convention on Persistent Organic Pollutants as provided at: http://chm.pops.int.
4. Assistance for the procurement, use or recommendation for use of pesticides.

5.4

Revisions

In accordance with 22 CFR 216.3(a) (9), if new information becomes available which indicates that activities to be funded by the Program might be "major" and the Program's effect "significant," the Negative Determination will be reviewed and revised by the originator of the project and submitted through the MEO to the BEO/Asia for approval and, if appropriate, an environmental assessment will be prepared.

Confidential information redacted

Confidential information redacted

Confidential information redacted

Confidential information redacted

Appendix D: Review of Existing EIA

This document presents the interim report against the Task 1 of the environmental assessment of the Gomal Zam Dam Multipurpose Project, and covers: i) review of the existing Environmental Impact Assessment (EIA) report; ii) description of any changes in environmental issues since the preparation of the EIA report in 1995; and iii) summary of the project's positive and negative impacts and the proposed mitigation and monitoring measures.

Review of Existing EIA Report

The EIA study of the project was carried out by Coyne et Bellier of France in 1995. This was essentially a first phase EIA study, and as stated in its report itself, "is not intended to fulfill the requirements of the complete EIA. The latter will be issued after the second (and final) phase of the environmental studies will have been performed during detailed design stage." However, the second phase EIA was never carried out. Various aspects of the report are discussed below.

Project Purpose: The project purpose is adequately described in this section, and the following aspects are discussed in this regard:

- Social and Economic Context
- The National Development Policy
- Purpose of Gomal Zam Project

Project Alternatives: In this section, two alternatives have been briefly discussed to provide additional irrigation water in the command area in general. This section however does not discuss any siting, technological, technical, procedural, or scheduling alternatives of the Gomal Zam project itself, which is an essential part of an EIA.

Project Description: This section describes various components of the project, provides salient features and technical details of each of them. Description of each component is elaborated with the help of maps and diagrams. The reservoir operation characteristics are also discussed in this section. The following key components are covered in this section:

- Project Location

  The project location is described and also elaborated with the help of area map.

- Structural components of dam

  These include the following specific components/aspects:

  - Dam and reservoir
  - Spillway, bottom outlet and sluice gates
  - Cofferdams and water diversion works
  - Power house and its waterways
  - Reservoir operation characteristics
- Structural components of irrigation system
  - Command area
  - Diversion barrage
  - Irrigation system and drainage works
  - Flood control structures
- Borrow areas
- Project facilities
- Implementation schedule and project costs.

Baseline Description. The existing EIA report provides description of the baseline conditions for which several separate studies were commissioned as part of the first phase EIA. The following aspects of the environment and socioeconomic aspects are covered under the baseline:

- Physical environment

  Separate studies have been carried out for the key environmental aspects of the project area (catchment, reservoir, dam site, and command area), and summary of findings presented in the EIA main volume. The following aspects are covered under the physical environment:

  - Climatology
  - Hydrology
  - Erodability of watershed area
  - Geology of reservoir area
  - Soils of command area
- Biological environment

  For biological resources also, separate studies has been carried out as part of the EIA. The following aspects are covered under these studies:

  - flora
  - fauna
  - protected areas
- Socioeconomic aspects

  A comprehensive socioeconomic study has been carried out in the project area during the EIA of the Gomal Zam project. The following specific aspects have been covered under this study:

  - administrative setup
  - population
  - community infrastructure and services
  - Economic activities
  - health
  - cultural resources
  - flood damages
  - attitudes and wishes of the people regarding the project.

The above baseline description has been amply augmented with maps covering different parts and aspects of the project area.

Impact Assessment. The existing EIA report also covers the preliminary impact assessment and their proposed mitigation measures associated with the design aspects of the project. The following aspects are covered under this preliminary impact assessment:

- Physical environment
  - Climatology
  - Hydrology
  - Geology of reservoir area
  - Reservoir siltation
  - Erosion of riverbed downstream of dam
  - Soils of command area
- Biological environment
  - Flora
  - Fauna

- Socioeconomic environment
  - Command area
  - Reservoir area

Recommendations for full EIA. The report recommends the aspects that need to be covered in the second phase EIA study. These include the following:

- Physical environment
  - Geodynamic features of the reservoir area
  - Erosion in the watershed
  - Erosion in the river bed downstream of the dam site
  - Salinity and sodicity of the soils in command area.
  - Water quality
- Biological environment
  - Flora
  - Fauna
- Socioeconomic environment
  - Socioeconomic aspects of the command area
  - Socioeconomic aspects of the reservoir region
  - Archeological aspects

However, the full EIA was never carried out, and no baseline studies or impact assessment were carried out for the aspects listed above.

Major Gaps in EIA. Several key aspects were not included in the existing EIA report, probably to be included in the second phase (and formal) EIA. The key deficiencies of the existing EIA report are listed below.

- The project description is not complete, and no details are provided for the construction activities, contractors' facilities or their machinery, equipment, or manpower, type and quantities of different materials and supplies, vehicular traffic, temporary facilities, type and quantity of wastes and their disposal arrangements. Similarly for the operation and maintenance (O&M) phase, no information is provided such as: offices and residences; type and quantity of different and materials; waste management arrangements; vehicular traffic; and manpower requirements.

- The description of policy, legal; and regulatory framework relevant to the environmental and social aspects of the project is not complete.
- Discussion of the project alternatives and their environmental implications is missing.
- Assessment of impacts caused by the construction activities, and the associated mitigation measures is missing.
- No environmental mitigation and monitoring plan (EMMP) is provided that would summarize the environmental impacts and mitigation measures, institutional arrangements, roles and responsibilities, environmental monitoring requirements, documentation and reporting protocol, environmental training needs, environmental management costs, and other necessary details.

On the basis of the above shortcomings/gaps, the existing EIA does not meet the national legal/regulatory requirements nor does it meet the international standards.

Major Changes in the Area

The only changes which have been identified in the project area during the site visit as part of the current assignment are associated with the project's temporary as well as permanent facilities. These include:

- Contractors' site facilities including offices, workshop, warehouse, temporary power house (diesel generators to provide power for the construction activities and site facilities), batching plant, stone crushers, residences, and associated facilities.
- Contamination of soil and water caused by improper waste disposal (work shop, temporary power house, offices, and residences). Most of the sewage from the temporary facility is discharged into the river through buried pipes as well as open channels, without adequate treatment. This not only contaminates the soil, but also the river water (the sewage is released in the river upstream of the water intake for the construction works and temporary facilities). Similarly, there exists no proper system at the temporary power house and its diesel storage to capture the leaked/spilled diesel and oils. As a result, soil has been contaminated with diesel/oils at and around these facilities. In addition, no proper system exists at the site for the collection and disposal of solid waste. Mostly, the solid waste is dumped openly, or thrown in the ravines and river.

- Permanent works, including dam itself, power house, and associated facilities/structures.

Most of the temporary facilities will be removed at the end of the construction phase. Appropriate site restoration will need to be carried out once these facilities are removed – this aspect will be included in the EMMP.

The soil contamination caused by improper sewage disposal and diesel/oil handling will need to be cleaned. This activity can be undertaken as soon as appropriate sewage treatment and disposal system, as well as appropriate oil/diesel handling/storage arrangements are made at the site.

In addition to the above, the project-related traffic may have deteriorated the condition of the road which passes through the project area, and links the dam site with Tank and D. I. Khan. Currently, this road is in very bad condition, and it can be argued that the project-related traffic is one of the main reasons for its current state, though the pre-project road condition is not known.

Summary of the project's impacts and associated mitigation and monitoring requirements

The summary of the project's impacts on various environmental and social parameters, and associated mitigation and monitoring requirements are provided in **Table 1**. These include the impacts discussed in the existing EIA report. Other potential impacts which are not covered in the existing EIA will be included in the EMMP, which will be developed under the Task 4 of the present assignment.

Table 1: Impacts and Mitigation (as reported in existing EIA)

Gomal Zam Dam Multipurpose Project

Aspects/Impacts	Mitigation	Monitoring
Positive Impacts Reduction of floods frequency in Gomal River/Gomal Zam	-	The reservoir inlet and water release data from the dam to be recorded.
Regulated supply of irrigation water from the reservoir, and hence increased cultivation in the	Capacity building and awareness raising of farmers on efficient irrigation techniques; appropriate use of fertilizers and pesticides; promotion of organic farming	-

Aspects/Impacts	Mitigation	Monitoring
command area.	practices; protection against water logging and soil salinity.	
Electricity generation from the project	Availability of electricity to the local population; spending a portion of the proceeds from the electricity generation on the area development.	
Negative Impacts		
Land slides in reservoir area	Keep the water level in the reservoir lower than the left bank saddle (for details, please refer to Section 2.1 of Annex D, EIA report of the project)	The land slides need to be monitored during the initial filling of the reservoir and afterwards.
Soil erosion and siltation in reservoir, thus reducing the reservoir capacity	Flushing sediments through the dam; further studies to determine the extent of soil erosion in the catchment area, and to identify remedial measures; develop and implement watershed management plan (plantation, controlled grazing, others)	Monitor the reservoir siltation and silt releases from the dam; Monitor the implementation and effectiveness of the watershed management plan.
Erosion of riverbed downstream of dam (caused by release of silt-free water from reservoir)	Reinforcement of bridges, culverts, and other structures where needed	Monitor the river bed erosion, particularly near the bridges, culverts and other structures.
Decreased soil fertility because of decreased silt in irrigation water	Use of fertilizer by the growers. Encourage using organic farming techniques. Capacity building and awareness raising needed.	Monitor the soil fertility and fertilizer usage practice in the command area.
Increased soil salinity	Use appropriate cultivation practices such as over irrigation and pre-sowing flooding for non- or slightly-saline soils. Capacity building of growers. Reclamation of coarse to	Monitor soil salinity for different soil types; monitor cultivation practices

Aspects/Impacts	Mitigation	Monitoring
	medium textured saline soils. Carry out further studies for saline, moderately fine to fine soils.	
Loss of natural vegetation in the project area	Re-plantation with local species; use salt resistant species for the saline areas; prepare re-plantation plan.	Monitor the implementation and effectiveness of the re-plantation.
Habitat destruction	Conduct field investigations for houbara bustard.	-
Increased fish population in reservoir	Planned and controlled introduction of appropriate species.	-
Increased risk of diseases caused by vectors such as mosquitoes	Use of approved and non-toxic insecticides.	Monitor the vector breeding; monitor the disease incidence/outbreak and key health parameters of the population.
Conflicts caused by unavailability of irrigation water to some communities in the area	Agreements between different communities/tribes. Uniform development of the area.	-
Influx of people in the area, potentially causing conflicts	Agreements between different communities/tribes.	-
Loss of grazing area because of reservoir impounding	Payment of Qaumi commission; controlled grazing near the reservoir rim; seeding for grasses as part of watershed management; rural development (social and physical infrastructure) in the area based upon the needs and preferences of the local population.	Monitor the negative impacts on the local herders/others.

Appendix E: Site Photographs

Reservoir Area

On-Going Construction Works on Gomal Zam Dam

Gomal Zam Dam

Powerhouse

On-Site Consultations with Project Staff

Natural Vegetation in Project Area

A Nomad (Pawinda) Family in Project Area

Drinking Water Supply Tank Downstream of Gomal Zam Dam

Waste Water Discharge

132 KV Grid Station at Tank District

www.ep-ep.com.pk
info@ep-ep.com.pk