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RAPID ENVIRONMENT ANALYSIS AND EMMP

SATPARA MULTIPURPOSE DAM PROJECT

November 2010

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USAID ENERGY POLICY PROGRAM

RAPID ENVIRONMENT ANALYSIS AND EMMP

SATPARA MULTIPURPOSE DAM PROJECT

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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 Satpara Dam Project, being constructed by the Government of Pakistan, near Skardu, about 300 km northeast of Islamabad, capital of Pakistan. This analysis is one of the several evaluations the United States Government (USG) is due diligently carrying out for the Project through the United States Agency for International Development (USAID), 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 with the help of a field visit and prepare an environmental mitigation and monitoring plan (EMMP) for: i) remaining construction works at the dam site and irrigation canals; ii) construction of the remaining two powerhouses; and iii) operation and maintenance (O&M) of these facilities.

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

Project Overview

Objectives of the Satpara Dam Project include supplying irrigation water to about 15,000 acres of land, protecting from floods, generating 13.2 MW of electricity, and supplying water to Skardu and its surroundings for the domestic needs. The Project comprises an earth fill dam, four powerhouses along with their ancillary structures, and two irrigation canals.

The dam is being constructed on the existing Satpara Lake, which stores Satpara nullah water, and supplies water for some small scale irrigation in and around Skardu town. The Satpara nullah originates from the Deosai plain, which is located south of the Lake.

The Project is at an advanced stage of completion: the construction works on the dam are about 93% complete, whereas the works at the irrigation canals are about 77% complete. Two of the powerhouses have been completed and are in operation; the construction on remaining two powerhouses has yet to commence.

The Project components being considered for the USG funding comprise the dam, the remaining two powerhouses, and the irrigation system.

An Initial Environmental Examination (IEE) of the Project was carried out in 2002, however it was not submitted to the Environmental Protection Agency (EPA) for their review and approval, as required by the law.

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, any project situated in environmentally sensitive areas – such as wildlife sanctuaries and national parks - requires an EIA to be carried out prior to its construction. The Satpara Lake has been notified as a wildlife sanctuary, hence an EIA should have been conducted for the Satpara Dam Project, and its report should have been submitted to the Gilgit Baltistan (GB) EPA, for review and approval.

Description of Environment

The Project Area is located in a predominantly high altitude land. The region is characterized by a pattern of high and steep hills, which are generally high towards south, closer to Deosai Plains. General elevation of the land gradually increase towards north of Skardu city. Altitude in the area ranges from 2,300 to 4,300 m above mean sea level (amsl). Abundant glacier deposits overlie in the valley, and intense avalanches/weathering has taken place in the area, which has left terraces in valley.

The Satpara nullah originates from the Deosai Plains, and has a width ranging form 50 m to 100 m. The nullah drops about 500 m within the project area. The nullah is quite noisy due to collision of flow over the boulders and sudden rapid falls. The local people have intensively planted the area using nullah water.

The total catchment area (area of influence) of the Satpara nullah is about 274 km^2. The average annual flow recorded at Satpara gauging station is about 5.602 m^3/s (198 ft^3/s or cusecs) and highest flow recorded is about 38.50 m^3/s (1,360 cusecs), on 22 June 1988.[1] The mean annual runoff at the dam site is about 120.6 x 10^6 m^3 (97,730 acre-feet).

The project area remains under the influences of severe cold during winter season. The rainfall is scarce and monsoon cannot cross the high Himalayan Mountains. Situated in the western most arm of Himalayan range, Satpara is located within semi arid and rugged mountain landscape (mountain desert). This whole region lies in a rain shadow area, with average annual precipitation less than 200 mm, but rising with the elevation to create a moist environment at the extensive high altitude range lands.

Project area is spread over two settlements namely Skardu valley and Satpara, consisting of several villages. These villages are located along the Satpara nullah upstream and downstream of the Lake. About 90% of the population depends upon farming, and about 14,700 ha of land is under cultivation in these communities.

The project area is inhabited by people from two different ethnic/linguistic compositions having distinct socio-cultural traditions, language and way of life. The upper part of the Satpara nullah is dominated by Shina speaking people, while the lower part of the valley is in habited by Balti speaking people.

Potential Impacts and Mitigation

The key environmental and social issues relating to the Project location and design include: i) land sliding and soil erosion and hence siltation in the reservoir; ii) erosion of nullah bed downstream of dam; iii) decreased soil fertility in the command area (area of influence) caused by irrigation with the silt-free water; iv) consequences of dam collapse; v) modified water flow regime after the construction of dam; vi) Project being located inside a wildlife sanctuary; 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) undertaking slope stabilization, watershed management and afforestation measures to address land sliding and reservoir siltation; ii) monitoring and repair of structures, bridges and culverts across the Satpara nullah to address the nullah bed erosion

[1] During June 2010, the maximum inflow in the Satpara Lake was recorded as 56.07 m^3/s (1,980 cusecs), according to the data provided by WAPDA.

downstream of the dam; iii) rational use of fertilizers to compensate decreased soil fertility; iv) preparing the wildlife sanctuary management plan; 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 potential adverse impacts such as reservoir induced seismicity, 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 will be adequately addressed by implementing EMMP, adopting appropriate environment, health, and safety guidelines, and following the relevant standards as well as international best practice.

Environmental Mitigation and Monitoring Plan

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

The cost of EMMP implementation has been estimated to be Rs. 240.81 million (about US$ 2.83 million)[2]. This includes about Rs. 212.53 million as land/assets compensation cost of which about Rs. 149 million has already been paid; Rs.20.20 million as one-time cost primarily for undertaking various environmental and social studies identified during the present assignment; and

[2] 1 US$ = Pak Rs. 85.

Rs. 8.08 million as annually recurring costs for environmental and social mitigation and monitoring. However, these estimates do not include some of the other costs such as implementing the watershed management and afforstation plan, since these costs are not known at this stage.

List of Acronyms

AEAI	Advanced Engineering Associates International
Amsl	Above mean sea level
AKRSP	Aga Khan Rural Support Program
BOD	Biological oxygen demand
DISCOs	(Electricity) Distribution companies
ECA	Employment of Child Act
EHS	Environment, Health, and Safety
EIA	Environmental Impact Assessment
EMMP	Environmental Management and Monitoring Plan
EPA	Environmental Protection Agency
ERP	Emergency response plan
GB	Gilgit Baltistan
GDI	Gender and Development Index
GoP	Government of Pakistan
GRAPs	gender reform action plans
GRM	Grievance redressal mechanism
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
MMR	Maternal mortality rate
MSDS	Material safety data sheet
NAPWD	Northern Areas Public Works Department
NATCO	Northern Areas Transport Corporation
NCSW	National Commission on the Status of Women
NEQS	National Environmental Quality Standards
NOC	No Objection Certificate
NORAD	Norwegian Agency for Development Cooperation
OP	Operational Policy
O&M	Operation and Maintenance
Pak-EPA	Pakistan Environmental Protection Agency
PCB	Poly chlorinated biphenyl
PEPC	Pakistan Environmental Protection Council
PM	Particulate matter
POPs	Persistent organic pollutants
PRSP	Poverty Reduction Strategy Paper
RCC	Roller compacted concrete
SC	Supervision Consultants

SDC	Satpara Dam Consultants
SOPs	Standards operating procedures
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
1 liter	0.21997 gallons (UK); 0.26417 gallons (US)

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1. Introduction

This document presents the result of rapid environmental and social analysis, and also provides the Environmental Mitigation and Monitoring Plan (EMMP) of the Satpara Dam Project, which is being constructed in Gilgit Baltistan (GB) by the Government of Pakistan, about 6 km south of Skardu, which is located about 300 km northeast of Islamabad, the capital of Pakistan (see **Figure 1.1** for Project location map). 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 Satpara Dam Project. To evaluate the environmental and social aspects of the Project and to develop an EMMP, USAID, through its contractors - Advanced Engineering Associates International (AEAI) - has commissioned the present study.

1.1. Background

In 1988, the Pakistan Water and Power Development Authority (WAPDA) conducted the feasibility study of the Satpara Dam Project, in which a 12.2 m (40 ft) high dam was proposed at the Satpara Lake, to supply water for irrigation and domestic purposes, and to generate 1.5 mega watts (MW) of electricity. In 2002, WAPDA revised the design for a 39 m (128 ft) high dam downstream of the original location. In 2003, WAPDA commenced the construction works on the Project; which is now in the final stage of completion.

An Initial Environmental Examination (IEE) of the Project was conducted by WAPDA in 2002. However this IEE was not submitted to the Environmental Protection Agency (EPA) for their review and approval. Hence the 'No Objection Certificate' (NOC) was not issued by the EPA for the Project.

No environmental management or monitoring is being carried out at the construction sites, and the IEE report is not available at the site to guide the supervision consultants and contractors to appropriately address the environmental concerns associated with 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 Satpara Dam Project; analysis of the Gomal Zam Multipurpose Project is presented under a separate cover.

1.2. Objective and Scope of Assignment

Objectives of the present assignment are to:

- review the IEE report prepared by WAPDA in 2002;
- determine any changes in the environmental and social conditions caused by the construction works with the help of the field visit;
- carry out a rapid environmental and social analysis; and
- prepare an environmental mitigation and monitoring plan (EMMP) for:
  - remaining construction works at the dam site and irrigation canals
  - construction of the remaining two powerhouses
  - operation and maintenance (O&M) of the Project.

Though the present analysis covers the irrigation canals, a separate environmental assessment will be carried out for the irrigation system in command area of the Project.

During the present study, the Project IEE report prepared by WAPDA in 2002 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 WAPDA IEE report. The terms of reference (ToRs) of the present assignment are reproduced 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 Satpara Dam Project are to provide irrigation water, to protect from floods, to generate electricity, and to supply water for domestic needs. The Project comprises an earth-filled dam at the Satpara Lake, four separate powerhouses, and two irrigation canals.

The Project is located 6 km south of Skardu, which is one of the districts of Gilgit-Baltistan (GB) – a self-governed region of Pakistan. The Project aims to provide irrigation water to about 6,070 hectares (ha) (15,000 acres) of land, supply 14 million liters (3.1 million gallons) of water for domestic needs, and generate 13.2 MW of electricity.

The key components of the Project include a 39 m (128 ft) high earth-filled dam across the Satpara lake, outlet structure, spillway, intake weir, a 17.68 km long right bank irrigation canal, a 15.83 km long left bank irrigation canal, and four powerhouses having a combined generation capacity of 17.66 MW and producing about 106 giga watt hours (GWh) of electricity annually.

The Project is in an advanced stage of completion: the construction works on the dam are about 93% complete, whereas the works at the irrigation canals are about 77% complete. Two of the powerhouses have been completed and are in operation; the construction on remaining two powerhouses has yet to commence.

Further details of the Project and its components are provided later in the document.

Scope of Activities Proposed for USG Funding

The Project components being considered for the USG funding include the dam, the remaining two powerhouses, and the irrigation network.

1.4. Review of the Past Environmental Assessment

The IEE study of the project was conducted by WAPDA's Environmental Cell in 2002. The IEE report has been thoroughly reviewed as part of the present assignment. Generally, the report is very sketchy, does not provide complete project information, and assesses the project impacts in a very superficial manner.

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

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[3] Sources: WAPDA 2002; *Initial Environmental Examination – Satpara Dam Project*. WAPDA 2010; *Satpara Dam Project – Presentation to USAID/AEAI*.

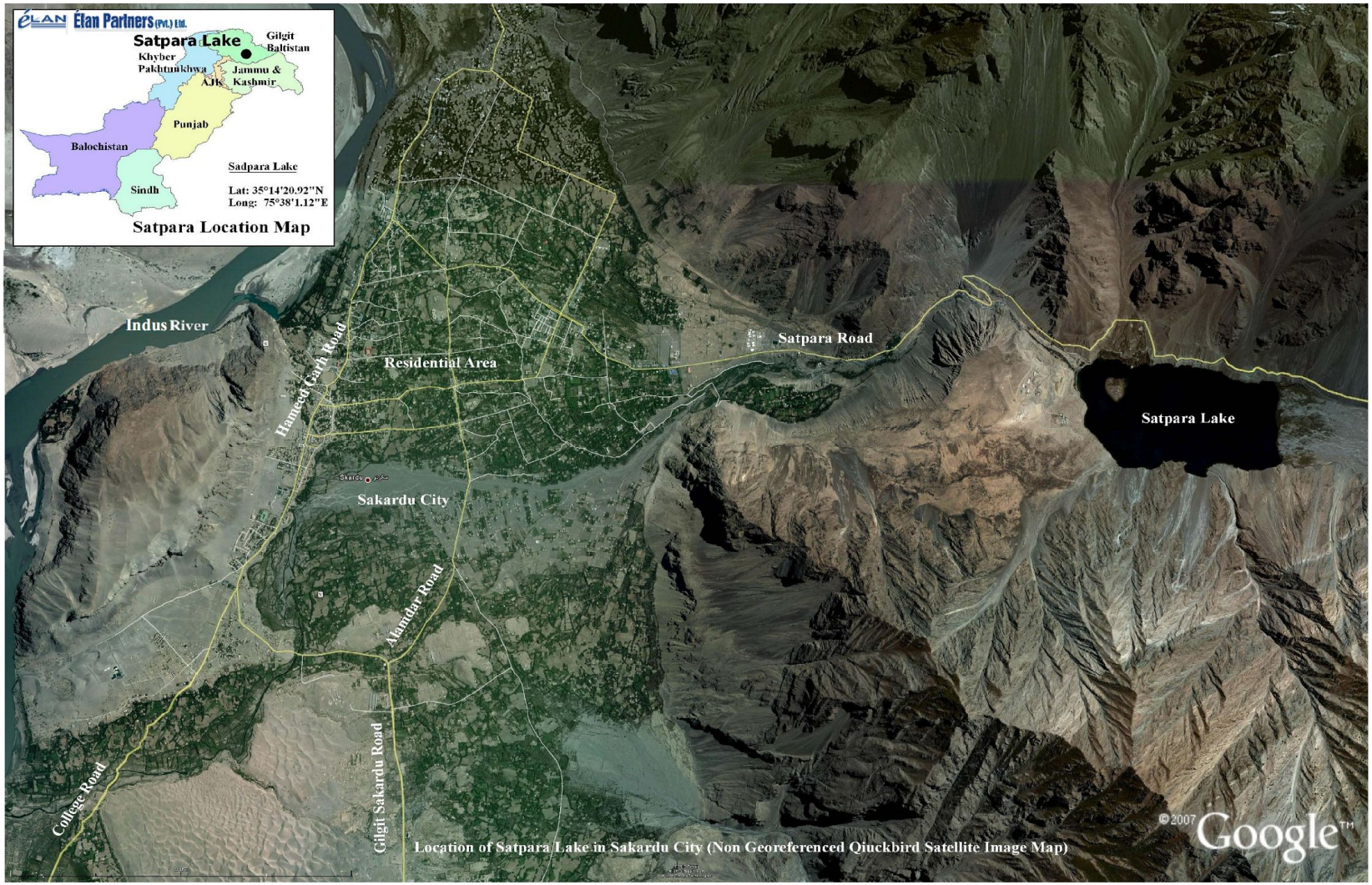
- The IEE methodology and scope have not been provided.
- The project description is not complete, no details are provided for various project components. Furthermore, no details are provided for the construction activities, contractors' facilities or their machinery, equipment, or manpower, type and 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 materials; waste management arrangements; vehicular traffic; and manpower requirements. Most importantly, it does not capture the exact nature of project and sequence of activities.
- 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.
- Environmental baseline description is not site specific. Most of the information is either for Gilgit-Baltistan in general, or specific to Deosai, which is about 10-15 km south of the site. Condition of the watershed area (area of influence) of the lake has not been discussed adequately.
- No record and outcome of stakeholder consultations has been provided.
- Impact assessment and mitigation sections discuss most of the potential impacts, however, impact characterization has not been carried out, nor the significance of the identified impacts determined. Several potential impacts, such as those related to vehicular traffic, mobilization/demobilization of contractors, camp establishment and its operation have not been discussed in the section.
- Resettlement aspects have not been discussed adequately. No procedure is specified to implement the resettlement actions.
- Proper environmental mitigation and monitoring plan (EMMP) has not been provided. Some aspects of the EMMP are covered (such as monitoring plan), however, other key aspects, such as institutional arrangements, roles and responsibilities, environmental trainings, reporting and documentation requirements have not been specified.

On the basis of the above shortcomings/gaps, and the fact that the Satpara Lake is a wildlife sanctuary, the existing IEE does not comply with the national legal/regulatory requirements nor does it meet the USAID environmental compliance procedures.

1.5. Document Structure

The present document has five additional Chapters. **Chapter 2** describes 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 covered in **Chapter 3**. **Chapter 4** presents the baseline conditions of the Project area's physical, biological, and socioeconomic environmental – as recorded during IEE study carried out by WAPDA in 2002; in addition to providing an overview of the key changes in these conditions identified during the reconnaissance field visit as part of the current assignment. Rapid environmental and social assessment of the Project carried out during the present assignment is discussed in **Chapter 5**. **Chapter 6** provides 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



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)[4] 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

[4] GoP 1997. *Act No. XXXIV OF 1997; the Pakistan Environmental Protection Act, 1997.* Government of Pakistan. December 1997

Protection Ordinance 1983,[5] have also been considerably enhanced under this 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, an IEE had to be carried out for the Project on account of the size of reservoir, powerhouse, and command area. However, any project situated in environmentally sensitive areas requires an EIA to be carried out prior to its construction. The Guidelines for Sensitive and Critical Areas (GoP 1997) define wildlife sanctuaries and national parks as the sensitive and critical areas. The Satpara Lake has been notified as a wildlife sanctuary, hence an EIA should have been conducted for the Satpara Dam Project.

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5 Superseded by the Pakistan Environmental Protection Act, 1997.

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

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/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. 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.

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

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.

2.1.5. Canal and Drainage Ordinance, 1873

The Canal and Drainage Act, 1873 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. This Act will be applicable to the irrigation system being established under the Project.

2.1.6. 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. As mentioned in **Section 2.1.2** above, the Satpara Lake has been notified as a wildlife sanctuary, a fact that has not been considered while conducting the Project IEE in 2002. This Act defines several restrictions on the activities that can be carried out in a wildlife sanctuary. This aspect is further discussed later in the document.

2.1.7. 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 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.

2.1.8. 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.

2.1.9. 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.

2.1.10. 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.

2.1.11. 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.

2.1.12. 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.

2.2. 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 Satpara Dam 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

[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.

that reaches out to all major stakeholders and ensures that their concerns are incorporated in any impact assessment study.

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 Satpara Dam 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

[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.

- 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.
- 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 GB EPA is the relevant environmental authority for the Satpara Dam Project.

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) up to 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) up to 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 $CaCO_3$	< 500 mg/l
TDS	‹ 1000
pH	6.5 – 8.5
Chemical	
Essential Inorganic	***mg/Liter***
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/liter***
Cyanide (CN)	≤0.05
Fluoride (F)*	≤1.5
Lead (Pb)	≤0.05
Manganese (Mn)	≤ 0.5
Mercury (Hg)	≤0.001
Nickel (Ni)	≤0.02

[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
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 history of Satpara Lake dates back to 1880, when the local Raja, Ali Sher, constructed a small dam across the Satpara nullah, for meeting the irrigation and domestic water needs of the downstream communities. The dam was breeched in later years. In 1976, the Government carried out some studies at the Lake, and also completed the construction of the old breached dam.

In 1988, WAPDA completed field investigations and prepared a detailed feasibility study of the multipurpose Satpara Dam Project downstream of the Satpara Lake. The proposal comprised an earth-filled dam, 12.2 m (40 ft) high and 384 m (1,260 ft) long; a spillway with a design capacity of 283 m^3/s (10,000 cubic feet per second or cusecs) containing ten gates; an outlet structure with a capacity of 3 m^3/s (105 cusecs); and a powerhouse with a capacity of 1.5 MW. Having a reservoir capacity of about 20.8 x 10^6 m^3 (16,900 acre-feet – AF), the Project envisaged providing irrigation water to about 4,100 ha (10,130 acres) of land, in addition to supplying 14 million liters (3.1 million gallons) of drinking water to the Skardu city and nearby communities on a daily basis.

In 2001, through a Cabinet decision, the Government included the Project in the WAPDA Vision 2025, and subsequently in 2002 WAPDA revised the feasibility of the Project for a 39 m (128 ft) high dam, and also prepared the PC-I.[15] In November 2002, WAPDA appointed the Satpara Dam Consultants (SDC) for the design review and construction supervision of the Project. The SDC is a consortium of six consulting firms: Pakistan Engineering Services, Mot Macdonald Pakistan, Mirza Associates Engineering Services, Zahiruddin Consultants, In-Consult, and Technica International. Coyne et Bellier is the Project Advisor.

The construction works on the Project were started in 2003, and various components are in different stage of completion. The construction works on the dam are about 93% complete, whereas the works at the irrigation canals are about 77% complete. Two of the powerhouses have been completed and

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[14] The Project description in this Chapter has been taken from: 1) WAPDA 1988; *Feasibility Report - Satpara Dam Multipurpose Project.* 2) WAPDA 2002; *Initial Environmental Examination – Satpara Dam Project*. 3) WAPDA 2010; *Satpara Dam Project - Presentation to USAID/AEAI*.

[15] 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.

are in operation since 2007/08; the construction on remaining two powerhouses has yet to commence.

3.2. Project Justification

The economy of Skardu area is largely based on agriculture. Since most of the arable land is 15 to 50 m above the level of Indus River, obtaining irrigation water from this source is not feasible. The present irrigation water in and around Skardu is derived from the Satpara nullah, which is a perennial stream, and some other semi- or non-perennial streams, flowing down the Deosai plain, discharge of which mainly comes from snow melt run-off. This irrigation water supply falls short of requirements primarily because the spring snow melt does not begin until after the time the irrigation water is needed for sowing. Furthermore, as much as half of the water in the canals is lost through leakage and seepage, since the canals are aligned in areas with porous materials. Water is also lost by improper regulation of the canals. All these factors result in the inadequacy of irrigation water supply and consequential low crop yields.

Before the commencement of the Project, two small hydroelectric powerhouses having a total capacity of 1.2 MW were functioning on Satpara nullah, providing electricity to Skardu town. Due to the shortage of water in the Satpara nullah, generally from mid November to mid April, these powerhouses used to run far below their installed capacity, and the shortage used to be met with the help of diesel generators and load shedding. Furthermore, many households within Skardu town, and many villages in its surrounding did not have electricity connections, primarily because of the electricity shortage. These households used to be dependent upon kerosene and fuel wood for their cooking, heating and lighting purposes.

Only about half of the Skardu town population used to be provided with potable water. People in the villages used to store water from the water courses in their underground earthen tanks for the winters. Due to the protected water rights of certain communities, during winters/low water availability, obtaining additional water from the nullah could not be obtained.

The Satpara Dam project would provide regulated irrigation water supplies through lined canals, generate additional electricity, and also provide water to the downstream communities for the domestic purposes – thus addressing all of the above-described problems being faced by the local population.

3.3. Project Objectives

The key objectives of the Project comprise improved water regulation, water supply for irrigation, water supply for domestic needs, and power generation.

The water flow regulation in the Satpara nullah downstream of the Dam will be greatly improved, and the area will be protected against low flows as well as floods causing damage to life and property, as well as soil erosion.

The Project will store up to 115 x 10^6 m^3 (93,310 acre feet - a-f) of water in the reservoir, and will provide 3.8 m^3/s (135 cusecs) of irrigation water in the left bank canal, and 1.5 m^3/s (52 cusecs) in the right bank canal – to irrigate more than 6,000 ha (15,000 acres) of arable land downstream of the Dam.

The Project will supply up to 14 million liters (3.1 million gallons) of water per day to the Skardu town and its surroundings for the domestic needs.

The Project will generate about 13.2 MW of electricity, producing about 105.77 giga watt hours (GWh) of electricity annually – to be provided to Skardu town and the nearby communities.

3.4. Project Location

The Satpara Dam Project is located on Satpara nullah about 6 km south of the Skardu town, which is one of the districts of Gilgit-Baltistan. The Satpara nullah is a left bank tributary of the Indus River, and flows from south to north direction. The nullah originates in the Deosai Plain, flows through Satpara village and Skardu town, and finally discharges into Indus River. The Satpara basin has two distinct parts: the upper part consists of high altitude hilly terrain and contributing about 90% of stream flow; and the lower part consisting of steeply sloping valley downstream of the Satpara Lake. The total watershed area of the nullah is about 274 km^2 (68,000 acres). **Figure 3.1** shows the Project area and its surroundings.

Access to Project Sites

The dam site can be accessed from Skardu through the road leading to Satpara Village and Deosai Plains.

3.5. Project Components

Salient features of the key components of the Project are described below and summarized in **Table 3.1**. **Figures 3.2** and **3.3** present layout and schematic diagram of the Project, respectively; whereas **Appendix E** provides some photographs of its components.

3.5.1. Reservoir

The gross capacity of the reservoir would be about 115 x 106 m^3 (93,310 a-f), while the dead and live storage in the reservoir would be about 49 x 106 m^3 (37,962 a-f) and 69 x 106 m^3 (55,948 a-f), respectively. The reservoir will cover an area of about 2.8 km2 (690 acres).

3.5.2. Dam

The dam is an earth and rock filled structure located downstream of the Satpara Lake, at an elevation of 2,630 m (8,629 ft) above mean sea level (amsl). Its length and width at the crest level would be 174 m (570 ft) and 9.1 m (30 ft), respectively. The free board of the dam would be about 3 m (10 ft). See **Appendix E** for some photographs of the dam.

3.5.3. Outlet Structure

The outlet structure consists of a box conduit of about 3 m x 3 m (10 ft x 10 ft), and a circular conduit of about 2.3 m (7.5 ft) diameter. The design capacity of the outlet structure is 39.6 m^3/s (1,400 cusecs).

3.5.4. Spillway

The spillway is a concrete structure, having a design capacity of about 142 m^3/s (5,000 cusecs), and consists of four gates. See **Photographs E.6** to **E.11** in **Appendix E** for some views of the spillway.

3.5.5. Intake Weir

The intake weir also has a design capacity of about 142 m^3/s (5,000 cusecs), whereas the headrace channel has a design capacity of 6 m^3/s (212 cusecs).

3.5.6. Irrigation System

The irrigation system consists of two concrete lined canals. The left bank canal is about 15.83 km (51,933 ft) long, and has a design capacity of 3.8 m^3/s (135 cusecs). See **Figure 3.4** for a schematic view of the irrigation network, and some photographs in **Appendix E**.

3.5.7. Command Area

The total command area (area of influence) of the Project would be more than 6,000 ha (15,000 acres). This includes about 4,200 ha (10,400 acres) as the left bank command area and about 1,860 ha (4,600 acres) as the right bank command area.

3.5.8. Powerhouses

The Project consists of four powerhouses, of which two have been completed and are in operation. The Powerhouses 1 and 2 are located downstream of the dam, and upstream of the diversion for the canals, whereas the remaining two powerhouses will be installed on the left bank canal (see **Figures 3.2** and **3.3**).

The Powerhouse # 1 consists of two units with Francis type turbines, with a total generation capacity of 4.86 MW, and annual electricity generation of 24.25 GWh. The Powerhouse # 2 also consists of two Francis type turbines, with a

total installed capacity of 9.0 MW, and 51 GWh of annual electricity generation. The Powerhouse # 3 consists of two Francis type turbines with 2.4 MW total installed capacity and 19.12 GWh of annual electricity generation. The Powerhouse # 4 consists of two Francis type turbines with 1.4 MW total installed capacity and 11.4 GWh of annual electricity generation. The combined installed capacity of these powerhouses is 17.66 MW, and these units will produce about 105.77 GWh of electricity on an annual basis.

The Powerhouses 1 and 2 have been completed and are in operation since 2007/8.

3.6. Shatung Nullah Diversion (Now Abandoned)

To optimize the capacity of the reservoir, the Shatung Nullah in Deosai Plains was to be diverted through a 5 km (16,400 ft) long tunnel, with a mean discharge of 6 m^3/s (212 cusecs). However, in view of the fact that the Deosai Plains have been declared as the Deosai National Park having critical habitat and threatened wildlife resources, this component has been abandoned, and is not included in the Project components being considered for USG funding.

3.7. Implementation Arrangements

WAPDA has the overall control and implementation responsibility for the Project, and is undertaking the construction of the dam, powerhouses, and the irrigation network. The works have been distributed in three different lots. The Lot 1A consists of civil works and hydraulic structures and has been contracted to Descon Engineering – a Pakistani engineering and construction company. The Lot 1B consists of the electromechanical works for the Powerhouses 1 and 2, and has been contracted out to CMIC – a Chinese construction company. The Lot 2 consists of the irrigation works and has been contracted out to CCPG – another Chinese contractor.

3.8. Technical Review of Project

In addition to the present environmental and social analysis, USAID has also commissioned technical evaluation of the Project, covering engineering design, operation, and instrumentation plans. In this respect, the Project's consultants have sent a letter to AEAI, explaining that they have reviewed the design of the Project in light of internationally accepted standards and practices. The letter is provided in **Appendix F** of this document.

Table 3.1: Key Project Data

Hydrology	
Catchment Area	274 km^2 (68,000 acres)
Mean annual runoff	120 x 10^6 m^3 (97,730 a-f)
Mean annual flow	5.6 m^3/s (198 cusecs)
Dam and Powerhouse	
Type of dam	Earth and rock filled
Height over foundation level	39 m (128 ft)
Length at crest level	174 m (570 ft)
Width at crest level	9.1 m (30 ft)
Free board	3 m (10 ft)
Installed capacity	17.66 MW
Mean annual generation	105.77 GWh
Reservoir	
Gross storage capacity	115.1 x 10^6 m^3 (93,310 a-f)
Dead storage capacity	48.8 x 10^6 m^3 (37,962 a-f)
Live storage capacity	69.0 x 10^6 m^3 (55,948 a-f)
Surface area - gross	279.29 ha (690.16 acres)
Surface area - dead	121.0 ha (299.21 acres)
Outlet structure	
Box conduit	3 m x 3 m (10 ft x 10 ft)
Circular conduit diameter	2.28 m (7.5 ft)
Capacity	39.6 m^3/s (1,400 cusecs)
Spillway	
Capacity	142 m^3/s (5,000 cusecs)
Number of gates	4
Intake weir	
Design discharge	142 m^3/s (5,000 cusecs)
Head race channel capacity	6 m^3/s (212 cusecs)
Irrigation system	
Capacity	142 m^3/s (5,000 cusecs)
Left bank canal	3.8 m^3/s (135 cusecs)
Right bank canal	1.5 m^3/s (52 cusecs)
Length of left bank canal	15.83 km (51,933 ft)
Length of right bank canal	17.68 km (58,000 ft)
Command area	
Left bank canal	4,209 ha (10,400 acres)
Right bank canal	1,862 ha (4,600 acres)
Total	6,070 ha (15,000 acres)

Figure 3.1: Project Area

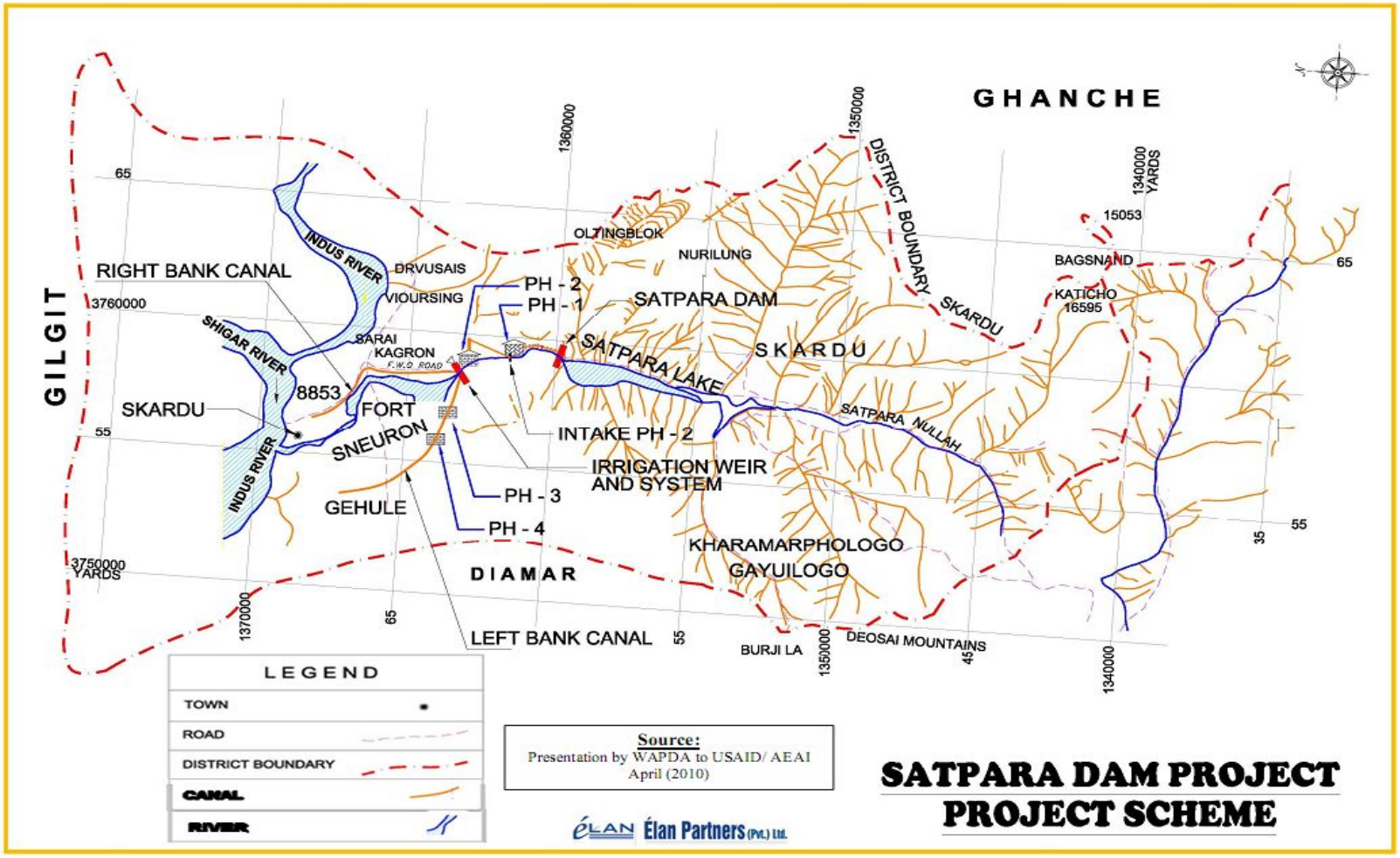


Figure 3.2: Project Layout

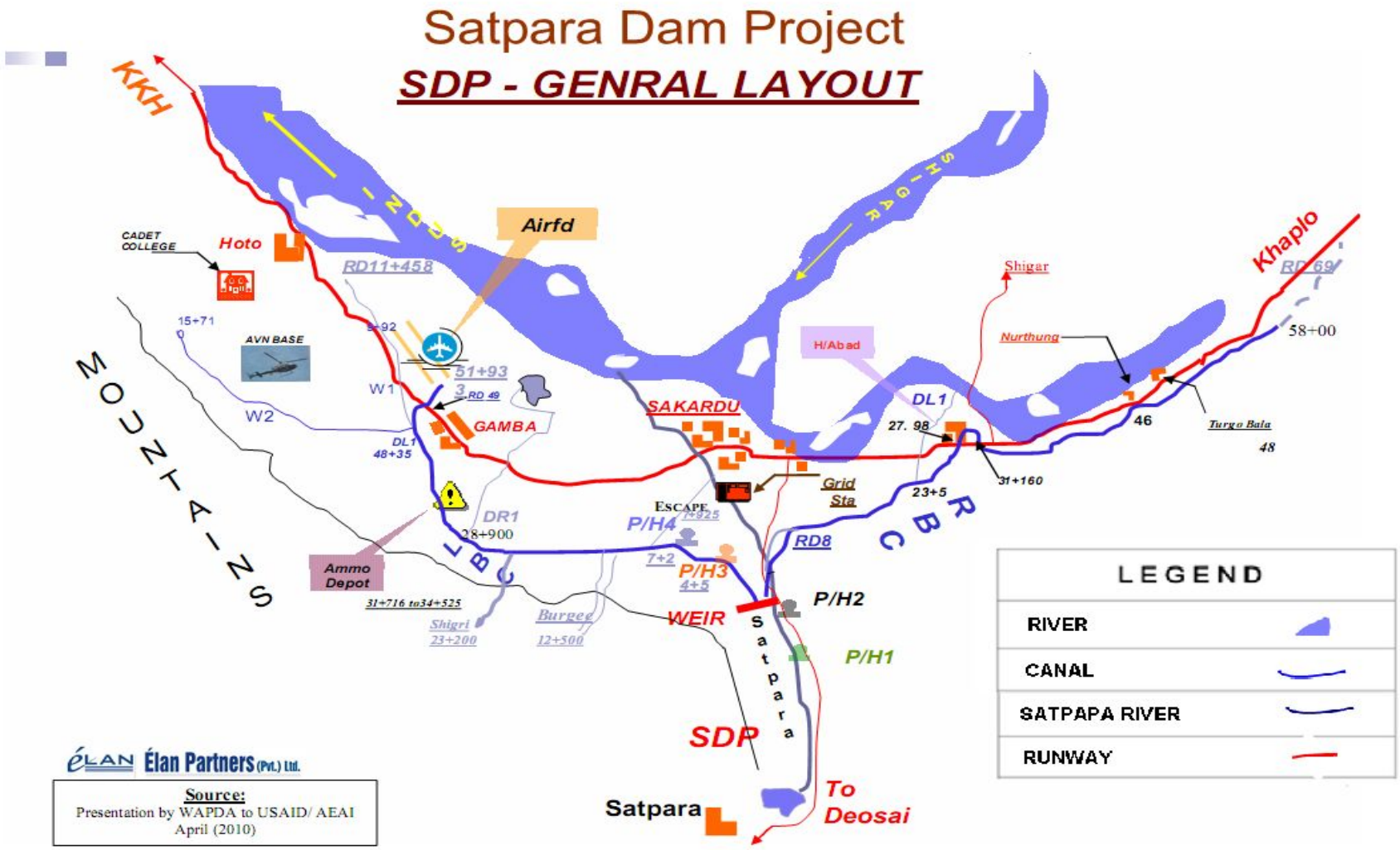


Figure 3.3: Project Schematic Layout

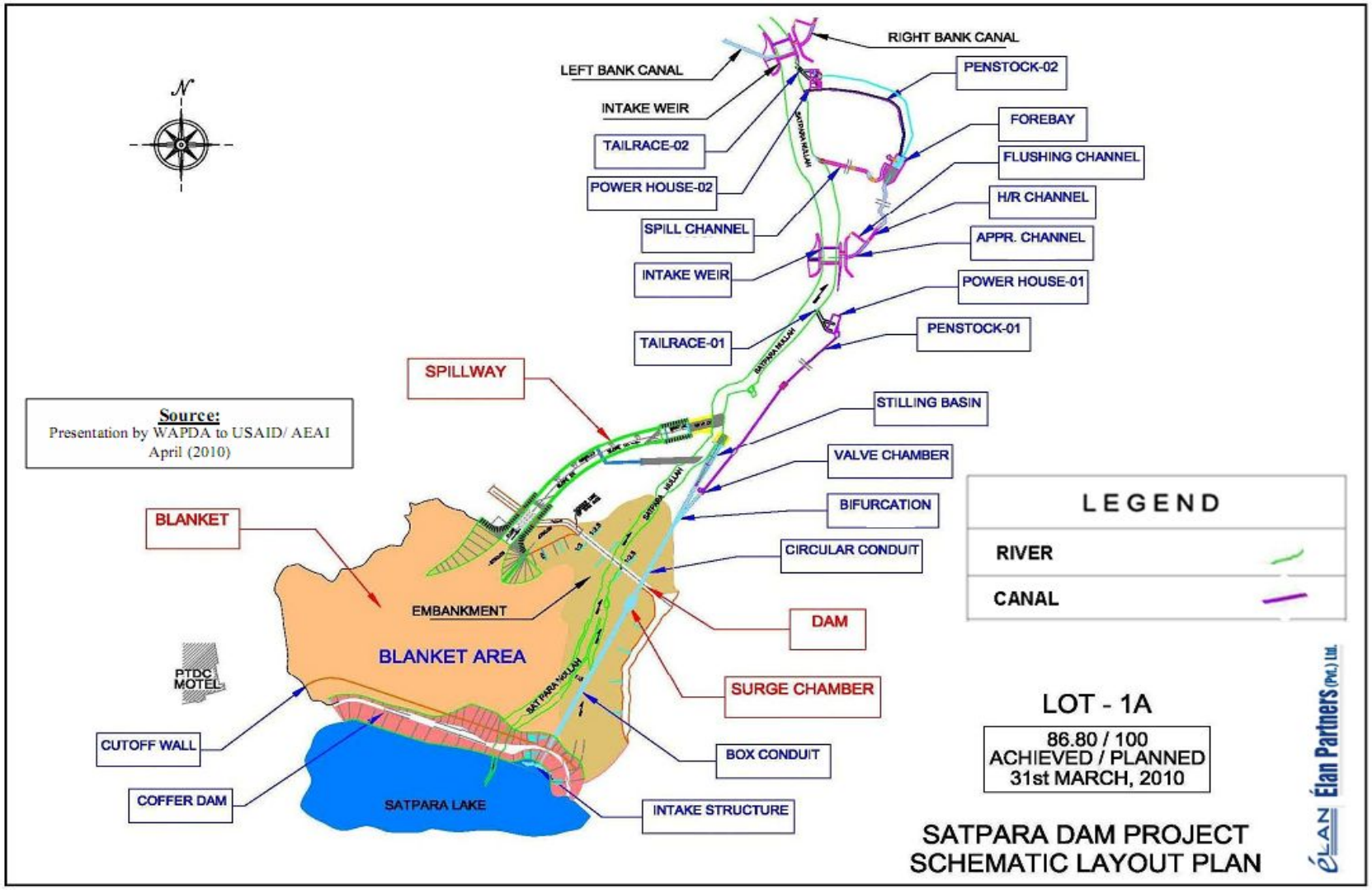
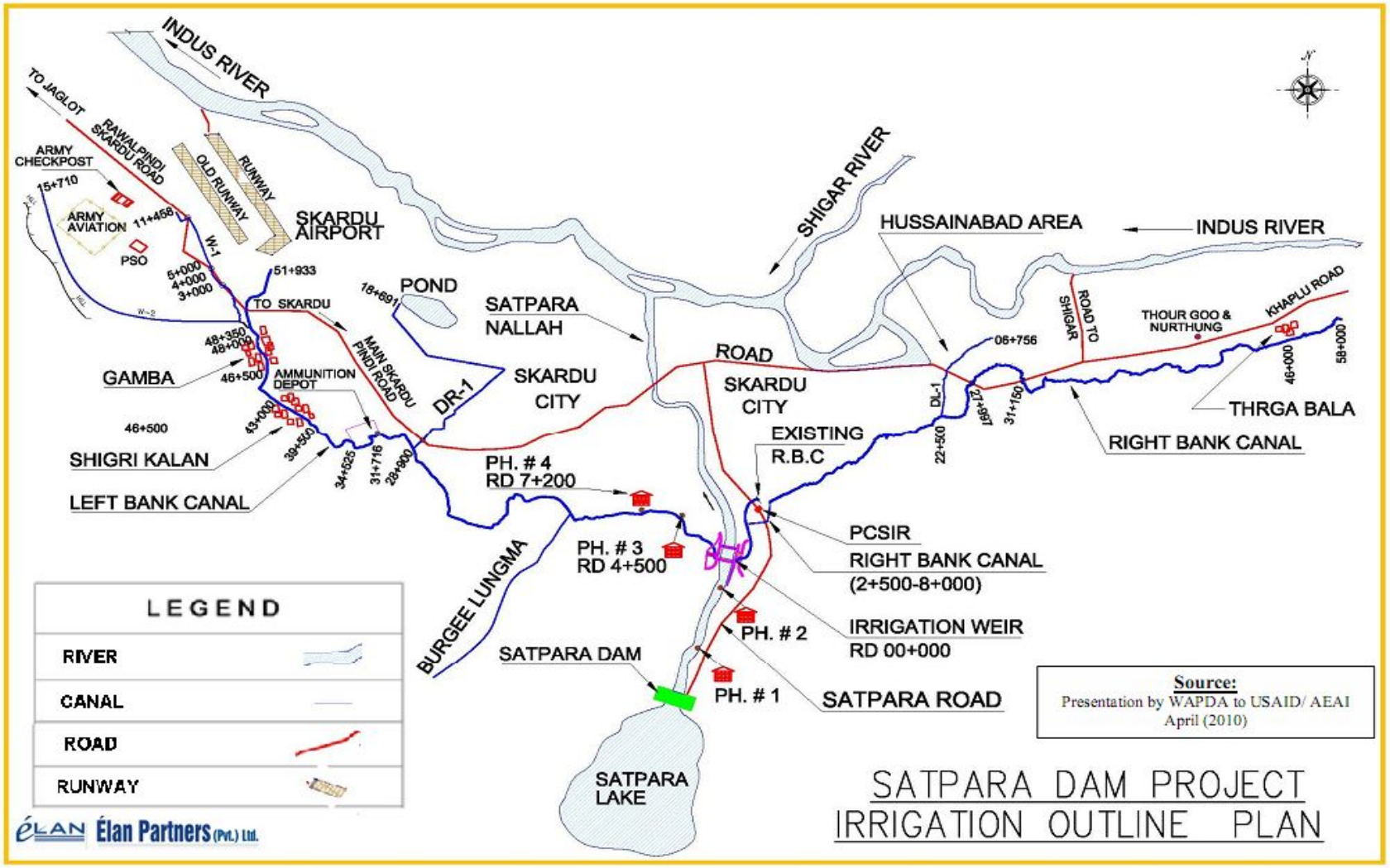


Figure 3.4: Irrigation Network



4. Overview of Baseline Conditions

This Chapter presents an overview of Gilgit Baltistan, as well as a description of the pre-project environmental and socioeconomic conditions of the area, as reported in the WAPDA IEE. The present environmental and socioeconomic aspects observed during the recent field visit are also discussed in the Chapter.

4.1. An Overview of Gilgit Baltistan [16]

Gilgit-Baltistan, formerly known as the Northern Areas, is the northernmost political entity within the Pakistan. It borders Pakistan's Khyber Pakhtunkhwa province to the west, Afghanistan's Wakhan Corridor to the north, China to the northeast, Azad Kashmir to the south, and Jammu and Kashmir State of India to the southeast. Gilgit-Baltistan covers an area of 72,971 km^2 (28,174 mi^2) and has an estimated population approaching 1,000,000. Its administrative center is the city of Gilgit (population 216,760).

The territory became a single administrative unit in 1970 under the name Northern Areas and was formed by the amalgamation of the Gilgit Agency, the Baltistan District of the Ladakh Wazarat, and the states of Hunza and Nagar.

4.1.1. History

Rock Art and Petroglyphs

There are more than 20,000 pieces of rock art and petroglyphs (rock engravings) all along the Karakoram Highway in Gilgit-Baltistan, concentrated at ten major sites between Hunza and Shatial. The carvings were left by various invaders, traders, and pilgrims who passed along the trade route, as well as by locals. The earliest ones date back to between 5000 and 1000 BCE, showing single animals, triangular men and hunting scenes in which the animals are larger than the hunters. These carvings were pecked into the rock with stone tools and are covered with a thick patina that proves their age. The archaeologist Karl Jettmar has pieced together the history of the area from various inscriptions and recorded his findings in Rock Carvings and Inscriptions in the Northern Areas of Pakistan and the later released Between Gandhara and the Silk Roads - Rock Carvings along the Karakoram Highway.

Before the independence of Pakistan and the partition of India in 1947, Maharaja Hari Singh extended his rule to Gilgit and Baltistan. After the partition, Jammu and Kashmir, in its entirety, remained an independent state. The Pakistani parts of Kashmir to the north and west of the cease-fire line

[16] Source: Wikipedia website (http://en.wikipedia.org/wiki/Gilgit-Baltistan) accessed on 16 October 2010.

established at the end of the Indo-Pakistani War of 1947, or the Line of Control as it later came to be called, were divided into the Northern Areas (72,971 km²) in the north and the Pakistani state of Azad Kashmir (13,297 km²) in the south. The name "Northern Areas" was first used by the United Nations to refer to the northern areas of Kashmir.

Autonomous Status and Present-day Gilgit-Baltistan

On 29 August 2009, the Gilgit-Baltistan Empowerment and Self-Governance Order 2009, was passed by the Pakistani cabinet and later signed by the country's President. The order granted self-rule to the people of the former Northern Areas, now renamed Gilgit-Baltistan, by creating, among other things, an elected legislative assembly. There has been criticism and opposition to this move in Pakistan, India, and Gilgit-Baltistan.

In early September 2009, Pakistan signed an agreement with the People's Republic of China for a mega energy project in Gilgit-Baltistan which includes the construction of a 7,000-megawatt dam at Bunji in the Astore District. This also resulted in protest from India, although Indian concerns were immediately rejected by Pakistan, which claimed that the Government of India has no locus standi in the matter.

On 29 September 2009, the Pakistani Prime Minister, while addressing a huge gathering in Gilgit-Baltistan, announced a multi-billion rupee development package aimed at the socio-economic uplifting of people in the area. Development projects will include the areas of education, health, agriculture, tourism and the basic needs of life.

4.1.2. Subdivisions

Gilgit-Baltistan is administratively divided into two divisions which, in turn, are divided into seven districts, including the two Baltistan districts of Skardu and Ghanche, and the five Gilgit districts of Gilgit, Ghizer, Diamer, Astore, and Hunza-Nagar. The main political centers are the towns of Gilgit and Skardu.

4.1.3. Geography

Gilgit-Baltistan borders the Wakhan corridor of Afghanistan to the northwest, China's Uygur Autonomous Region of Xinjiang to the northeast, the Indian state of Jammu and Kashmir to the south and southeast, the Pakistani-controlled state of Azad Jammu and Kashmir to the south, and KP province to the west.

Gilgit-Baltistan is home to five of the "eight-thousanders" and to more than fifty peaks above 7,000 meters. Gilgit and Skardu are the two main hubs for expeditions to those mountains. The region is home to some of the world's highest mountain ranges—the main ranges are the Karakoram and the western

Himalayas. The Pamir mountains are to the north, and the Hindu Kush lies to the west. Amongst the highest mountains are K2 (Mount Godwin-Austen) and Nanga Parbat, the latter being one of the most feared mountains in the world.

Three of the world's longest glaciers outside the Polar Regions are found in Gilgit-Baltistan — the Biafo Glacier, the Baltoro Glacier, and the Batura Glacier. There are, in addition, several high-altitude lakes in Gilgit-Baltistan:

- Sheosar Lake in Deosai Plains - Astore region
- Satpara Tso Lake in Skardu - Baltistan
- Katzura Tso Lake in Skardu - Baltistan
- Zharba Tso Lake in Shigar - Baltistan
- Phoroq Tso Lake in Skardu - Baltistan
- Bara Tso Lake in Gangche - Baltistan
- Byarsa Tso Lake in Gultari - Baltistan
- Borith Lake in upper Hunza - Gilgit
- Rama Lake near Astore
- Rush Lake near Nagar - Gilgit
- Kromber Lake In Kromber Pass - Ishkoman Valley, Ghizer District
- Barodaroksh lake in Bar valley Nagar

The Deosai Plains, are located above the tree line, and constitute the second-highest plateau in the world at 4,115 meters (14,500 feet) after Tibet. The plateau lies east of Astore, south of Skardu and west of Ladakh. The area was declared as a national park in 1993. The Deosai Plains cover an area of almost 5,000 square kilometers. For over half the year (between September and May), Deosai is snow-bound and cut off from rest of Astore and Baltistan in winters. The village of Deosai lies close to Chilum choki and is connected with the Kargil district of Ladakh through an all-weather road.

4.1.4. Climate

The climate of Gilgit-Baltistan varies from region to region; surrounding mountain ranges creates sharp variations in weather. The eastern part has the moist zone of the western Himalayas, but going toward Karakoram and Hindu Kush the climate dries considerably.

There are towns like Gilgit and Chilas that are very hot during the day in summer, yet cold at night, and valleys like Astore, Khaplu, Yasin, Hunza, and Nagar where the temperatures are cold even in summer.

4.1.5. Economy and Resources

The economy of region is basically based on traditional route of trade through Silk Road. China Trade Organization was the leading economic forum through which most of barter trade activity made a phenomenal change in the general economical outlook of the area which being the remotest region of Pakistan was neglected for over quarter of century. This forum led the people of the area to actively invest and learn the modern trade know how from its neighbor Xingjiang. The participation of the all ethnic groups and active force behind this activity, legendary economist of the area Ashraf Khan brought a great change in the region. Later the establishment of Chamber of Commerce and Sust dry port is the key milestones. Rest of the economy is shouldered by mainly agriculture and tourism.

4.1.6. Transport

Prior to 1978, Gilgit-Baltistan was cut off from Pakistan due to the harsh terrain and the lack of all-weather roads. All of the roads to the south opened towards the Pakistani-controlled state of Azad Jammu and Kashmir (AKJ) and to the southeast towards the present-day Indian-controlled state of Jammu and Kashmir. During the summer, people could walk across the mountain passes to travel to Rawalpindi. The fastest way to travel, however, was by air, but air travel was accessible only to a few privileged local people and to Pakistani military and civilian officials. Then, with the assistance of the Chinese government, Pakistan began construction of the Karakoram Highway (KKH), which was completed in 1978. The Karakoram Highway (KKH) connects Islamabad to Gilgit and Skardu, which are the two major hubs for mountaineering expeditions in Gilgit-Baltistan. The road journey from Islamabad to Gilgit takes approximately 20 to 24 hours. Landslides on the Karakoram Highway are very common. The KKH connects Gilgit to Tashkurgan and Kashgar in China via Sust (the customs and health inspection post on the Northern Areas side) and the Khunjerab Pass, the highest paved international border crossing in the world at 4,693 m (15,397 ft).

Northern Areas Transport Corporation (NATCO) offers bus and jeep transport service to the two hubs and several other popular destinations, lakes, and glaciers in the area.

In March 2006, the respective governments announced that, commencing on June 1, 2006, a thrice-weekly bus service would begin across the boundary from Gilgit to Kashgar, China, and road widening work would begin on 600 km of the Karakoram Highway. There would also be one daily bus in each direction between the Sust and Tashkurgan border areas of the two political entities.

Pakistan International Airlines used to fly a Fokker F27 aircraft daily between Gilgit Airport and Islamabad International Airport. The flying time was approximately 50 minutes, and the flight was one of the most scenic flights in the world, as its route passed over the mountain Nanga Parbat, the peak of which was higher than the aircraft's cruising altitude. PIA also offers regular flights of Boeing 737 between Skardu and Islamabad. However, the Fokker F27 aircraft was retired after a crash at Multan in 2006. Currently, flights are being operated by PIA to Gilgit on the brand-new ATR42-500 aircraft, which was purchased in 2006. With the new plane, the cancellation of flights is much less than it was the Fokker aircraft. All flights, however, are subject to weather clearance, and, in winter, flights are often delayed by several days.

4.1.7. Demographics

The population consists of many diverse linguistic, ethnic, and religious groups, due in part to the many isolated valleys separated by some of the world's highest mountains. The population of this area is a mixture of many ethnic groups like Natives Shins, Yashkuns, Kashmiris, Kashgaris, Pathans,and Kohistanis. Ismaili sect is in present unlike rest of Pakistan. Urdu is the lingua franca of the region, understood by most of the inhabitants. The Shina language (with several dialects such as Asturjaa, Kharuchaa, and chilasi) is the language of 60% of the population, spoken mainly in Gilgit, Astore throughout Diamer, and in some parts of Ghizer. The Balti dialect, a sub-dialect of Ladakhi and part of Tibetan language group, is spoken by the entire population of Baltistan. Minor languages spoken in the region include Wakhi, spoken in upper Hunza, and in some villages in Ghizer, while Khowar is the language of Ghizer. Burushaski is an isolated language spoken in Hunza, Nagar, Yasin (where Khowar is also spoken), in some parts of Gilgit and in some villages of Punyal. Another interesting language is Domaaki, spoken by the musician clans in the region. A small minority of people also speak Pashto. At the last census (1998), the population of Gilgit and Baltistan was 870,347. Approximately 14% of the population was urban.

4.2. Physical Environment[17]

4.2.1. Topography

The topography of the project area can be classified into four topographic units by the feature of landforms and geological conditions as follows:

- Rocky Mountains

[17] Most of the baseline description in this and the following sections in the Chapter is based upon the IEE Report of the Project (WAPDA 2002).

- Higher terraces
- Lower terraces
- Alluvial fans

In the lower terraces the vegetation cover consists of grass and trees. The local people cultivate these terraces. The local geographic area of the Satpara valley is about 275 km^2.

The Satpara Lake on which the Satpara dam project is located is predominantly high altitude land. The region is characterized by a pattern of high and steep hills, which are generally high towards south, closer to Deosai plains. General elevation of the land gradually increase towards north of Skardu city. Altitude ranges from 2,300 to 4,300 m amsl. Abundant glacier deposits overlie in the valley. Intense avalanches/weathering has taken place in the area, which has left terraces in valley.

The Satpara nullah has a width ranging from 50 m to 100 m the nullah drops about 500 m within project area. The nullah is quite noisy due to collision of flow over the boulders and sudden rapid falls. The local people have intensively planted the area during the recent years.

4.2.2. Geology

Satpara valley is a narrow valley, which shows evidence of past glaciations. The nullah has a steep gradient with falls at different locations and its bed contains large size boulders of various sizes, which are brought down by the glaciers and avalanches. Apart from the glacial characteristics, the valley shows talus/scree accumulation and alluvial terraces, which indicates that valley is a modified glacial valley, where glacis-fluvial and collegial activities have taken place.

4.2.3. Soils

The local soils of the area are well drained and even during heavy rainfall the soil does not become saturated and no pounding occurs. The basement of the lake is consisting of rock and aquifers have low hydraulic conductivity.

4.2.4. Water Resources

Hydrology

Before the commencement of the Project, a gated weir used to control the flows from the lake. The flows used to be released from the lake according to the downstream requirements for irrigation and water supply during low flow period, however, during summer time the discharge used to increase and surplus water used to be disposed to the Indus River. The average annual flow

recorded at Satpara gauging station is 5.602 m^3/s and highest flow recorded as on June 22, 1988 was 38.50 m^3/s, whereas during the June 2010 floods, the maximum inflow into the Satpara Lake was recorded to be 56.07 m^3/s (1,980 cusecs), as reported by WAPDA. The total catchment area (area of influence) of the Satpara nullah is 274 km^2.

Irrigation is the most dominant use of the Satpara nullah water, accounting for 74% of all water demand. The flow of Satpara nullah is controlled through temporary weirs, built by local people and Northern Area's Public Works Department. The water for irrigating is diverted to the fields through number of channels. Small watercourses are constructed by the farmers for their land coming under the command of that channel. New channel has been constructed on right bank of Satpara nullah. The water for this will be drawn from the power channel of existing powerhouses. The channels lead water to irrigate the land of Hussainabad village. The proposed project will irrigate about 15,000 acre of land in Skardu area.

Surface Water/Ground Water Quality

The seasonal rainfall is low and the groundwater level is very deep close to the relatively impermeable rock. Lower groundwater levels are encountered near Indus River. No borehole to establish the groundwater level has been carried out in the area so far. No groundwater level data is available about the project at the time of assessment.

The chemical and biological tests for the water quality of the Satpara nullah were carried out at different laboratories by several departments. These departments are Northern Area Public Works Department (NAPWD), Water and Sanitation Program of (Aga Khan Rural Support Program (AKRSP) and WAPDA on different locations. The water quality results of the Satpara and reference values are given in **Tables 4.1** to **4.5**.

The water sample was taken at Khosho site for laboratory analysis. According to the test performed by the National Institute of Health Islamabad the sample was found unsatisfactory due to high viable count and coliform contamination. This may be due to presence of residences at the intake site which discharges its sewage indirectly or directly into the Satpara nullah from the field and other sources. Hardness, organoleptic, TDS, and potable water quality and all other remaining parameters appear to be within the permissible limits and found acceptable for drinking purposes.

Similarly WAPDA staff took the water samples from upstream and downstream of Satpara Lake. The sample taken from upstream of the lake shows high number of E-coliform. The reasons of this high coliform may be human faeces.

The people in project area do not have proper sewerage system. Another reason is the astray animals that come to the lake for grazing.

Present Water Quality Status

Consultation with Northern Areas Public Works Department (NAPWD) official and WASEP department of Aga Khan Rural, Support Program indicated that no routine monitoring or research program exists from which baseline water quality data for Satpara nullah may be obtained. However, NIH Islamabad and Water & Sanitation Extension Program (WASEP) of Aga Khan Rural Support Program got tested the water of Satpara nullah at two different occasions. The samples were sent to National Institute of Health Islamabad by NAPWD. The tests show that the chemical quality of the water sample appears to be good. No survey was carried out to determine the aquatic ecology in the Satpara Lake and nullah. No chlorophyll tests carried to know the biomass in the nullah. The nullah flows with high velocity therefore the biomass move quickly downward and cannot grow. But the algal biomass can be observed in the Satpara Lake, which shows influx of nutrients (P and N) into the Lake from the upper village and other sources. This indicates a tendency towards eutrophication is likely to have been caused by anthropogenic inputs of nutrients. It is not know that in which season the inflow and outflow of nutrients are entering into the Lake. A regular chemical and biological analysis will determine the source and high concentration time. No hyacinth plant was observed during the field visit.

4.2.5. Climate

The project area remains under the influences of severe cold during winter season. The rainfall is scarce and monsoon cannot cross the high Himalayan Mountains. Situated in the western most arm of Himalayan range, Satpara is found within semi arid and rugged mountain landscape (mountain desert). This whole region lies in a rain shadow area, with average annual precipitation less than 200 mm, but rising with the elevation to create a moist environment at the extensive high altitude range lands. Because of latitude the area has marked seasonal climate comparable to that of temperate zone. The mean annual rainfall in the highlands of Skardu region varies from 150 mm to 225 mm. The maximum temperature during summer is around 35oC while mercury drops to -15oC in winter. The lowest temperature recorded in the Skardu city is -29°C in 1995. The mean minimum monthly temperature is -2°C in Skardu. The Climate at the Satpara area is similar to Skardu. Average temperature and precipitation record for a period of 25 years is shown in **Table 4.6**.

4.2.6. Wind

The wind in the Skardu valley blows from North side to South side. The local meteorology is characterized by high frequency of wind during winter season. Prevailing southern winds occur about 40% of the year. The Shigar river valley and Indus River are the sources of wind blowing in the Skardu. The maximum wind recorded at Kachura site is 219 miles/hour in the month of September 1970 and minimum the climatological station in 1970 just upstream of Ayub suspension bridge on Indus River. The data is related to year 1970 only. The wind in the area is the major source of erosion and dust. Given the recorded conditions, wind erosion of exposed ground is likely to be significant source of airborne dust. Dust generated by the wind has little effect on the normal life of the Skardu city.

4.3. Biological Environment

4.3.1. Flora

The total area of Northern Areas is 7.04 million hectares, out of which the forest area is 4%, agricultural land is 14%, and glaciers 59% land area under Baltistan is 2.592 million hectares. The Deosai Plateau is a rolling area at elevations mostly above 4,000 meters. It has a cold climate and remains covered with snow for three quarters of the year. It is located at the junction of four major mountain ranges, the Karakoram, Ladakh, Zanskar and Himalayas. The known flora includes 342 species in 36 families and 142 genera. The area was declared as national park in 1995, and management plan for the area is currently being prepared. There is an active program underway to study brown bears on the plateau and protect them. The reasons for the high level of biodiversity on the Deosai Plateau are multiple, which include topography, location at the junction of 4 major mountain ranges and the adaptations of the plants and animals. Some species, such as the burrowing vole (Hyperaicrius) serve as keystone species, allowing numerous other species to make use of underground burrow system for shelter and foraging activities, thus maximizing species numbers and diversity in an otherwise austere region.

The Deosai Plateau is an uninhabited mountain wilderness surrounded by deep and snowy peaks in the north of Pakistan. In this rugged terrain the Plateau stands apart as an expanse of open area grass, flowers, streams and lakes. Lapersonne (1928) vividly described the area when he wrote “It was month of confined valleys and dreadful gorges, to see the sun set without intervening mountains or the gold orb of the moon rise over the rim of the world.”

Humans have subjected these regions to extensive exploitation during the past 50-100 years, with population growth, pastoral grazing, hunting, tourism and development having led to a great reduction of biodiversity. However on the Deosai, most of these activities have had very little impact, and as result, the flora and fauna of the Deosai are largely intact.

The plateau is located about 25 km south of Skardu in the Northern Areas (now Gilgit Baltistan) of Pakistan in Baltistan. It is bounded on the south by the Deosai Mountains, on the west by the Astor Valley, and on the north by a series of high ridges south of the Indus River. A jeepable road passes across the plateau from Ali Malik Mar Pass (4,084 m), Chakor Pass (4,266 m) just above Sheosar Lake, and down to the village of Chilam (3,350 m). The Deosai Plateau occupies an area approximately 35 km from east to west and 20 km from north to south, and ranges in elevation from 3,400 m to 4,300 m, with occasional peaks over 5,000 m.

The Deosai Plateau is an area of high plains with sloping southeast. There are three main rivers draining the Deosai. The Astor River originates from the western slopes of Burzil Pass. It also drains Chilam Nullah and the Deosai Mountains surrounding the Parashing Valley north of Astor, and roughly forms the western boundary of the plateau.

The Shigar River is the major river of the interior Deosai Plateau. It is also known as the Bara Deosai. It originates from the Shiga Mountains, and drains most of the area of the northern, northeastern and northwestern Deosai. In the upper reaches it is divided into many smaller branches. The Shatung River is the main branch, and drains the eastern uplands and flows westward to join the Shigar upstream of the wooden suspension bridge across the Shigar River, which is a major landmark on the Deosai. Another major tributary of the Shihgar River is the Kala Pani River, which drains the northern and western uplands, including the Sheosar Lake area, and joins the main river below the wooden suspension bridge. These rivers drain a region or open rolling hills, spring-led nullahs and mountain peaks and lakes that form the upland regions of the Deosai. This whole region is often called Bara Deosai, which means “big Deosai”.

The Gultari River is on the southern and southeastern side of the Deosai. The river originates on the northern slopes of Burzil Pass, and flows eastward. Below the village of Gultarui the river joins the main Shigar River. It flows on to the north and east, joining the Suru River from Zanskar, and finally joins the Indus upstream of Kargil. This lower area of the Deosai in the region of the Gultari River is called the Chota Deosai (“small Deosai”).

The Chota Deosai as defined by Khan and Zakaria (1995) is restricted to an area south and west of the main Deosai Plateau. It begins near the village of Chilam, and runs eastward as a narrow valley to Gultari. This area valleys and lower plains range in elevation from 3,300 – 4,000 m, and are more populated and ecologically than the upper reaches of the Deosai Plateau proper.

The area receives abundant snowfall during the winter and rain during the brief summer season. The moisture percolates through the course soil, and emerges in springs along nullahs and in open grassy valleys. In areas where springs emerge, deep rich grasslands and numerous flowers abound. The high elevation and strong winds combine to prevent trees from growing on the higher areas of the plateau.

The forest area under Baltistan is 0.0058 million ha. The natural forest area is 0.036% while the forest type is dry type. The land within and surrounding of the project areas are largely composed of intensive settlement. The vegetation in Skardu and Satpara valley generally consists of agro-ecosystem with wheat, maize, apricot, and cherry etc. Special attention has been focused on the plants in the reservoir area, which will be submerged due to increased water level, particularly endangered species. Several species are found in the site, none of them, is recorded as endangered species globally or locally. Along the right bank of Satpara lake vegetation consists of cylix, apricot and mulberry trees. The banks of Satpara nullah are free of vegetation right from the intake area to the powerhouse site. There are small irrigation fields on the right of lake where wheat is grown as observed during field visit. High peaks are on all sides of lake, which are covered by snow during winter and avalanches frequently come down to take. The vegetation in the project area is given in the **Table 4.7**.

4.3.2. Aquatic Flora and Fauna

Data regarding flora and fauna in the Satpara Lake and nullah is not available. So far no such studies have been carried out. However, during field visit it was reported by the staff of Fisheries Department that two types of trout fish are found in the lake and phytoplankton exists. The phytoplankton consists of blue green algae. The significance of phytoplankton to the fisheries is in terms of food for zooplankton and juvenile fishes. Algae has been observed in the lake Satpara during field trip which is an indicative of eutrophic conditions due to nutrients input from irrigation and human population areas on right bank of lake.

4.3.3. Fisheries

The area has extensive water potential for the development of inland fisheries. These are eight major rivers and 121 streams that drain water in Indus River

besides lakes over an area of 570 hectares including Satpara (48 hectares). Clean water is ideal for trout while the muddy water breads local fish species. The Satpara Lake has two types of trout fish, which are given in the table below. Fisheries department has been introducing trout fish in the lake for the last several years. Every year approximately 10000 juvenile fishes are introduced in the lake. The rooted vegetation on wither bank of the stream is sparse and at a distance adding little to the biomass of the stream in the form of falling leaves and litter. Due to fast running nature of the stream filamentous algae and other macrophytes are not found except in some back, water where pool-like situation exists. The fish fauna found in Skardu district is given in **Table 4.8**:

No site-specific data for indigenous or native species are available. Satpara nullah is a perennial stream fed by rainfall and snowmelt. The stream length up to Indus River is 34.5 km and the catchment area up to intake site is 275 Km^2. the quality of water is good as anthropogenic pollution at present is bare minimum. The use of fertilizer and pesticides is also limited. The water is fast running and big boulders; cobbles, gravels and pebbles constitute the bed of stream. Very few pools and puddles are located along its course.

4.3.4. Historical Background of Trout Fish in Northern Areas

The trout fish was introduced in Areas in 1908. The breading season of fish start from 15 march and lasts in 15 October. During this period fishing is not allowed. Trout fish growth has increased in Northern Areas for the last 6 years. The lake was supplied brown rainbow from Australia in 1908 and from America in 1985. From 1985 another exotic fish kamloop imported from USA and Australia and bred successfully in Northern Areas. There is no commercial fishing in the Skardu area. The fishes caught are for the personal consumption. Residents of project area and Skardu were interviewed for ascertaining the quantity of fish consumed. The survey showed that very few people consume fish as a part of their diet. These fishes are tolerant to extreme cold conditions in the lake. Phytoplankton, snails, fruit, plants etc are the feeders of trout fish.

4.3.5. Fauna

The Deosai Plateau is an uninhabited mountain wilderness surrounded by deep valley and snowy peaks in the far north Pakistan. In this rugged terrain the plateau stands apart as an expensive open area of grass, flowers, streams and lakes. LaPersonne (1928) vividly described the area when he wrote. "It was a relief being able to see such an expanse of open country after months of confined valleys and dreadful gorges, to see the sun set without intervening mountains or the gold orb of the moon rise over the rim of the world".

Satpara Lake and nullah are rich in aquatic fauna. Several kinds of fish exist in the waters of project area. Some fish types are from high altitude waters i.e. Triplophysa stoliczkae High Altitude Loach. This high altitude fish was originally described from Lake Tsho Mararai at 4,728 m elevation in western Tibet. Its distribution extends from Central Asia in the Oxus and Tarim river system both of which occur at high elevations. In the Indus river system it has only been recorded from headwaters areas at elevations from 4.179 m to 4,905 m. The upper Gultari river is the only documentable site for the occurrence of this species in Pakistan. Nineteen specimens of this species were collected in the Gultari river at an altitude of 3,680 m from a site located 10 km upstream from where Sufaid Nullah joins the Gultari river.

4.3.6. Reptiles and Amphibians

The number of replies and amphibians in the Deosai plateau is very limited because of the high elevation. At Deosai the specimens were collected near the edge of Sheosar Lake, and in tall grass around small pools of water. Near Babusar Pass it occurred in the same kinds of wet habitats under rocks at the edge of stream channels. Therefore, it is predicted that this frog may be widely distributed on the Deosai Plateau in wet, grassy habitats up to highest elevation at such habitats are found (5,000 m). According to Auffenberg (pers. comm.) this frog can occur as high as 5,643 m in some areas where there are pockets of open ground in the permanent snowline.

Little is known about its natural history. A specimen from Babusar had a wasp in its mouth when collected. The tadpoles may take two years to develop into adults (Auffenberg, pers. comm.), and can be observed in deeper still pools of water in grassy areas where springs emerge. Tadpoles are found in both still and flowing water. Adult frogs are very slow moving and are not usually observed moving about until after the sun has warmed the surface of the ground.

It appears to be restricted to alpine habitats. Dubois (1978) found it in high mountain torrents between 2,680-3,900 m in India. In addition to finding refuge from cold in water (streams and pools) and under rocks, this was observed emerging from the burrows of Hyperacrius (burrowing voles) and from rock crevices. The burrows of Hyperacrius also are known to shelter Sicista (birch mice) and Alticola and numerous insects, and may play a major role in the survival and distribution of these frogs on the Deosai.

4.3.7. Birds

The actual number of birds occurring on the Deosai Plateau is confusing because many migratory species pass through the area, and there is also a

significant amount of altitudinal migration. Khan and Zakaria (1995) report that over 100 bird species have been observed on the Deosai Plateau. Mathews (1941) studied birds in the area between 15 July and 20 August, 1941. Form his overall list of 58 birds; he documented 23 occurring on the proper Deosai Plateau. Khan et al. (1986) reported that they have observed 108 species of birds over three year period, 81 of which were confirmed breeding, 23 were passing through the area as migrants and 4 were vagrants. In the list of the 41 birds that are likely to be observed in the overall area of the Deosai Plateau published records have been consulted, and the range maps and discussion in Roberts (1992). The list is not a complete record. The reliable published data on the birds of the region is too limited to allow such an analysis of the avifauna of the Deosai. Some of the more easily observed or ecologically significant species recorded on the Deosai Plateau are listed below.

- Order Accipitriformes

  Family Accipitridae

Haliaeetus leaucoryplus	Palla's or Ring-tailed Fish Eagle
Gypaeetus barbatus	Lammergeier or Bearded or Bearded Vulture
Gyps himalayensis	
Accipiter nisus melaschistos	Eurasian Sparrow Hawk
Aquila chrysaetos	Golden Eagle

- Order Falconiformes

  Family Falconidae

Falco tinnunculus	Eurasian Kestrel

- Order Galliformes

  Family Phasianidae

Tetraogallus himalayensis	Grey Himalayan Snowcock

- Order Charadriiformes

  Family Charadrtidae

Characdrius mongolus	Lasser Sand Plover or Mongolian

  Family Scolopacidae

Actitis hypoleucos	Common Sandpiper
Tringa tetanus	Common Redshank

Family Laridae	
Larus burnnicephalus	Brown-headed or Tibetan Gull
Laws burnnicephalus	Tibetan Common Tern
Family Sternidae	
Sterna hirundo tibetana	

- Order Columbiformes

Family Columbidgae	
Columba rupestris	Turkistan Hill Pigeon
Columba leuconota	Snow Pigeon

- Order Cuculiformes

Family Cuculidae	
Cucules canorus	Eurasian Cuckoo

- Order Caprimugiformes

Family Caprimulgidae	
Caprimulgus europaeus	

- Order Apodifroms
  Family Apodidae
  Apus apus pekinensis
- Order Coraciiform
  Family Upupidae
  Upupa epos — Hoopoe

4.3.8. Aquatic Birds

Satpara Dam project was visited and surveyed for aquatic birds during the IEE study. Several species of aquatic birds were recorded. None of the species was endangered or locally. According to the available data with Forest Department of Northern Areas Skardu, waterfowls, eagles and ducks are found abundantly. However, many of the birds roost on the trees, especially on the Satpara Island located at the middle of the lake. There are presently enough trees for them to do this. Fortunately the area has been planted abundantly.

4.3.9. Mammals

Information on the mammals of the Deosai Plateau is very limited, Roberts (1977) available is the only source of reliable information. Since few investigations have collected or studied mammals on the Deosai, even Roberts

has little information on the mammals of the plateau. About 19 mammals living on the Deosai Plateau have been reported according to research of local IUCN officials, ranging in size from the tiny Tibet re-toothed shrew (sorex fhfefanus) weighing less than 7 grams to the Himalayan brown bear (Ursus arctos) weighing approximately 150 kilograms. Both species are relatively rare, and it is uncommon to encounter either. On the other hand, the long-tailed marmot (Marmota caudate) is extremely common on the Deosai, and at time a dozen or more individuals can be observed across the rolling terrain. The marmot is the mammalian symbol of the area, sitting at the entrance to its extensive burrow system, vocalizing loudly. Few places in Pakistan have large concentrations of marmots. However, in terms of total biomass, the most dominate mammalian species on the Deosai Plateau is the small burrowing vole (Hyperacrius fertilis). Even though most individuals of this species weigh less than 20 grams, they live in huge colonies that cover large areas where the soils are deep and not too compacted. It is possible to find large areas of excavated soil and small burrow openings throughout the area of both the Bara and Chota Deosai, and when the total number of individuals is multiplied by the average mass of 20 grams, the total biomass of this species on the Deosai is extraordinary.

The activities of marmots and burrowing mice are important to the ecology of the Deosai in many ways. They excavate the soil, keeping it porous and loamy. They disperse plant materials. They serve as the major source of food for carnivores such as brown bears, foxes, predatory birds, and even the snow leopard. In addition, their deep burrows serve as shelters and nesting places for a number of insects, reptiles, amphibians and even other mammals.

Birds have been used as indicator group of fauna. Previous studies have been carried out by IUCN and individuals on the fauna of Deosai plans. The island within the Satpara lake is best shelter and safer place for the aquatic birds. A list of the small mammals known to occur on the Deosai is given in **Table 4.9**, along with their numbers, localities and respective elevation of capture site. The distribution of the small mammals more or less coincides with the boundaries of the Deosai Plateau.

Deosai plain has been declared as protected area for brown bears (Ursus circles) and their better management in the Deosai National Park. The Deosai Plain is a Plateau 20 km wide and 30 km long, situated about 30 km south of Skardu and 80 km east of the Nanga Parbat Range in Pakistan. The elevation ranges from 3500 to 4500 m above sea level and falls in the alpine ecological zone. Activities prohibited in the Deosai plains include:

- Killing, trapping and hunting of different species like birds, bear, marmots, snow cock, partridges etc.
- Destruction of any animals habitat (Deosai Plain is habitat of brown bear and marmot).
- Collecting of live animals or parts of animals dead or alive for any purposes.

The Northern Areas Forest Department Skardu has provided the following data about wildlife, which is responsible for safeguarding the forest and wildlife. The wildlife found in Skardu and its surroundings district include Asiatic ibex (Capra ibex sibirica), Snow leopard (Panthera uncial) wolf (Canis lupus), red fox (Vulpus vulpus), marmot (Marmota caudate) and mouse (Ocholona sp). Musk deer (Moschus moshifeus) is known to be found in the area but has been highly priced hunted for its musk. Common birds include chukor partridge (Alectoris choukor), jungle crow (Corvus machrohyncos char) and Huimalayan snowcock or ram chakor (Telraogallus himalayensis). Asiatic ibex is probably the most abundant caprinae in Pakistan, in restricted to relatively dry mountains of Northern Pakistan, which include the inner Himalayas, Hindukush and Karakoram. Population numbers for Northern areas (district Gilgit, Diamer and Baltistan) were estimated to be between 9,000 and 10,000 ibex in 1983 (Hess et al. 1977).

Satpara is a scattered settlement with meager population. Considering its wildlife resources to be protected and preserved, shooting, trapping of wild animals is banned except with a special permit. Killing and capturing of animals and birds is also restricted and specified in the permit. Snow leopard and ibex are declared, as endangered and other species of mammals are scarce. But trophy hunting is allowed which is beneficial to the local community as the 70% of the funds go to the local community, which is used for the development of the local area.

Local inhabitants were interviewed, during the IEE study, about sighting of game animals. Their observation was that Ibex descends down village Satpara Bala during winter. Game watcher posted to monitor the wildlife in Satpara valley stated that poaching and illegal hunting is not common. However, the decline in wildlife has been witnessed over number of years.

4.3.10. Forestry

Forestry is important for fuel and timber, in addition to control of the soil erosion and reduction of silt load in lakes and rivers, Survey in Satpara valley showed that utilization of wood as a fuel, for construction purpose and for grazing has a great important for each household. To encourage and involve people top grow

more forest, a Forestry Development Program has been initiated with the assistance of AKRSP and local community organization with the help of Norwegian Agency for Development Cooperation (NORAD). A new program of planting trees over private land by the people of the project area has been started with the help of Forest Department. The forest areas including uncultivated wasteland are State Forests onward by the government. Wood is used for timber, fire and fuel throughout the year. Firewood is used winter season. Agriculture university of Norway is striving hard to save the resource. Satpara in the valley more forest plots are planted to reduce the pressure on existing forest.

4.3.11. Vegetation in the Project Area

The area falls under three major vegetation types (Schweinfurth, 1957). The lower northeastern part of the Indus River to about 2500 m elevation is described as sub-tropical semi desert. Dry, steep slopes with outcrop of rocks dominate the area. People practice single cropping agriculture and sub-tropic horticulture based on irrigation channels leading the glacial water from higher up the valley. The area above the sub-tropical semi-desert is classified as Steppe of Artemisia dominated by shrubs such as Artemisia maritime, ceratoides and Kochia. The average annual rainfall in the area is less than 150 mm, lacking a defined rainy season. The average rainfall may approach 400-500 mm, depending on location. Most of the precipitation is received as snow during winters.

High snow-covered mountain peaks surrounded by the valley and slides into moraine from the valley sides. Vegetation various from drier eastern facing slopes to the moister northwestern slopes. Natural blue pine forest covers the north western facing moraine slopes. The forested moraines are led by deep gulches and glaci fluvial gravel farms sparsely vegetated by pine trees, willow (subx sp) and shrubs. Grassy slopes and juniper (Juniper macropda) cover areas where the forest has been cut down. About the pine, patches of birch (Belula utillis) delineate the upper forest line at about 3,800 m amsl. Steep slopes with artenisia (Artemiri maritime) characterixe) characterize the southeastern facing parts of the valley up to 3,600 m amsl. Patches of blue pine and Juniper are found around the lower part at about 3,300 m amsl. Average rainfall is 400-500 mm depending on location and precipitation is received primarily as snow during winter. The Altitude limits cultivation to single cropping favoring alpine species such as barley.

The class high alpine scrub and meadows cover all areas above 3800 m and contains different habitats such as Scree slopes, boulder areas, meadows, etc.

The upper part of the valley Charimond and Mangalistrong was recorded under this class. The grazing areas above Sari and Birtay and Ruskin (Steppe of Artemisia on Moraine) stops appear to be heavily grazed.

4.3.12. Cultivated Plants

In and around the villages various trees are grown for full, shade, timber and firewood. In northern parts of the state where there is great scarcity of timber and fuel wood, these plantations are very jealously guarded. Poplar (Populus nigra) trees, which are grown for timber, are very often protected from browsing damage by typing thorny branches around them. More commonly plants are black poplar (Populus nigra), apricot (Prunus armenica), wainut (Juglans regia), mulberry (Morus spp), grape (Vitis vinifera), apple (Pyrus malus), pear (Pyrus communis), pomegranate (Punica granatum), sour cherry (Prunus cerasifera), sweet cherry 9prunus aviium), peach (prunus persica), Amlock (diospyros lotus), fig (Ficus carica), almond 9prunus amygdalus) maple (Plantanus orientalis) and willow (Salix spp).

4.3.13. Pastures

The natural pastures are found above tree limit from about 3811 meters elevations. Only herbaceous plants grow and the density of found cover depends on available moisture and soil depth. The most common grasses are Astrangalus spp, Ptygonum ssp, saxifrage spp, Oxyfropis spp, corydalis spp, and poterntilla spp. These Pastures are used from April to October.

Beside these natural pastures large blanks areas within the forest is also used as pastures during different months depending on their altitude. Common grasses and plants are Salix spp, Juniperus spp, Rose spp, Berberis vulgaris spp, Lonicer spp, Prunus jacquenmontil, Betula utills, Rhamnu minula, Heracleum thomsoni, Ribes villosum Ephedra gerardiana and Vibumum continifolium.

The inhabitants keep large of goats and sheep to supplement their food supplies in the form of milk and meat as well as for providing wool, which is used in various local craft, During the winter months when practically the whole of the tract remains under the cover of the snow, flocks are fed on oak leaves for which purpose the oak trees are lopped. The intensity of lopping is heavy and quite frequently the entire new growth is removed. During the mild summer months these flocks are grazed in the alpine pastures where they often herd in the upper forest limit.

The oak branches lopped for the leaf fodder are utilized as fuel wood in the villages, in areas adjacent to Oak forests, which are cut ruthlessly for this

purpose. In certain areas deodar is also lopped for fuel wood due to the absence of oak. In upper reaches there is acute shortage of fuel wood and the people burn bushes like Artemisia spp, and Ephera spp. A survey carried out in the project area while conducting the IEE study showed that average houses hold consumption is around 20-25 mounds in winter and around 10-15 mounds in summer. This requirement is higher in upper pats of the valley while comparatively lower in lower parts.

4.3.14. Protected Areas

The Satpara Lake has been notified as a wildlife sanctuary. Another protected area – Deosai National Park – exists about 16 km south of the Project site.

4.4. Socioeconomic Environment

The Northern Areas (now Gilgit Baltistan) are divided into five districts. These districts work under the decentralized system of government responsible for the general administrative. The districts are further divided in to tehsils and Sub-tehsils. Local councils run these tehsils and formulate polices, resolving issues and providing leadership at grass root level. They play most important role in the local government. Socio economic indicators show that Skardu is backward with low quality of life. The means of communication are available by air as well as by road throughout the year. Life style is gradually improving after the construction of Karakoram-Gilgit – Skardu road.

4.4.1. Population

The increase in population of Northern Ares has been more than double since the first population census in 1951 compared to second census in 1981 as it increased from 0.25 million to 0.57 million showing 126.4 percent increase. According to population census 1998 the population of the northern Areas was 0.87 million as against 0.57 million in 1981 showing annual growth rate of 2.5%. The overall urban proportion for Northern Areas has increased form 8.34 percent in 1981 to 14.05 percent in 1998. The density of population has increased from 8 persons per sq. Km in 1981 to 12 person per km^2 in 1981. If the population continues to grow at its present rate it is likely to be double in 26 years unless some effective measures are taken to reduce birth rate, in rural areas population concentration is mostly along rivers and streams. Majority of the villages are spread out on the both of river/streams.

The study of population as well as the growth and distribution is highly important to forecast load of the areas, which based on these parameters. With the objective in view the detailed analysis of the information, contained in 1981 and 1998 censes (brief) of Northern Areas was made. Data collected from the

offices of Deputy Commissioner/Assistant Commissioners was also considered. The population of Northern Areas is unevenly distributed among its districts. The district Gilgit has the maximum population i.e. 27.96% while Ghanche, the minimum i.e. 10.15%. Urban and rural annual growth rates are the highest in Diamir district (urban 6.29% and rural 2.8%) between 1981 and 1998 whereas the same are the lowest in Skardu district (urban 4.85% and rural 1.82%).

Literacy ratio in the project area population is low being 6% to 38%. Only limited number of households has access to water supply. The size of landholdings per family varies from 23 to 6 acres, 5 acres being self-sustainable.

4.4.2. Settlements Households

Project area is spread over two settlements namely Skardu valley and Satpara consisting of several villages. These villages are located along the Satpara nullah upstream and downstream of the Lake.

4.4.3. Family Structure

Field enquiries show that majority of households are inhabited by single families. According to 1998 population census average size of household of the Northern Areas comes to 7.9 persons as compared to 7.1 to 1981. Variation in the average household size exists among the district i.e. 8.2 persons per household and the lowest in Ghanche district i.e. 6.7 persons per household. Population statistics subdivision wise showing growth rates and persons per household are in socioeconomic section. The average family size in Satpara valley is 10 members per household.

4.4.4. Ethnicity

The project area is inhabited by people from two different ethnic/linguistic compositions and has distinct socio-cultural traditions, language and way of life. The upper part of the Satpara nullah is dominated by Shina speaking people. The lower part of the valley is in habited by Balti speaking people.

4.4.5. Agriculture

Most of the agricultural activities in the Skardu and Satpara Valley are carried out on the terraces prepared in the vicinity. The land is much fragmented and per capita land holding is 1.5 kanals (0.089 ha). About 14,700 hectares of land is under cultivation.

About 90% of the population depends upon farming. Agricultural production cannot cope with the food requirement for whole of the year, therefore the

farmer research side earning through labors and trade especially during winter season. Agriculture is the dominant domestic economic activity and is essential to the rural populations who have to depend upon the production of their land holding when alternative income sources are insufficient. In view of peculiar climatic and topographic conditions of the area only single crop is practiced and in some areas buck wheat/kangari is cultivated as fodder crop after wheat harvesting.

Irrigation intervals reported for maize are 15 to 20 days depending on the rise in temperature and grain filling time. A serrated sickle close harvesting and threshing is done either by hand or trampling of grain by oxen.

4.4.6. Horticulture

A variety of crop patter is practiced in the system. The main crops grown in the project area are wheat, maize and barley. A special importance is given to the cultivation of fruits. Fruits are grown for household consumption as well as for market sale in the farm. Fruits include apricot, cherry and mulberry. Eucalyptus is grown on the sides of roads. There may be some variation in the farm size or in the status of minor crops in the overall cropping practices but the general combination of crops; livestock and other farm related activities are more or less the same. Majority of the trees are grown on the field boundaries and banks of watercourses. The Agriculture Department and Aga Khan Support program (AKRSP) are making efforts to improve crops and fruits production through various schemes of seed production and multiplication, development of horticulture and plant protection operations. Scheme for land reclamation and construction of irrigation channels are also underway to bring more area under plough.

The agricultural department of Skardu has recently provided about 10,000 plants to the people for plantation purposes.

4.4.7. Occupation and Income

In the Satpara valley majority of population is engaged with agriculture profession about 5% are employed in other fields (mainly in the field of education department and NGOs) 5% engaged in hotel business and about 10% in labors.

Annual average income per household in Satpara Valley is given in **Table 4.10**, the lowest 9% have Rs. 20,000 to Rs. 30,000 annually, and the maximum 30% have Rs. 5,000. The average income per household is Rs. 16,500 per annum.

4.4.8. Migration

Field survey shows that a big percentage of permanent migration of population is taking place from down country and rural areas to Skardu urban areas mainly of business related persons. Skardu town is the district headquarter where all administration setup based. Jobs and business opportunities are available. Due to limited employment opportunities, transport and marketing problems of high value crops, people have to look for jobs or business in and outside their villages to earn their livings. Various forms of migration have been reported in Satpara village. Firstly there is a periodic migration when people go on appointment or transfer to other part of the states and visit their families. Secondly a number of students are studying in other parts of the country and come to their villages on vacations or special occasions. Thirdly there is a seasonal migration, which takes place during winter from the area of high altitude due to extreme cold. People along with their cattle move to the lower part where pasture fields can be found. As summer approaches these people return to their houses in the upper part with the cattle.

The NAPWD is already facing problems in providing drinking water, sanitation and electricity facilities due to rapid population growth and the seasonal migration are causing further threat to these facilities. The household income is estimated/derived from various farming activities and the other sources of income such as wages, salaries, pension, shop keeping, trade and small-scale industries. Average household income varies from area to area.

4.4.9. Education

The overall literacy rate in the entire Northern Areas was about 30% according to the census of 1981. The literacy ratio in urban areas is 36.8 percent compared to 12.6 percent in rural areas, which is even poorer when compared to the state where it is 47.1 percent (59.0 percent male and 35.4 percent female).

During the survey as part of the IEE study it was observed that the number of schools is increasing and people are very keen to get their children educated. Some Non-Government Organizations are striving hard to develop education facilities in the Northern Areas. The government of Northern Areas and local community based organization are taking great interest to develop education facilities in the project area. Primary education has been the top priority within education sector as is evident from the fact that half of the budget allocation had been earmarked for the promotion of primary education.

4.4.10. Health

Health facilities are not well developed within the project area. Lack of adequate facilities has affected the incidence of malnutrition, illness, mortality and fertility. The local government within the project area provides health care facilities. The health facilities are scarce and the life expectancy in the valley is short. Infant mortality rate is high. One government dispensary is located in the Satpara village, which has no qualified doctor only a dispenser is serving and treating the patients. Serious patients and maternity cases are taken to the Skardu hospital, which is located about 15 km from Skardu city. Some old experienced women in this field make deliveries at home. However, nowadays government is employing lady health workers for this purpose. These workers actually belong to local area and after being trained will be deputed in the village to look after the children and maternity cases.

The prevailing diseases in the project are asthma and bronchitis, probably caused by the prevailing adverse in door atmosphere due to the poor ventilation and extensive use of kerosene and wood for heating and cooking. Chronic lung diseases were regarded as the extensive "traditional ways of dying", from January to March being the period having the heaviest toll. Diagnosed eye diseases are also commonly connected with in-door climate. During load shedding the use of generators to provide electricity to government houses and hotels create air pollution that may also be the risky to the common health.

Increased vegetation cover in Skardu Town due to afforestation along the Indus River during the past decades has considerably reduced the sand storms related problems, and health professional believe this has had a positive health impacts.

Other common diseases like typhoid, hepatitis A & B, seasonal diarrhea, gastrointestinal fever, clod, and tuberculosis/asthma are common. The children and women particularly are the more vulnerable to these diseases.

4.4.11. Existing Power Stations

There are two hydroelectric powerhouses constructed by NAPWD on the right bank of the Satpara nullah along the Satpara road, downstream of the dam. The capacity of these powerhouses is 960 KW. These powerhouses used to supply electricity to the Skardu city as well as adjoining areas. However, cooking and heating was not allowed from these hydroelectric powerhouses. After the commissioning of Powerhouses 1 and 2 of the Satpara Dam Project, the NAPWD powerhouses have been decommissioned.

4.4.12. Cultural Heritage

So far no initiatives have been taken to explore the archaeological resources of the area by the Governments. Although the population of the area has been in the valley for since long people are not aware of any archaeological features site in and around the valley. A fort namely Kharpochu is resting on the mount in the Skardu city.

4.4.13. Women in Project Area

In Northern Areas of Pakistan women take all responsibilities at home. Their responsibilities include taking care of household activities, bringing up of children, agriculture (sowing, watering, weeding), livestock, poultry and collection of wood for cooking etc. Female population also carries out drying of apricot and mulberry; men also participate in leveling of land and sowing of crop. Now women are taking interest in all the fields especially education and health.

4.4.14. Tourism

Tourism is the backbone of the Northern area's economy. Hundreds of people are engaged with this profession. The whole of the Northern Areas is known as the paradise for mountaineers, climbers, trekkers, hikers, painters and photographers. The area is well known in Pakistan for its scenic beauty and high mountains. The three mighty mountain ranges i.e. the North West Himalayas, the Karakoram and the HIndukush are the places of the world. These are not only representing the geographical phenomenon but also a part of the history and civilization in the past. Through these passes Buddhism reached China and other far eastern countries has become the part of many cultures.

Hunza, Naltar, Yaseen, Deosai plain, Astore and Skardu are the valleys of immense beauty in the Northern Areas. Skardu has a historic fort known as castle of Queen Mindoq and two lovely lakes, Kachura and Satpara, which are at a distance of 29 km and 8 km from Skardu, respectively. In Diamer district there is the Rama lake, covered with snow, is a place of worth seeing. Shigar valley, 32 km from Skardu, is the gateway to the mountain peaks of the Karakoram.

The culture patterns in these areas are as interesting as its topography. The people with their typical costumes, folk dances and sports provide some interesting area of study. The tourist season remain in full swing from April to October. During the mountaineering season the government collects million of rupees from trekking groups. The increasing numbers in mountaineering and

trekking expeditions has created pollution too. The Government started receiving US$ 200 per expedition party to overcome this problem since 1989. There is a continuous flow of tourists in the area from other parts of the country. China and abroad and the tourist industry is flourishing In view of the past trend it is expected that tourist traffic will increase further in future.

Realizing the immense potential of tourism for the Central Karakoram area, one criteria' for World Heritage list nomination has been world-class mountaineering and trekking opportunities. Indeed, in numerous mountaineering and scientific expeditions have visited the area since over 150 years. Trekkers and adventures have followed their footsteps since the 1980's, when the area was opened for regular tourist flow. The Central Karakoram is estimated to provide 70% to 75 % of regulated foreign tourism in Pakistan. Baltistan is estimated to receive ca. 4.000 foreign tourists annually and a considerably larger number of porters, guides and cooks from other parts of the country. It goes without saying that this increasing trend of tourism to the area does leave its marks on the natural environment and the local cultures. To lessen the negative impact on the area, the concept of 'eco-tourism' is propagated in the planning process. Eco-tourism can be simply defined as form of tourism, which is socially and environmentally sustainable. Another version of this form of tourism, ethno-tourism, may become a viable option once the area becomes better known for its outstanding culture features, and tourists will be attracted to experience the unique ways of life still found in these remote regions. This has already happened partly in Gilgit region and areas falling into the buffer zone of the park, i.e. Hunza, Nagar. Considerably larger numbers of foreign tourists than the figures given above for trekking and mountaineering, frequent these buffer zone areas for sightseeing and independent trekking. Tourism infrastructure is particularly well developed in these areas and partly; the concept of a culture zone, already exists here in practice. Nonetheless, the establishment of cultural zone to attract more tourists into the buffer zone around the park should be provision in the initial park management plan.

4.5. 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 sites, the reservoir area, and area along the irrigation canals), during the reconnaissance site visit as part of the current assignment. No obvious evidence was observed of any changes in the environmental media since the IEE study conducted in 2002 – 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.

4.5.1. Environmental Aspects at the Dam Site

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:

- Enlargement of the Satpara Lake caused by of the construction dam, and associated landuse and land form changes, including cutting of trees.
- Possible increase in fish population in the Lake.
- Widening of the road passing through the Project area (and leading to Deosai)
- Contractors' site facilities including offices, workshop, warehouse, residences, labor camp, and associated facilities.
- Borrow areas for the project
- Contamination of soil and water caused by improper waste disposal (work shop, offices, and residences). Most of the sewage from the temporary facility is discharged into the river/streams without adequate treatment. This not only contaminates the soil, but also the river water. 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, canals, and associated facilities/structures.
- Adverse impacts on the tourism activity in the area.

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.

4.5.2. Social Aspects

Resettlement and community development action plan: The Resettlement and Community Development Plan proposed in the feasibility study is not in place. Due to compulsory land acquisition, the communities are economically marginalized. The community grazing areas have been squeezed and tree stock reduced. The communities of Satpara live upstream of the Lake and they consider that the project is having adverse affect on their lives, while it is beneficial to the people living in Skardu. To address the grievances of the communities there is a need to develop an environmental management and community development action plan in a participatory manner with experts' inputs.

Compensation issues: Discussions with the effected population and WAPDA officials has revealed that there exists a variety of issues related to land acquisition. The WAPDA record shows that Rs.148.973 million has been paid as compensation so far for 58.98 acres; cases of compensation of Rs.4. 666 million and Rs.27.379 million are under process; and 19.13 acres of land valuing Rs.31.509 million is to be acquired. It is also observed that there are rate enhancement issues and multiple ownership claims which need resolution.

The community of Satpara has a collective claim of trees inundation valuing Rs.20.086 million and WAPDA has accepted their claim after due process, but the district administration has not yet cleared it. However, community representatives highlighted that chief secretary GB has cleared the case and once the funds will be available the compensation payments will be released. The whole process needs to be accelerated in a transparent manner.

Special development package: Residents of Satpara are economically displaced through inundation of grazing area and cutting of trees. AKRSP has already constructed an irrigation channel and construction of more such channels will enable the communities to get enough land to improve their livelihood. A planned tree plantation around the lake will contribute a lot to the fuel wood and fodder requirements of the communities. It will also contribute to enhance the scenic beauty and will stabilize the slopes.

Access Road: Access to powerhouse 3 and 4 passes through built up area. An alternate road from powerhouse 3 should be considered. It will not only help in smooth construction of the powerhouses but will be helpful in operational phase as well. The present access is narrow and there are chances of accidents.

Employment on the project: The people of Satpara feels that they are not accommodated as unskilled and semi skilled workers by the contractors and WAPDA. However during discussions the contractors were of the view that

they were in final phase of construction and did not need so much unskilled workforce. Nonetheless, employment opportunities should be made available to the local population.

Impact on Skardu: People of the region at large get enough electricity. The drinking water supply system for Skardu has improved and is having positive impact on their lives. However it was observed that proper billing system is not in place.

Borrow areas: Borrow areas needs proper treatment afterward, totaling eight in number. It was observed that one of the borrow area is quite near the dam, and measures such as terracing with plantation will be needed to stabilize the slope.

Flood protection: Satpara nullah downstream the dam needs flood protection work as well as land use control. It was observed that the flood plain is encroached upon by construction activity and agriculture. During discussions with the officials and communities they put it on priority due to 2010 flood experience.

Tourism: Satpara was a favorite destination of tourists due to its scenic view and available facilities before the Project commencement. The construction of the dam inundated the facilities and once the reservoir is filled, it will further shrink the facilities. The Pakistan Tourism Development Corporation (PTDC) has constructed a motel near the Lake, but due to unavailability of water supply system, it is not functional. There is a need of coordination and facilitation mechanism to boost tourism at appropriate locations.

4.6. Floods of 2010

The 2010 floods caused large scale damages across the country, and the Skardu and its surroundings also experienced heavy rains. According to the information provided by WAPDA, during June 2010, the maximum inflow in the Satpara Lake was recorded to be 56.07 m^3/s (1,980 cusecs), and the maximum outflow from the Lake was recorded as about 36.39 m^3/s (1,285 cusecs). However these high flows did not cause any damage to the Project components or facilities. No significant damages were reported along the Satpara nullah downstream of the dam either.

Table 4.1: Water Sample # 1 Test Results at Khosho Skardu (NIH)

Analytical Parameters	Reference Value	Results	Analytical Parameters	Reference Value	Results
Calcium (mg/l)	200	40	Chloride (mg/l)	200	14.95
Chlorine (mg/l)	0.3	Nil	Nitrate (mg/l)	10	0.425
Magnesium (mg/l)	200	4.80	Sulfate (mg/l)	200	45.35
Sodium (mg/l)	500	15	Nitrite (mg/l)	0.1	Nil
Hardness (mg/l)	150	120	Bicarbonate (mg/l)	500	91.53
Potassium (mg/l)	100	3.0	Iron (mg/l)	0.3	-
Ozone (mg/l)	0.5	-	Fluoride (mg/l)	1.5	-
Total Dissolved Solid (mg/l)	1,000	168	Suspended Solids (mg/l)	Nil	++
pH	6.5-8.5	7.86	Color	Unobjectionable	Normal
Turbidity (NTU)	5.0	224	Odor	Unobjectionable	Normal
Conductivity (µS/cm)	1,334	-	Taste	Unobjectionable	-

NTU= Nephiometric Turbidity Unit

Result obtained from Mr. Nazir, AEE, NAPWD Skardu.

Table 4.2: Water Samples # 2 Test Results (WASEP)

Parameters	Satpara Lake	Powerhouse 1		Powerhouse 2		WHO	
		Up-stream	Down-stream	Up-stream	Down-stream	Guidelines	Standards
pH	6.5	6.8	7	7.2	6.8	7.5	6.5 – 8.5
Turbidity (NTU)	8	8	9	12	8	5	5 – 25
Total Dissolved Solid (mg/l)	111	114	117	42	115	200	500-1,500
Suspended Solid (mg/l)	56	68	68	4	65	80	75-200
Total Alkalinity (mg/l)	46	50	58	60	58	100	30
Total Hardness (mg/l)	88	92	100	72	92	75	45
K (mg/l)	28.8	60.5	33.6	24	32	50	
Mn (mg/l)	3.9	3.9	3.92.9	3	2.9	0.05	200-400
Nitrate (NO_3) (mg/l)	0.03	0.03	0.04	0	0	0.35	
Cl (Chloride) (mg/l)	20	40	40	0.01	20	70	
Sulfate SO_4 (mg/l)	60	65	58	6	68	100	
Greece traces (mg/l)	0	0	3.4	0	1.9	0	
Iron (Fe) (mg/l)	0.03	0.06	0.04	0.1	0.1	0.3	

NTU= Nephiometric Turbidity Unit

Result obtained from Mr. Nazir, AEE, NAPWD Skardu.

Table 4.3: Chemical and Bacteriological Analysis of Water Samples of Satpara Nullah and Lake

Sample Code	Date Sampled	Location	Temp (°C)	Q. ($m^{3/}s$)	DO (mg/l)	CO_3 (mg/l)	Mg (mg/l)	NH_3	NO_3	COD (mg/l)	T Coli-form	E. Coil MPN/100ml
SDP-01	18/5/02	U/s lake	9°C	14.2	9.9	48	0.2	0.2	0	4	17	17
SPD-02	18/5/02	U/s lake	12°C	-	10.0	70	Nil	0.1	0	90	2	Nil
SPD-03	18/5/02	D/s dam	9°C	S5.8	10.4	74	Nil	Nil	0	52	2	2
SPD-04	18/5/02	D/s dam	10°C	-	10.0	70	0.3	Nil	0	20	4	4

Analyzed by Institute of Environment Engineering and research. UET, Lahore.

Sample Code	Date Sampled	Location	Temp (°C)	Do. %1	DO Mg/l	AJK Mg/l	MG (mg/l)	NH_3-N	NO_3	COD (mg/l)	Ca	PO_4
SDP-05	03/09/02	U/s bridge	9°C	73.2	11.6	56	4.8	0.2	4	20	24	12
SDP-06	03/09/02	Lake	14.5°C	85.4	10.3	56	9.6	0.1	4	4.0	24	0.7
SPD-07	03/09/02	D/s Lake	14.5°C	86.4	10.3	56	5.8	0.05	4	32	24	0.1
SPD-08	03/09/02	Powerhouse	14.5°C	92.2	10.3	52	5.8	0.05	4.5	5.0	23.6	0.8

Solubility of Do in water in equilibrium with dry air at 760mmoh Hg and containing 20.9% oxygen.

Analyzed by Institute of Environment Engineering and research. UET, Lahore.

Table 4.4: Chemical analysis of water samples of Satpara nullah and Lake.

Sample Code	Date Sampled	Location	Temp (°C)	Q. (m^3/s)	Ca++ (mg/l)	CO_3 (mg/l)	Mg (mg/l)	Na (mg/l)	HCO_3	SO_4 (mg/l)	DS EVP PPM	pH
SDP-01	18/5/02	U/s lake	9°C	14.2	0.9	0	0.1	0.24	0.8	0.25	73	7.78
SPD-02	18/5/02	U/s lake	12°C	-	1.1	0	0.41	0.50	1.40	0.40	119	7.77
SPD-03	18/5/02	D/s dam	9°C	5.8	1.2	0	0.41	0.401	1.40	0.30	121	7.78
SPD-04	18/5/02	D/s dam	10°C	-	1.1	0	0.6	0.40	1.60	0.20	125	7.79

Analyzed by Scarp Monitoring Organization, WAPDA, Lahore.

Sample Code	Date Sampled	Location	Temp (°C)	K	Ca++ (mg/l)	CL	Mg (mg/l)	Na	HCO_3	SO_4 (mg/l)	DS EVP PPM	pH
SDP-01	03/09/02	U/s bridge	9°C	.04	1.3	.800	0.40	.71	1.10	.50	140	7.07
SDP-02	03/09/02	Lake	12°C	.04	0.2	0.20	1.30	.18	1.10	.40	97	8.14
SPD-03	03/09/02	D/s Lake	9°C	.04	1.2	0.20	0.3	.18	1.10	.40	97	8.15
SPD-04	03/09/02	Powerhouse	10°C	.04	1.3	0.50	0.3	.42	1.10	.40	116	7.7

Analyzed by Scarp Monitoring Organization, WAPDA, Lahore.

Table 4.5: Laboratory Findings of Bacteriological Test of Water

Sample No.1 Spring water		Sample No.2 Tap water	
Analytical Parameters	**Results Mg/l**	**Analytical Parameters**	**Results Mg/l**
Total Viable count	$5x10^3$ per/ml	Total Viable count	$1.9x10^3$ per/ml
Coliform count	$2.4x10^3$ per/ml	Coliform count	$3.8x10^3$ per/ml
MPN for coliform	240^+/100 ml	MPN for coliform	240^+/100 ml
MPN for faecal coliforms	Negative	MPN for faecal coliforms	Positive/100 ml

Result obtained from Mr. Nazir AEE NAPWD Skardu

Table 4.6: Mean Monthly Temperatures and Precipitation

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temp (^oC)	-2	1.3	6.8	11.6	15.5	20.8	24	24	19.5	12.2	5.5	-0.8
Precipitation (mm)	15	20	21	36	32	7	9	16	8	7	3	13

Table 4.7: Vegetation in the project area

Woody (trees and shrubs)	Popular, Willow, Rubina, Apricot, Almond, Peach, Walnut, Pine trees, Mulberry, Selix spp, Betula utills.
Crops	Alfalfa, Maize, wheat.

Table 4.8: Types of Trout Fish in the Satpara Lake

Brown Trout	Salmo truta fario
Rainbow Trout	Salmo gairdneri
Kamlcop	Salmo gairdneri Kamloop

Table 4.9: Relative Numbers of Small Mammals on Deosai Plateau

	Bara Deosai				Shota Deosai				
	Shatung (4.050)	Shatun (3.880)	Kala (3,970M)	Sheosar (4,150m)	Barzil (4,200m)	Sufaid (3,650m)	Parashin (3,333m)	Chitam (3.350m)	Total
Sorex	0	2	2	2	0	2	0	1	9
Crociduia	0	0	0	0	0	0	0	1	1
C. sunveolens	0	0	0	0	0	0	1	0	1
Mustefa	1	1	0	0	0	0	0	0	1
Ochotona royfei	1	0	0	0	0	1	2	0	4
Hypwacms	21	15	28	16	9	4	9	8	110
Alttcola	26	0	7	1	0	2	15	0	51
Siesta concolor	0	0	5	4	0	1	0	0	10
Apodemus	0	0	0	0	0	0	18	4	22
Rattus	0	0	0	0	0	0	0	2	2
Maimofa	8	8	10	10	0	0	0	0	36
E. fimbriatus	0	0	0	0	0	0	1	0	1
Pipislrgllas sp	0	0	0	1	0	0	0	0	1
Total	57	26	52	34	9	10	46	16	250

Source: IUCN Sakrdu Baltistan.

Table 4.10: Annual Income of Population of Satpara Valley

% of Population	Annual Income (Rs.)
17	30,000
9	20,000-30,000
11	15,000-20,000
9	10,000-15,000
24	5,000-10,000
30	Up to 5,000
Total 100%	:

5. Rapid Environmental and Social Assessment

This Chapter discusses the negative and positive impacts 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 described 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 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.

Categories	Characteristics
	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 provided 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. Project Siting/Design Impacts Identified in WAPDA IEE [18]

The IEE report prepared by WAPDA in 2002 identified the potentially significant adverse impacts associated with the site and design of the Satpara Dam Project. These included resettlement issues, erosion of watershed, and erosion of nullah bed downstream of the dam. These impacts, their various characteristics and significance, as well as the mitigation and control measures to reduce if not totally eliminate these adverse impacts are discussed below.

5.2.1. Resettlement Issues

The land take needs of the Project are about 42 ha (103 acres), of which about 34 ha (84 acres) has already been acquired in accordance with the procedures defined in the LAA 1894 (see **Section 2.1.4**). According to the information

[18] The IEE study conducted by WAPDA identified these impacts, but did not characterize or assess the significance of these impacts, as has been carried out in this Section.

provided by WAPDA[19], compensation has already been paid for 24 ha (59 acres) of the land take, and payment is in process for further 10 ha (25 acres) of land. The land acquired for the Project includes eight houses also; compensation has been paid to the owners of these houses.

Significance of this impact has been determined as follows:

Nature:	direct
Duration of impact:	long term
Geographical extent:	local (reservoir and adjacent area)
Timing:	Construction phase
Magnitude:	medium
Reversibility:	irreversible
Probability:	likely
Impact intensity:	high
Significance:	high.

Mitigation. WAPDA should facilitate early payment for the remaining portion of the compensation. WAPDA should also maintain liaison and coordination with the communities to address and resolve any pending issues or grievances associated with the land acquisition and compensation assessed/paid. WAPDA should also ensure complete transparency of the entire compensation assessment and payment of compensation. It is further recommended that a Grievance Redressal Mechanism (GRM) is established at the Project site, to receive, document, and address the grievances of the stakeholders particularly of the communities in a systematic and transparent manner.

The IEE conducted by WAPDA mentioned that WAPDA would prepare and implement a Resettlement and Community Development Action Plan. This Plan has not been prepared so far. It is now recommended to prepare and implement this Plan, focusing on the community development, in addition to addressing any remaining resettlement issues.

Employment opportunities should be maximized for the local population, particularly those who have been directly affected by the Project.

5.2.2. Land Slides, 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

[19] WAPDA 2010; Satpara *Dam Project - Presentation to USAID/AEAI*.

solid load in Satpara nullah, can potentially cause siltation in the reservoir, and reduction in the water storage capacity. In addition, several slides exist on either sides of the reservoir, posing a potential risk of accelerated reservoir siltation, and also damage to the physical infrastructure including the road leading to the Deosai Plains. The WAPDA studies carried out in 1987 estimated the reservoir capacity reduction of about 5% in 15 years of reservoir operation (Satpara Dam IEE Report – WAPDA 2002).

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:	medium
Reversibility:	irreversible
Probability:	likely
Impact intensity:	moderate
Significance:	medium.

Mitigation: Watershed management upstream of the dam, and slope stabilization around the Lake can reduce the slit load in the reservoir. A comprehensive slope stabilization, 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 land slides and soil erosion in the catchment area particularly on the hills surrounding the Lake (see **Photographs E.3** to **E.5** in **Appendix E**), and to identify and design various types of structural (such as gabions, check dams) and non-structural (such as plantation) measures – as well as combination of structural and non-structural measures through techniques such as bio-engineering[20] - to control the soil erosion and land slides in the area. WAPDA has previous experiences of developing and implementing such plans for the Mangla and Tarbela dam catchment areas. Appropriate terracing and where necessary gabions may be needed to protect the Deosai Plains road on the right bank of the Lake.

[20] 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.

5.2.3. Erosion of Nullah 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 nullah bed erosion. The nullah bed erosion can potentially affect the physical structures built across the Satpara nullah, such as components of the powerhouses (such as head race and tail race), as well as bridges and culverts. However, in view of the fact that Satpara Lake existed even before the Project commencement, there will only be an incremental change in the silt load in the water releases from the dam after the Project completion. The Significance of this impact has been determined as follows:

Nature:	indirect
Duration of impact:	long term
Geographical extent:	local (nullah bed downstream of dam)
Timing:	after reservoir impoundment
Magnitude:	small
Reversibility:	irreversible (during the life of the project)
Probability:	likely
Impact intensity:	mild
Significance:	low.

Mitigation. Despite the low significance of this potential impact, the Satpara nullah 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 nullah bed downstream of the dam will be monitored on a regular basis, particularly near the powerhouse components bridges and other structures. Repairs will be carried out where necessary.

5.2.4. Loss of Natural Vegetation and Biodiversity in the Project Area

Several thousand trees were standing in the area to be submerged prior to the Project commencement (Satpara Dam IEE Report – WAPDA 2002). Many of these trees were removed when the additional impounding started in the Satpara Lake after the partial completion of the dam, as reported by WAPDA officials during the present assignment. Additional trees will be submerged when the reservoir attains its design level. Some of this vegetation provided habitat to wildlife particularly birds as well. Furthermore, establishment of the project's temporary and permanent facilities would also have caused some de-vegetation and loss of biodiversity. 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:	medium
Reversibility:	reversible (at least in the medium to long term)
Probability:	likely
Impact intensity:	moderate
Significance:	medium.

Mitigation. Compensation has been agreed to be paid to the owners for cutting of trees on privately owned land (see **Section 4.5.2**). Re-vegetation and tree plantation will need to 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. Use of indigenous, non-invasive species will be ensured. The NGOs active in the area and the affected communities should be involved in the planning and implementation of tree plantation. The Wildlife Sanctuary Management Plan, discussed later in this Section, will also address conservation and restoration of the biological resources and biodiversity of the area.

5.3. Additional Impacts Associated with Project Siting/Design

The potentially significant negative impacts associated with the Project Design/Siting not covered under the IEE conducted by WAPDA in 2002 are discussed in this section.

5.3.1. Dam Collapse

The collapsing of the dam can have catastrophic impacts downstream, including the powerhouses, command area communities and the Skardu town. This could be caused by a number of factors, including earthquakes, extreme flooding, vibrations caused by any damaged gate, or other similar events/situations.

Geotechnical investigations have been carried out and the dam design has been prepared in accordance with their findings. However, no information is

available on frequency and intensity of floods considered as part of the technical design of the dam and spillway. The earlier design of the 12.2 m (40 ft) high dam (see **Section 3.1**) was based upon flood with return period of 10,000 years, and the spillway was accordingly designed for a maximum flow of 284 m^3/s (10,000 cusecs), however the current spillway has been designed for 142 m^3/s (5,000 cusecs).

This aspect is assessed as follows.

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

Mitigation. Though the significance of this impact is 'medium', however, because of the large magnitude of the potential impacts to the communities along the Satpara nullah downstream of the dam, including the Skardu town, this aspect needs particular attention. The safe operation of dam and its auxiliaries will need to be adequately covered in the Project Operational Manual, which should also include an Emergency Preparedness and Response Plan and an Early Warning System.[21] Capacity building of the O&M staff will need to 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 Satpara nullah downstream of the dam. 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 Satpara nullah releases in the Indus river, however owing to the fact that the annual average flow in Satpara nullah is small (0.0977 MAF, compared to 48 MAF in Indus River – about 0.2 %), most

[21] The Federal Emergency Management Agency (FEMA) website on dam failure (http://www.fema.gov/hazard/damfailure/index.shtm) provides information useful for ERP preparation.

of which is currently diverted for irrigation, its overall impact on Indus River flow is likely to be nominal.

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

The powerhouse operation will not alter the water flow regime of the nullah, since these are essentially run-of-the-river type of powerhouses, and the water is released back into the nullah (or canal in case of Powerhouses 3 and 4) after passing through the turbine.

No information is currently available on the aquatic habitat downstream of the dam and its state after the Project completion. This aspect as well as the effects of possibly modified Satpara releases in the Indus River mentioned above need to be studied further.

This impact has been assessed as follows.

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

Mitigation. The pre-Project flow will be maintained in the Satpara nullah downstream of the dam and canal diversion, in order to support aquatic habitat, and to ensure that the nullah water reaches the Indus river.

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 canals, water released in the nullah downstream of canal diversion, and water reaching the Indus river.

5.3.3. Drinking Water Quality

Supply of unsafe drinking water to the communities can potentially have serious health concerns, particularly among the children. This impact is assessed as follows.

Nature:	indirect
Duration of impact:	long term
Geographical extent:	local (downstream communities including Skardu town)
Timing:	after the project completion
Magnitude:	medium
Reversibility:	reversible
Probability:	likely
Impact intensity:	moderate
Significance:	medium.

Mitigation. A water quality monitoring system needs to be established, through which water samples should be collected from various location (upstream and downstream of settling tanks, near the major communities, and randomly at the consumer/household level. Depending upon the quality of water, appropriate treatment will need to be determined, and the treatment plant/arrangements established.

5.3.4. Project Location in Wildlife Sanctuary

The Satpara Lake has been notified as a wildlife sanctuary; this aspect should have been considered before commencing the Project, and an EIA should have been conducted for the Project instead of an IEE, as described in **Section 2.1.2** earlier. Concerns have been raised in the past regarding the loss of biodiversity in the area, therefore it is important that appropriate steps are taken to safeguard the precious flora, fauna and biodiversity of the Sanctuary This impact has been assessed as follows.

Nature:	direct
Duration of impact:	long term
Geographical extent:	local (within the Sanctuary)
Timing:	construction and operation
Magnitude:	medium

Reversibility:	irreversible (during the life of the Project)
Probability:	certain
Impact intensity:	severe
Significance:	high.

Mitigation. This aspect needs to be urgently discussed with the Wildlife Department and the GB EPA. WAPDA should liaise and collaborate with the Wildlife Department for the development and implementation of the Satpara Wildlife Sanctuary Management Plan, which would define the measures to conserve (and restore if needed) the key biological resources of the Sanctuary.

5.3.5. Water Table Rise

Expansion of the Satpara Lake and the resulting increase in its water level may cause rising of groundwater table. The only area where this phenomenon can potentially have any negative impacts is the Satpara village upstream of the Lake. The rising groundwater table can adversely affect the cultivation that is carried out in this settlement, particularly in the fields along the river at the lower elevation; the fields located on the terraces at comparatively higher elevation than the nullah are unlikely to be affected.

Availability of additional and regular irrigation water supply in the command area can also result in rising of the groundwater table.

This impact has been assessed as follows.

Nature:	indirect
Duration of impact:	long term
Geographical extent:	local (in Satpara village, and in the command area)
Timing:	operation
Magnitude:	small to medium
Reversibility:	irreversible (during the life of the Project)
Probability:	likely
Impact intensity:	moderate
Significance:	medium.

Mitigation. In view of the sloping nature of the area, rising of the groundwater table is not certain. Therefore, no immediate remedial action is needed at this stage. The groundwater table however needs to be monitored, and appropriate

mitigation actions need to be designed and implemented, if any significant rise in the groundwater table takes place. The mitigation measures include educating the farmers in appropriate cropping and irrigation techniques suitable for high water table areas, cultivating crop varieties that are tolerant to high water table, and installing tube-wells to pump ground water and lower the water table in the area.

5.3.6. Decreased Soil Fertility in Command Area

The decreased silt load in the irrigation water may also reduce the natural fertilization of the soils. However, the Satpara Lake existed even before the commencement of the Project; hence the impact of the Project with enlarged lake on the silt load of the water is likely to be small. This potential impact will be partially compensated because of the increased water availability, and can further be mitigated with rational use of fertilizers, if needed. 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
Reversibility:	irreversible (during the life of the Project)
Probability:	likely
Impact intensity:	mild
Significance:	low

Mitigation. Soil fertility will be monitored through regular soil analysis. Rational use of fertilizers along with organic farming and Integrated Pest Management (IPM) techniques will be promoted if the results of these analysis so warrant.

5.3.7. 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, command area)
Timing:	after reservoir impoundment
Magnitude:	small to medium
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 the nearby communities, and dam/powerhouse staff. 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.

5.3.8. 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.

The Satpara Dam is only 39 m (128 ft) high, and a lake though small in size existed at the site even before the commencement of the Project. Therefore the significant reservoir induced seismicity is not likely to take place. This potential impact is assessed as follows.

Nature:	indirect
Duration of impact:	long term
Geographical extent:	regional
Timing:	after the reservoir impoundment

Magnitude:	medium
Reversibility:	irreversible
Probability:	unlikely
Impact intensity:	moderate to severe
Significance:	low to medium.

Mitigation. Further earthquake studies are needed at the Satpara dam to determine the likelihood, consequence severity, and other aspects of this issue. Appropriate instruments to be installed to monitor the seismicity at the site.

5.3.9. 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 there exists just one small village upstream of the Satpara Lake, the nutrients flow from the anthropogenic source would be nominal. Owing to the nature of the area, the natural nutrients inflow is also likely to be nominal. However trees and vegetation have been submerged due to the increased impounding of the lake, and more trees and vegetation are likely to be submerged with further increase in the reservoir level (see **Photographs E.1** and **E.12** in **Appendix E**). 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:	likely
Impact intensity:	moderate
Significance:	medium.

Mitigation. Trees and vegetation should be removed from the areas yet to be submerged. Possibility should be explored for tree cutting from the area already submerged during the low flow months. 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.

5.3.10. 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.

5.3.11. 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 Related to Construction Activities

The construction works at the dam site and irrigation canals are nearing completion, while two of the powerhouses are already in operation. However the works are yet to be started on the remaining two powerhouses. The potential impacts relating to the remaining works at the dam site, irrigation canals, powerhouse construction, 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.

5.4.1. Soil/ Mountain Slope Erosion and Degradation

The borrow area for the rip rap is adjacent to the reservoir on left bank. If appropriate measures are not undertaken, erosion and sliding can potentially affect the safety of dam and reservoir siltation. Furthermore, soil erosion can potentially be caused by borrow material excavation, the vehicular traffic on unpaved roads, and land clearing for construction camps and other site facilities (for the remaining powerhouse works). These impacts have been characterized below.

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

Mitigation Measures. It is unlikely that the fill material for powerhouse construction will need to be obtained from any cultivation fields (during the Powerhouse construction 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 excavation is carried out, fill material is obtained or surplus soil deposited, will be landscaped/treated to minimize erosion/land sliding and hazard for people and livestock.

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

Operation of vehicles close to the nullah/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.

5.4.2. 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 remaining Powerhouse construction works,

these arrangements should be included in the design of the temporary facilities). For the Powerhouse construction works, the contractor(s) will submit to the Supervision Consultants 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**).

5.4.3. Air Quality Deterioration

Construction machinery, diesel generators and project vehicles 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.

5.4.4. 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 remaining Powerhouse construction 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
Reversibility:	reversible
Probability:	likely
Impact intensity:	moderate
Significance:	medium.

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

5.4.5. Blocked Access

The road leading to the dam site is a public road leading to the Satpara village and beyond. The construction activities and Project-related vehicular traffic cause hindrance to the traffic on this road. Similarly, the construction works at the Powerhouse 3 and 4 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. It should be ensured that the road passing through the Project area is not blocked for the through traffic. For the remaining works at the irrigation canals, and the construction works at the remaining two powerhouses, the access routes should not pass through the communities, rather, the service roads along the canals should be used for this purpose.

5.4.6. Noise and Vibration

Most of the heavy construction works at the dam site has already been completed. However, the Powerhouses 3 and 4 would be located near the communities, and the construction works would 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. The vehicles noise will comply with the NEQS (**Table 2.2**). The noise from the worksites will comply with the guidelines defined by the WB (55 dB(A) for daytime and 45 dB(A) for nighttime, or a net increase in the background noise level by 3 dB, measured at the receptors). Nighttime works and 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.

5.4.7. Safety Hazard

The construction activities involve operation of heavy construction machinery, vehicular traffic, excavation, filling operations, works on heights, high voltage (in powerhouse). In addition, the project traffic on the local roads leading to the site poses safety risks to the nearby communities. The powerhouse construction 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 (eg, 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.

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.

5.4.8. Public Health

The public health concerns related to the safe disposal of wastes have been covered under the soil and water contamination (see **Section 5.4.2**). 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).

5.4.9. Gender and Social Issues

The construction works near the communities (such as for the irrigation canals and Powerhouses 3 and 4) can potentially cause social issues such as disturbance and hindrance to the local population, particularly women. 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.

5.4.10. 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 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
Reversibility:	irreversible (though repairs/restoration can be done on damaged assets)
Probability:	unlikely
Impact intensity:	severe
Significance:	medium.

Mitigation Measures. Sanctity of mosques, graveyards, and shrines will be respected during the remaining construction 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.

5.4.11. 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 2.1.11**) will be made part of the construction contracts, in order to ensure that no child labor is employed at the project sites or campsites.

5.5. Impacts Related to Operation and Maintenance Activities

The activities related to the operation and maintenance (O&M) of dam, powerhouse, and irrigation canals 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.

5.5.1. Soil and Water Contamination

The O&M activities of the Project facilities (powerhouses, offices, 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, 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, powerhouses, 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, powerhouses, 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 powerhouse.

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 powerhouses 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.

5.5.2. 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 operation and maintenance activities pose safety hazards to the nearby population. The project traffic on the local roads leading to the site also 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 irrigation canal maintenance works, where necessary.

5.5.3. Loss of Agriculture

During the repair and maintenance activities on the irrigation canals, 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 canals. 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. Beneficial Environmental and Social Impacts

5.6.1. Environmental Benefits

The beneficial environmental impacts associated with the Project include i) reduction in green house gas (GHG) production associated with the hydropower generation (more than 66,000 tons of CO_2 annually, based upon 105.77 GWh of electricity generation per year from the powerhouse);[22] ii) implementation of watershed management activities; iii) expansion of a wetland which is likely to attract water fouls; and iv) increase in the aquatic fauna including fish in the reservoir.

5.6.2. 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[23] 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.

5.6.3. Gender Aspects

Country overview: Although[24] 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

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

23 Drinking water quality would need to be monitored on a regular basis. Appropriate treatment would need to be carried out if needed.

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

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 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[25] 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.

The World Bank's OED assessment[26] 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 Project benefits which 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

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

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

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.[27]

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.[28] The improved electricity supply in the area is likely to reduce reliance on such fuels, thus improving the in door air quality, in turn decreasing the respiratory diseases prevalence in the area.

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

Currently, the construction contractor (Descon) has established an EHS system at site, and an EHS Officer has been appointed. Safety trainings are regularly arranged for the site staff, and their reports prepared. The safety adherence at site is 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. However, environmental aspects are not adequately covered in the EHS system. The EHS Officer is not trained on environment, and no environmental mitigation or monitoring is carried out or has been carried out at the work sites. The IEE report prepared by WAPDA in 2002 is not available at site; in fact the Supervision Consultants and Descon personnel including their EHS Officer do not even know about the existence of such report. As a result, no EMMP exists at the site. No environmental trainings have been conducted at the site, as reported by the EHS Officer. As a result, the environmental management and awareness at the site is quite poor.

[27] WB 2008. Environmental Health and Child Survival, Epidemiology, Economics, Experiences. The World Bank 2008.

[28] Ibid.

Table 5.1: Impact Significance

Impacts	Significance
Project Siting/Design	
Resettlement issues	High
Land sides, soil erosion and siltation of reservoir	Medium
Erosion of nullah bed downstream	Low
Loss of natural vegetation and biodiversity	Medium
Dam collapse	Medium
Changed water flow regime	Low
Drinking water quality	Medium
Project located in wildlife sanctuary	High
Water table rise	Medium
Decreased soil fertility	Low
Increased risk of vectors	Low to medium
Reservoir induced seismicity	Low to medium
Reservoir eutrophication	Medium
PCB in transformer oil	Medium
Climate change	unknown
Construction activities	
Soil erosion/degradation	Medium
Soil and water contamination	High
Air quality deterioration	Medium
Damage to infrastructure	Medium
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

6. Environmental Mitigation and Monitoring Plan

This Chapter presents the environmental mitigation and monitoring plan proposed for the remaining construction activities, 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, powerhouses, and irrigation canals; 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 contractors for the dam and powerhouse construction should designate appropriate persons as the EHS Officer, having relevant experience. Similarly, the Supervision Consultants (SC) should also designate a suitable site staff as EHS Engineer. The EHS Officers of the contractors 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 Officer, and ensure that the EMMP is adequately implemented. The EHS Engineer will also liaise with the Pak-EPA and GB EPA for matters related to environmental management and compliance of the Project.

The contractors and SC 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**.

6.3. Environmental Monitoring

6.3.1. Monitoring Parameters

A comprehensive list of the parameters to be monitored is summarized below.

- Water inflow in the reservoir; outflow from the dam, releases in the canals, releases in the nullah downstream of canal diversion, and water discharges in the Indus River.
- Suspended solids (sediment) analysis of the river water at the inlet of the reservoir, and at the outlet of the dam.
- Bacterial count: E-coli test for the drinking water supply
- pH, total suspended and dissolved solids, sulfate, etc.
- Meteorological data
- Stored water volume in the reservoir
- 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
- 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
- Public health and disease vectors

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

6.3.2. Biological Resources

Due to the scarcity of baseline data on the ecology of the area including its terrestrial and aquatic ecosystem and bio-diversity, and the fact that the Project is located in a wildlife sanctuary, a comprehensive Satpara Wildlife Sanctuary Management Plan should be developed and implemented. The Plan will include a composite monitoring plan for wildlife, natural vegetation of significance, fisheries, microflora, microfauna, aquatic weeds, benthic organisms, and bio-diversity. The personnel required for this monitoring will include biologists and a chemist. The chemist will be responsible for chemical analysis of water resources while the biologists 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. 240.81 million (about US$ 2.83 million)[29]. This includes Rs. 212.53 million as land/assets compensation cost of which about Rs. 149 million has already been paid, Rs.20.20 million as one time cost for environmental and social management of the Project, and Rs. 8.08 million as recurring costs on annual basis. However, these estimates do not include the costs of: i) implementation of watershed management and afforestation plan; ii) implementation of eutrophication control plan; and iii) implementation of landscaping and plantation plan.

The details are provided in the table below.

[29] 1 US$ = Pak Rs. 85.

Environmental and Social Management Cost

Description	Cost Estimates (Pak Rupees)	Basis	Notes
Construction Phase			
EHS Officer and EHS Engineer	0	The existing site personnel will be re-designated.	-
Compensation for land and other assets [a]	148,973,000	58.98 acres	Already paid
	4,666,000	3.66 acres	Payment under process
	27,379,000	21.36 acres	Payment under process
	31,509,000	19.13 acres	Land to be acquired
Water quality analysis	1,200,000	5 samples per month; Rs. 20,000 per analysis; 12 months	Annually recurring cost during construction phase.
Environmental and social trainings	500,000	Master trainer to provide training to EHS Officer and EHS Engineer. Rs. 30,000 x 10 days; plus miscellaneous expenses.	One time cost
Environmental and social audit	2,500,000	1 environmental + 1 social specialist x 30,000 per day x 30 days; miscellaneous expenses	One time cost
O&M Phase			
EHS Engineer	1,200,000	Rs. 100,000 per month	Annually recurring
Meteorological	1,200,000	-	One time cost

Description	Cost Estimates (Pak Rupees)	Basis	Notes
Station			
Water laboratory analysis (annual cost estimates)	480,000	2 samples per month; Rs. 20,000 per analysis; 12 months	Annually recurring
Trainings (annual cost estimates)	200,000	One training course per year in Lahore or Islamabad	Annually recurring
Additional Studies			
Preparation of Resettlement and Community Development Plan	1,500,000	1 specialist x 45 days x 30,000; miscellaneous expenses.	One time cost
Preparation of watershed management and afforestation plan	4,000,000	2 specialists (geotechnical and forester) x 60 days x 30,000 per day; plus miscellaneous expenses	One time cost
Implementation of watershed management and afforestation plan	Not known at this stage		
Study to evaluate reservoir induced seismicity	2,000,000	1 geotechnical specialist x 60 days x 30,000; miscellaneous expenses.	One time cost
Preparation of reservoir eutrophication control plan	1,000,000	1 biologist x 30 days x 30,000; miscellaneous expenses.	One time cost
Implementation of	Not known		

Description	Cost Estimates (Pak Rupees)	Basis	Notes
eutrophication control plan	at this stage		
Development of site landscaping and plantation plan	2,000,000	1 landscaping specialist x 45 days; 1 horticulturist x 45 days x 20,000; miscellaneous expenses.	One time cost
Implementation of site landscaping and plantation plan	Not known at this stage	-	One time cost
Development of the Wildlife Sanctuary Management Plan	4,000,000	2 biologists x 60 days; x 30,000; miscellaneous expenses	One time cost
Monitoring of biological resources / implementation of Wildlife Sanctuary Management Plan	5,000,000	2 biologists x 180 days; 1 chemist x 100 days x 10,000; miscellaneous expenses	Annually recurring
Studying climate change implications	1,500,000	1 specialist x 45 days x 30,000; miscellaneous expenses.	One time cost
Total	**240,807,000**		

[a] Source: WAPDA presentation for USAID/AEAI on Satpara Dam Project, April 2010.

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 IEE. Rapid Environmental and Social Analysis; Mitigation measures; EMMP; Social and cultural values of the area.	Selected project management staff	EHS Engineer (SC)
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 (SC); EHS Officer
EMMP; Safety issues; Waste disposal	Construction crew	EHS Officer
Road safety; Defensive driving; Waste disposal; Cultural values and social sensitivity.	Drivers	EHS Officer
Camp operation; Waste disposal; Natural resource conservation; Safety Housekeeping.	Camp staff	EHS Officer
Restoration requirements; Waste disposal	Restoration teams	EHS Engineer; EHS Officer

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 Satpara nullah	-	-	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; GB 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; Provincial line departments (Local Government and Rural Development, Education, Health, and others)	-	-

Aspects/Impacts	Mitigation		Monitoring	
	Action	Responsibility	Action	Responsibility
Negative Impacts				
Resettlement issues	Prepare and implement Resettlement and Community Development Plan focusing on the community development, in addition to addressing any remaining resettlement issues Early payment for the remaining portion of the compensation. Maintain liaison and coordination with the communities to address and resolve any pending issues or grievances associated with the land acquisition and compensation assessed/paid. Ensure complete transparency of the entire compensation assessment and payment of compensation. Establish grievance redressal mechanism to address grievances of the stakeholders, particularly the communities. Maximize employment opportunities to the local population; give priority to the directly affected communities.	WAPDA	Grievance monitoring	WEC Independent environmental and social audit
Land sliding, soil erosion and siltation in reservoir, thus reducing the reservoir capacity	Develop and implement slope stabilization, watershed management and afforestation plan (structures such as check dams and gabions; terracing; bio-engineering; plantation of trees,	Operations Staff (WAPDA) EHS Engineer	Monitor the reservoir siltation; Monitor the implementation and effectiveness of the watershed management plan.	Operations and Maintenance Staff (WAPDA) WAPDA (GM

Aspects/Impacts	Mitigation		Monitoring	
	Action	Responsibility	Action	Responsibility
	shrubs and grasses; controlled grazing; others.) Appropriate terracing and where necessary gabions may be needed to protect the Deosai Plains road on the right bank of the Lake.	(WAPDA) WAPDA to coordinate with Works and Communication Department	Monitor the slope along the road.	Hydro); WAPDA Environmental Cell (WEC)
Erosion of nullah bed downstream of dam (caused by release of silt-free water from reservoir)	Survey of nullah bed downstream of dam to identify potentially at-risk structures. Reinforcement of bridges, culverts, and other structures where needed	WAPDA; Works and Communication Department	Monitor the nullah bed erosion, particularly near the Powerhouse components, bridges, culverts and other structures.	EHS Engineer (WAPDA)
Dam collapse	Prepare and implement Project Operational Manual (OM). ERP to be part of OM. Capacity building of O&M staff.	WAPDA Hydor	Compliance monitoring	GM Hydro, WAPDA
Modified water flow regime in Satpara nullah	Pre-project flow will be maintained in the Satpara nullah downstream of the diversion for the canals. Install meteorological station at the dam site to record the key meteorological data including temperature, precipitation, humidity, and wind speed/direction. Install river rim stations upstream and downstream of the dam, and monitor water	GB Irrigation Department WAPDA	Monitoring of river flow at different locations (reservoir inlet, dam, barrage, canals, confluence with Indus River)	Dam Operations (WAPDA); EHS Engineer

Aspects/Impacts	Mitigation		Monitoring	
	Action	Responsibility	Action	Responsibility
	inflow in the reservoir, water releases from the reservoir, irrigation water diverted in the canals, water released in the nullah downstream of canal diversion, and water reaching the Indus river.			
Drinking water quality	A water quality monitoring system needs to be established, through which water samples should be collected from various location (upstream and downstream of settling tanks, near the major communities, and randomly at the consumer/household level. Depending upon the quality of water, appropriate treatment will need to be determined, and the treatment plant/arrangements established.	WAPDA EHS; NA PWD	Compliance; review of water testing reports	NAPWD
Decreased soil fertility because of decreased silt in irrigation water	Rational use of fertilizer by the growers. Encourage using organic farming and IPM techniques. Capacity building and awareness raising needed.	GB Agriculture Department	Monitor the soil fertility and fertilizer usage practice in the command area.	GB Agriculture Department
Groundwater table rise due to increase in lake water level	Capacity building of farmers for appropriate cultivation and irrigation techniques; adopting to shallow groundwater; installation of tube-wells to extract groundwater in areas having shallow groundwater.	GB Agriculture Department	Monitor the groundwater table in Satpara village and command area	GB Agriculture Department
Loss of natural vegetation and biodiversity in the project area	Compensation to be paid to the owners for cutting of trees on privately owned land.	EHS Officer	Monitor the implementation and effectiveness of the re-	EHS Engineer

Aspects/Impacts	Mitigation		Monitoring	
	Action	Responsibility	Action	Responsibility
	Re-plantation with local, non-invasive species; prepare re-plantation plan. Prepare and implement Wildlife Sanctuary Management Plan	EHS Engineer (WAPDA)	plantation.	WEC
Project located in wildlife sanctuary	Prepare and implement Satpara Wildlife Sanctuary Management Plan. Conduct composite monitoring of biological resources in the area on a regular basis.	EHS Engineer (WAPDA) WAPDA to coordinate with the Wildlife Department	Compliance monitoring.	WEC
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 (where applicable), and awareness raising. Strengthen the health care facilities in the command area.	Health Department	Monitor the vector breeding; monitor the disease incidence/outbreak and key health parameters of the population.	EHS Engineer (WAPDA)
Reservoir induced seismicity	Conduct further earthquake studies and risk analysis. Appropriate instruments to be installed to monitor the seismicity at the site.	WAPDA Hydro	Compliance	GM Hydro, WAPDA

Aspects/Impacts	Mitigation		Monitoring	
	Action	Responsibility	Action	Responsibility
Eutrophication of Reservoir	Trees and vegetation to be removed from the area to be inundated. Consider cutting the trees from the already submerged area during low flow.	EHS Officer	Compliance	EHS Engineer
	Conduct further studies to determine the extent of problem, and to identify remedies.	WAPDA	Compliance	WEC
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/Powerhouses

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
1	Contractor Mobilization, 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 Officer; EHS Engineer	Before construction (BC) (of Powerhouses) 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. o Fugitive dust emissions will be minimized by appropriate methods, such as spraying water on soil, where required and appropriate.	Contractors	EHS Officer	AC
		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	Contractors	EHS Officer	AC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				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. o The vehicles noise will comply with the NEQS (**Table 2.2**).			
		1.4	Safety Hazards	o The access routes to the Powerhouses 3 and 4 will not pass through the communities. 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	Contractors	EHS Officer	AC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				hazard and dust emissions. o EHS plan will be strictly followed (The IFC's EHS Guidelines[30] 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 Officer; EHS Engineer	AC

[30] 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	
2	Construction Camp Operation	2.1	Soil Erosion / Contamination; water contamination	o Contractors will prepare a waste disposal plan and submit to SC/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 Skardu. o The inert recyclable waste from the site (such as card board, drums, broken/used parts, etc.) will be sold to recycling contractors in Skardu. 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	Contractors	EHS Officer	During construction (DC); AC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				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 Officer	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 Officer	DC
		2.4	Noise	o Generators and vehicles will have exhaust mufflers (silencers) to minimize	Contractors	EHS Officer	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				noise generation. Compliance with NEQS will be ensured.			
		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 Officer	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 Officer	DC
		2.7	Social and Gender Issues	o Employment to locals will be maximized. o No child labor will be employed.	Contractors	EHS Officer	DC
3	Transportation of Equipment and	3.1	Soil Erosion and	o Vehicular traffic on unpaved roads will	Contractors	EHS Officer	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
	Construction Materials		Contamination	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.			
		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 Officer	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 Officer	DC
		3.4	Safety Hazards	o Road signage will be fixed at appropriate locations to reduce safety hazard associated with project-related vehicular traffic.	Contractors	EHS Officer	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				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.			
		3.5	Damage to Infrastructure	o All damaged infrastructure will be restored to original or better condition.	Contractors/ WAPDA	EHS Officer; 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 Officer	DC
		4.2	Noise and Vibration	o Construction machinery will be appropriate noise muffling arrangement. NEQS will be followed.	Contractors	EHS Officer	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 Officer	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 Officer	DC
		4.5	Social Issues	o Employment to locals will be maximized. o No child labor will be employed.	Contractors	EHS Officer	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 Officer; EHS Engineer	DC
		4.7	Soil/ mountain slope erosion	o 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. o The borrow areas will be protected	Contractors	EHS Officer	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				against land slide/soil erosion, through using appropriate techniques (such as terracing, gabions, vegetation, bioengineering, and others) 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.			
		4.8	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. 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	Contractors	EHS Officer	DC

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				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. Relevant NEQS will be complied. o Fugitive dust emissions will be minimized by appropriate methods, such as spraying water on soil, where required and appropriate.	Contractors	EHS Officer	DC
		4.10	Loss of natural vegetation / Aesthetic Value	o Tree plantation will be carried out at the site.	Contractors	EHS Officer	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 contractors in Skardu. o The inert recyclable waste from the site (such as card board, drums, broken/used parts, etc.) will be sold to recycling contractors in Skardu. 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. o The standard EHS Guidelines (eg, IFC's EHS Guidelines) to be followed.	Facilities Maintenance department	EHS Engineer	During O&M
		1.2	Safety hazards	o The dam safety risk assessment will be carried out (if not already done) by an independent panel of experts.	ESH Engineer		During O&M

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				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 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.			

	Project Activities		Impact	Action	Responsibility		Timing
					Execution	Monitoring	
				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 canals maintenance works, where necessary.			
		1.3	Loss of agriculture	o The crop damage will be minimized during the O&M activities of the irrigation canals. 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: Monitoring Plan

No.	Monitoring Parameter	Monitoring Locations	Frequency [a]	Responsibility	Resource Requirement	Documentation
1	Water inflow in the reservoir	Upstream of the lake	Continuous	WAPDA	Rim station	Rim station readings
2	Water outflow from the reservoir	Outlet structure	Continuous	WAPDA	Record Gauge	Gauge readings
3	Water flow through the spill way	Downstream of spill way	Continuous	WAPDA	Record Gauge	Gauge readings
4	Water flow through the powerhouses	Powerhouses 1, 2, 3, and 4	Continuous	WAPDA	Record Gauge	Gauge readings
5	Water diversion in the canals	Right Bank Canal and Left Bank Canal	Continuous	WAPDA	Record Gauge	Gauge readings
6	Water releases in Satpara nullah downstream of canal diversions	Downstream of canal diversion	Continuous	WAPDA	Rim station	Rim station readings
7	Satpara nullah water releases in Indus river	At the confluence of Satpara nullah and Indus river	Continuous	WAPDA	Rim station	Rim station readings
8	Sediment load in Satpara nullah	Upstream of Lake	Continuous	WAPDA	Sediment meter	Meter readings
9	Sediment load in Satpara nullah	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	-	Record of calculations
11	Water quality (BOD, E. coli, pH, TSS, TDS, Sulfates, etc.)	Lake water	Once a month	WAPDA	Sampling bottles	Analysis results
12	Water quality (BOD, E. coli, pH, TSS, TDS, Sulfates, etc.) (WHO Standards)	Out let of the water treatment plant for drinking water supply	Once a month	WAPDA	Sampling bottles	Analysis results

No.	Monitoring Parameter	Monitoring Locations	Frequency [a]	Responsibility	Resource Requirement	Documentation
13	Meteorological data (temperature, wind, precipitation, humidity, etc.)	At the dam site	Continuous	WAPDA	Met station	Complete record of the measurements
14	Water level in reservoir	At the dam site	Daily	WAPDA	Level gauge	Measurement record
15	Vegetation cover changes	In the watershed	Regularly	WAPDA	Surveys by biologists	Survey reports
16	Wildlife (aquatic flora and fauna, key avian species, key terrestrial species, etc.)	In the watershed, lake and Satpara nullah downstream of dam	Regularly	WAPDA	Surveys by biologists	Survey reports
17	Erosion and land sliding	In the watershed	Regularly	WAPDA	Surveys by field staff	Survey reports
18	Disease vectors	In the Satpara village and command area,	Regularly	Health Department	Data collection from hospitals and health centers	Disease record
19	Soil fertility	In command area	Once in six months	Agriculture Department	Laboratory analysis	Results of analysis
20	Groundwater table	In Satpara village and command area	Once in six months	Irrigation Department	-	Record of measurements

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

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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: Review of Existing IEE (Prepared by WAPDA)

This Appendix presents: i) review of the existing Initial Environmental Examination (IEE) report; ii) description of any changes in environmental issues since the preparation of the IEE report in 2002; and iii) summary of the project's positive and negative impacts and the proposed mitigation and monitoring measures.

1. Review of Existing IEE Report

The IEE study of the project was carried out by WAPDA's Environmental Cell in 2002. The IEE report has been thoroughly reviewed as part of the present assignment. Generally, the report is very sketchy, does not provide complete project information, and assesses the project impacts in a very superficial manner. According to the list of the protected areas posted on the Pakistan EPA website[31], Satpara Lake was notified as a wildlife sanctuary in 1975, however this aspect is not discussed in the IEE report at all; in fact an EIA should have been conducted, in accordance with the regulatory requirements in the Country (Pakistan IEE/EIA Regulations 2000).

Various aspects of the report are discussed below.

Introduction: The project's background, purpose, and objective of the project have been provided in this section. No information on the study methodology, study team, and study scope has however been provided.

IEE Requirement: In this brief section, purpose of the IEE has been discussed. The potential typical impacts of water resource and river basin development projects have also been briefly covered in this section. The discussion on environmental legislation, regulations and guidelines is however missing.

Project Description: In this brief section, the key project information is presented. The following key components are covered in this section:

- Project Location
  The project location is described and also elaborated with the help of area maps.
- Dam
- Reservoir
- Hydropower characteristics

[31] Website http://www.environment.gov.pk/eia_pdf/f_Crit_%20Areas.pdf accessed on October 2, 2010.

- Irrigation network

Baseline Description. The existing IEE report provides description of the baseline conditions of the project area. The following aspects of the environment and socioeconomic aspects are covered under the baseline:

- Physical environment

  The following specific aspects are covered under the physical environment:

  - Topography: general description of the area has been provided.
  - Geology: a brief, general description is provided.
  - Water resources: this covers hydrology of the area, as well as quality of surface and ground water.
  - Climate: general information on climate has been provided, in addition to the temperature, precipitation, and wind data. No information on air quality is presented.

- Biological environment

  Information on the biological resources of Baltistan in general and, in many places, Desai Plain[32] in particular has been provided, but the site specific information/data is mostly missing. The following aspects are covered under this section: flora; aquatic flora and fauna; fisheries; historical background of trout fish in Northern Area; fauna; reptile and amphibians; birds; aquatic birds; mammals; forestry; vegetation in project area; cultivated plants; and pastures.

- Socioeconomic aspects

  This section provides some site-specific information as well. The following specific socioeconomic aspects have been covered under the IEE study: population; settlements/households; family structure; ethnicity; landuse; agriculture; horticulture; occupation and income; migration; education; health; existing power stations; mineral resources and archeology; women in project area; and tourism.

No maps or photographs have been provided in the IEE report to augment and elaborate the description of various aspects of the environmental and socioeconomic baseline conditions.

Impact Assessment. The existing IEE assesses the potential impacts of the project. For this purpose, it employs a checklist specifically developed for

[32] The Deosai Plain is located about 10-15 km south of Satpara Lake.

water reservoirs and hydropower projects. The following aspects are covered under this preliminary impact assessment:

- Construction stage impacts on physical and biological environment: water quality; sedimentation; irrigation; watershed erosion; downstream erosion and siltation; waste water discharge; fisheries and fish life; air quality and dust emissions; and noise.
- Construction stage impacts on socioeconomic environment: lifestyle and culture; employment opportunities; income generation; human resource development; resettlement; and health.
- Operation stage impacts on physical and biological environment: water quality; sedimentation; irrigation; watershed erosion and sedimentation; downstream erosion and siltation; waste water discharges; fisheries and fish life; Air quality, emissions, and dust; and noise.
- Operation stage impacts on socioeconomic environment: lifestyle and culture; employment opportunities; income generation; human resource development; and health.

Mitigation Plan. This section proposes mitigation actions to address the above-described environmental impacts caused by the different activities/phases of the project. The mitigation for construction and operation phases of the project have however not been discussed separately. The following aspects have been covered under this section: water related mitigation; land related mitigation (resettlement issues); local infrastructure maintenance; land and resources (addressing landuse changes); erosion control; disposal of excavated material; wildlife; air pollution; noise; employment; fisheries; irrigation; water pollution; land development; safety measures; and fire protection.

Environmental Management Cost. This section tabulates the cost of various aspects of the environmental management. However, no basis has been provided for most of these estimates.

Environmental Management and Training. This section proposes the institutional arrangements for environmental management of the project. It also recommends development and implementation of area rehabilitation and plantation program. In addition, environmental monitoring requirements during construction and operation stages have been defined. Finally, the section specifies the requirement of dam safety risk assessment.

Major Gaps in IEE. Several key aspects were not included in the existing IEE report. The key deficiencies of the existing IEE report are listed below.

- The IEE methodology and scope have not been provided.
- The project description is not complete, no details are provided for various project components. Furthermore, 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. Most importantly, it does not capture the exact nature and project and sequence of activities.
- 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.
- Environmental baseline description is not site specific. Most of the information is either for Baltistan in general, or specific to Deosai, which is about 10-15 km south of the site. Condition of the watershed area of the lake has not been discussed adequately.
- No record and outcome of stakeholder consultations has been provided.
- Impact assessment and mitigation sections discuss most of the potential impacts, however, impact characterization has not been carried out, nor the significance of the identified impacts determined. Several potential impacts, such as those related to vehicular traffic, mobilization/demobilization of contractors, camp establishment and its operation have not been discussed in the section.
- Resettlement aspects have not been discussed adequately. No procedure is specified to implement the resettlement actions.
- Proper environmental mitigation and monitoring plan (EMMP) has not been provided. Some aspects of the EMMP are covered (such as monitoring plan), however, other key aspects, such as institutional arrangements, roles and responsibilities, environmental trainings, reporting and documentation requirements have not been specified.

On the basis of the above shortcomings/gaps, and the fact that the Satpara Lake is a wildlife sanctuary, the existing IEE does not meet the

national legal/regulatory requirements nor does it meet the international standards.

2. 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:

- Enlargement of the Satpara Lake caused by of the construction dam, and associated landuse and land form changes, including cutting of about 300,000 trees (as reported in the WAPDA records).
- Possible increase in fish population in the Lake.
- Widening of the road passing through the project area (and leading to Deosai)
- Contractors' site facilities including offices, workshop, warehouse, residences, labor camp, and associated facilities.
- Borrow areas for the project
- Contamination of soil and water caused by improper waste disposal (work shop, offices, and residences). Most of the sewage from the temporary facility is discharged into the river without adequate treatment. This not only contaminates the soil, but also the river water. 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, canals, and associated facilities/structures.
- Adverse impacts on the tourism activity in the area.

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.

3. 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 IEE report. Other potential impacts which are not covered in the existing IEE will be included in the EMMP, to be developed under the Task 4 of the present assignment.

Table 1: Impacts and Mitigation (as reported in existing IEE)
Satpara Dam Project

Aspects/Impacts	Mitigation	Monitoring
Positive Impacts Reduction of floods frequency in Satpara nullah	-	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 command area.	Capacity building and awareness raising of farmers on efficient irrigation techniques; appropriate use of fertilizers and pesticides; promotion of organic farming practices; protection against water logging and soil salinity.	-
Electricity generation from the project; improvement of air quality; protection of forest	Availability of electricity to the local population; spending a portion of the proceeds from the electricity generation on the area development.	
Negative Impacts		
Water quality	Septic tanks to be provided to treat the waste water from site camps and offices. Drainage channels to be built around or downstream of the construction areas. These channels to discharge the water in treatment and settling tanks. Sludge collected from septic tank and other solid waste to be disposed off properly through landfill method. Diesel, oils and lubricants will be stored properly in accordance with the relevant regulation.	Compliance monitoring. Water quality analyses.

Aspects/Impacts	Mitigation	Monitoring
Land related issues	Compensation to be paid to the eight families who are to be displaced. Compensatory tree plantation with native species for the trees to be removed/submerged in the lake. NGOs to be involved in this activity.	Compliance monitoring. Grievance monitoring.
Infrastructure deterioration	The road network used by the project to be maintained/restored.	Compliance monitoring.
Land use changes, blocked access,	Consultations to be carried out with the affected communities. Adequate compensation to be provided to all the affected people. Strict control of contractors' activities, and proper route selection, to minimize land use changes, obstruction/hindrance to local population. The road leading from Skardu to Deosai that passes through the project area to be widened and improved to allow transport of heavy machinery and equipment for the project.	Compliance monitoring. Grievance monitoring.
Erosion	Plan the alignment and construction activities in accordance with the topography, soil, drainage, and natural vegetation at the site. Expose the smallest area of land for work over a shortest possible time Apply soil erosion control practices Protect and preserve forest and vegetation as much as possible.	Compliance monitoring. Visual observations.
Impacts of disposal of excavated material	Excavated material will be used as the fill material as far as possible.	Compliance monitoring. Visual observations.
Impacts on wildlife	Lubricants, oils, and wastes will not be released in the water or on the soil. Raise awareness for wildlife protection. Minimize blasting; minimize noise generation. Coordinate with authorities for wildlife	Compliance monitoring. Visual observations.

Aspects/Impacts	Mitigation	Monitoring
	protection.	
Air pollution	Sprinkle water to minimize dust emissions. Control the vehicular speed near settlements. Tree plantation to minimize dust emissions. Control of exhaust emissions from machinery and vehicles through proper maintenance. Stone pitching of roads and tracks. Brick soling of the unpaved roads.	Compliance monitoring. Visual observations.
Noise	Noise level of 55 dB at the powerhouse boundary will be maintained. A nighttime noise level of 35 dB will be maintained. Vehicles and powered machinery to have appropriate and functioning mufflers (silencers). High noise machinery will not be used at nighttime. Noise shunting devices to be used to diffuse blasting noise.	Noise measurements
Socioeconomic issues	Employment opportunities to be provided to the local population. On-job trainings to be provided to the site workers. Regular liaison and dialogue with he communities to be maintained.	Compliance monitoring. Grievance monitoring.
Impacts on fisheries and aquatic fauna	Minimum compensation flow to be maintained in the nullah to protect the aquatic life. Fish ladder to be provided in the intake structure.	Compliance monitoring.
Issues related to irrigation and cultivation	Minimum discharges to be allowed from the dam during the dry season. Land leased for construction to be returned to owners after full restoration.	Compliance monitoring.
Safety hazard	Environmental health and safety standards to be enforced Accident prevention and response	Compliance monitoring.

Aspects/Impacts	Mitigation	Monitoring
	plans/systems should be made available at the site. First aid, fire protection, fire fighting, oxygen masks, oxygen supply, helmets, and other safety gear should be made available at the site. Handing of explosive should be carried out according to the proper rules, regulations, and procedures, by the trained and certified personnel. Rules for health and safety of workers, the Explosive Act, and Factories Act should be implemented where applicable. Safety signage should be placed at appropriate locations at and around the site. The work site should have fencing around it, to avoid any unauthorized entry. The power house to have fully equipped fire fighting system, consisting of fire service main, hydrants and fire hoses cabinets, fire extinguishers, breathing apparatus, fire walls and other necessary equipment/arrangements.	

Appendix D: IEE Prepared by USAID

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FROM THE AMERICAN PEOPLE

PART A - INITIAL ENVIRONMENTAL EXAMINATION FOR SATPARA DAM

PROGRAM/ACTIVITY DATA:

Country: Pakistan

Objective: To provide access to reliable source of electricity and of water for irrigation thus increasing economic opportunities to the underdeveloped area of Gilgit-Baltistan. To improved quality of life of the poor people in the area through supply of potable drinking water by completing the dam, hydropower plants and irrigation system of WAPDA's high priority project at Satpara Dam.

Activity Name: Satpara Dam Construction completion.

Funding Begins: FY 2010 **Funding Ends**: FY 2011 **LOP Amount:** $ 26 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 review of the reasonably foreseeable effects on the environment as well as recommend threshold decisions for construction completion of the Satpara 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 study developed by the Government of Pakistan..

1.2 Background

The basic objectives of USG support for the completion of the Satpara multi-purpose project are: (1) Reduce the electricity supply/demand gap and provide economic opportunity in underdeveloped that are vulnerable to extremism in Northern Areas of Gilgit- Baltistan area (2) Add power generation capacity and energy to the isolated and remote town of Skardu; (3) Store water for the companion down stream irrigation projects; (4) Provide potable drinking water and (5) Control flood.

The Satpara Dam project is located near the city of Skardu in the Gilgit-Baltistan territory (formally 'Northern Areas') of Pakistan. Since 1850's there have been several dams built and destroyed over time. The earlier dams on the existing Satpara lake were not engineered and rather primitive. These dams were built at that time for flood control, to provide water for residential as well as irrigational use. This project will be the first engineered and well constructed dam on the same site.

The multipurpose project designed for 17.66 MW of power generation (energy equivalent to 106.25 GWh per annum), irrigation supplies to 15,536 acres of land, and 3.1 million gallon of potable drinking water to 280,000 people of Skardu and surrounding villages. The completed project envisions four small hydro power stations with an associated 128 feet high dam and two canals for irrigation purposes. Skardu is an isolated generation and distribution system and is not connected to the national transmission system. Upon completion of the project, the Water and Power Development Authority will be responsible for operations and maintenance of the project. Electricity will be sold to the Gilgit-Baltistan Public Works Department (GBPWD),

The dam is located on the Satpara Nullah about 6 km south of Skardu city. The Satpara Nullah is the left tributary of the Indus River and flows from south to north. The Nullah starts from Deosai plane, flows through Satpara village and Satpara city and finally discharges into Indus River. The Satpara basin has two distinct parts; the upper part consisting of high altitude hilly terrain, which contributes almost 90% of the flow and the lower (downstream of Satpara) which provides about 10% of the flow.

A feasibility study on the Satpara Dam Project was first completed in 1988 and a PC-1 report was completed in 2001. WAPDA completed design and tender documents in 2002. Consultants for design review and construction supervision were also selected at the end of 2002. A revised PC-1 was finalized in May 2008 and the same was approved by the Planning and Development Division in July 2009 to update the budget.

1.3 Prior Environmental Reports and 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 until an IEE or EIA is completed and submitted to the Federal or Provincial EPA for approval. In case of the Satpara project, WAPDA's environmental unit completed the attached

IEE in 2002. As Satpara falls in a federally controlled area, the IEE was submitted to the Federal EPA for approval.

Diviners & Bitmen International based in Lahore completed a seismic assessment report dated February 2006. This report concluded that the project area is in a seismically activity area. Therefore, the report concluded that a short array Seismic Network is recommended to monitor seismicity of the eastern region of Nanga Parbat where the project is located. WAPDA reviewed the engineering design and revised them based on the assessment. However, the Seismic Risk Assessment, indicate a low probability for the occurrence. " *Probabalistic Analysis has given maximum level of ground motions ranging from 0.3g to 0.38g (with an average of 0.34g) for a return period of 10,000 years (1% probability of exceedence in 100 years),. This is in well agreement with the PGA (0.34g) worked out from the deterministic analysis and is, therefore, selected as Maximum Design Acceleration.*"

In additional, WAPDA awarded the project construction to reputable contractors through competitive bidding. WAPDA selected four companies for engineering and constructions that commenced work in 2003/ 2004: (1) Pakistan Engineering Services (PVT) Ltd Consortium - prime contractor for dam design and construction supervision; (2) Descon Engineering Ltd. – civil & hydro steel structures; (3) China Machine International Corporation (CMIC) – electro-mechanical works for power house; (4) China Central Power Group (CCPG) - irrigation system.

The Satpara Dam project was initiated in April 2003. Due to lack of funding, construction is progressing slowly and the following activities remain to be completed:

Table 1- Project Status (As of July 1, 2010)

No.	Description of Work	Completion Status	Outstanding Works	Expected Completion Period From Date of Funding
1.	Dam	91.0%	9.0%	8 months
2.	Power House 3 & 4	0.0 %	100 %	22 months
3.	Completion of Power House 1 & 2	99%	1%	8 months
4.	Irrigation	75 %	25%	8 months

A. **Civil Works/ Dam**

Only another 5 feet of dam height construction is left out of the 125 ft design. Similarly, construction on all other dam related civil works including roadways, embankments, access roads, spillways, and surge chambers are about 91% complete.

B. **Power Generation House**

Two small generation houses need to be constructed to accommodate a 2.0 MW and 1.8 MW capacity hydro turbines. The powerhouses will include necessary switchgear

and a transformer. Both these power houses will be connected via a 11 kV transmission line to the onsite switch yard.

C. Irrigation System

The irrigation system consists of a six foot wide cemented channel that will be bifurcated to deliver water in both east and west directions. The water exiting the hydro turbine will be gravity fed into the channels. The water in the channels will flow downhill into southern area of Skardu to cultivate land that is presently unutilized for any purpose. Already about 75% of these two channels have been completed and only 25% of construction activity remains.

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 by an Initial Environmental Examination that WAPDA completed in 2002. 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 initial 2002 IEE was designed to meet the standard guidelines of the Pakistan Environmental Protection Agency (PEPA), the World Bank and the Asian Development Bank. The report was approved by the PEPA and no further Environmental Impact Assessment (EIA) was required as the GOP environmental guidelines do not require detailed EIA for projects less than 50 MW installed capacity.

Major environmental objections were related to construction of the Shatung tunnel. Based on objections, especially from the WWF, that component of the project was eliminated. Subsequently, the 2002 IEE report concluded that the project will have minimum environmental impact:

- There would be no loss of any rare and endangered species.
- Snow leopard, brown bear and other wild life are found in the area south of Satpara on the Deosai Plateau and will not be impacted by the project.
- Minimal change in water quality such as increased turbidity is expected during construction periods.

- Presently there are no resettlement issues. Only eight families and two hotels were displaced and compensation was paid accordingly.
- No reduction in fish production or population is expected.

The only minor sociological impact was the loss of some hectares of privately owned land which has been already acquired by WAPDA with compensation paid accordingly. So far WAPDA has acquired 58.98 acres of the land and 39.75 acres are in process of acquisition. About 5 acres will be utilized at the dam site and the remaining 34 acres for the irrigation system. WAPDA is in discussion with the Office of the Deputy Commissioner Skardu to acquire this land. There are no resettlement issues with purchase of this government owned There has been no objection by the local residents on this impending acquisition of land.

4.0 Environmental Assessment Guideline Reference Documentation

An Environmental Monitoring and Mitigation Plan was also developed as part of the IEE. The purpose was to manage the environmental effects in order to minimize impacts and maximize secondary benefits. Following items list the possible environmental impacts and the mitigation measures that were recommended as part of the mitigation plan.

A. Water related Mitigation

The water quality of the Satpara nullah, used for providing water to inhabitants of Skardu, will be affected during construction of the project due to increase of sediments. Drainage channels should be built around or at the downstream ends of all construction areas and these channels should lead the water to the treatment and settlement ponds.

For mitigation, septic tanks should be provided to treat the waste water from site installation camps and sanitary appliances. Sludge collected from the septic tanks and solid wastes should be disposed of properly through landfill methods. Diesel, oil and lubricants should be properly stored in accordance with the petroleum regulations.

B. Land related Mitigation

The land between the full supply level and existing level will come in the reservoir area and also 8 families located near existing weir will be displaced. All families will be compensated according to the Land Acquisition Act. Also trees located on the right bank and in the island will be submerged. As a mitigation measure WAPDA will plant native tree species in the area of right bank, front side and along the Satpara road. Re-plantation will be carried out in consultation with the Forest Department.

C. Disposal of Evacuated Material

The excavated material produced during construction period, will be used as back fill material and as aggregate for different project structures and access roads. Therefore disposal of excavated material is not an issue.

D. Wildlife

Manpower working at construction site should be aware to protect wildlife. Noise produced by blasting and other construction activity should be kept to acceptable level.

E. *Air Pollution*

The Satpara project will contribute towards improvement of air quality. The provision of the electricity will reduce the trend of burning wood and kerosene oil which is widely used in Skardu as a source of fuel. During construction of the project, the increase in the suspended dust and exhaust emissions can be effectively mitigated by adopting the following preventive measures: (1) sprinkling of water on the service roads and access tracks; (2) controlling the vehicles within limit; (3) planting rapid growing trees in the project area; (4) control of exhaust gases of vehicles used of construction.

F. *Noise*

The plant should be designed in such as way that noise level does not exceed the following limits:

- At a distance of 5m from the noise source 90dB
- At boundry of power house 55dB
- Night time level 35dB

All vehicles should be equipped with effective mufflers and high noise machinery should not be used in night shifts.

G. *Employment*

The construction of the power plant will create job opportunities for the people living in the surrounding area. Other facilities like commodity market, medical clinic etc., will also be established that will result in opportunities for local people to establish small business.

H. *Fire Protection*

Fire protection equipment at the powerhouse shall consist of the following:

- Underground fire services main with the valve pits
- Hydrants and fire hoses in cabinets
- Fire extinguishers (CO_2, dry gas, foam)
- Sufficient sets of breathing apparatus should be available at the site area.
- Fire walls shall also be constructed around main transform

I. *Safety Measures*

- WHO environmental health and safety rules should be followed
- Generally the site should be adequately equipped to handle accidents
- Medical aid, fire extinguishing equipment, artificial oxygen supply/masks and helmets should all be present on site in adequate numbers
- Explosion handling and conveyance should be done according to rules laid down by the Government
- The Government of Pakistan rules for health and safety of workers under the Explosives Act 1984 and the factories Act 1934 should be followed

- Permanent sign should be erected in the area under construction
- WAPDA should erect safety fencing around any unsafe areas to keep out people and animals

Note: 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 Satpara multipurpose project. The conditions will include the use of environmentally sound materials and safe construction practices, monitoring and evaluation, update 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 both Satpara 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, 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 Satpara dam project.

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

d. For the remaining scope of work for Satpara dams to be implemented under USG funding, conduct a quick environmental analysis and develop a single/integrated comprehensive and detailed 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	Minor. 91% construction of the 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. The EMMP developed will be approved by the BEO/Asia.
Construction of power house #3 and #4	Minor to Moderate. Negligible adverse impact on the natural and physical environment.	**Negative Determination with Conditions** per 22 CFR 216.3 (a) (2) (iii), the Conditions (with reference to the Pakistani laws

	Runoff water from power house #1 and #2 will be used for driving turbines in power house #3 and #4 respectively.	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. The EMMP developed will be approved by the BEO/Asia
Construction completion of irrigation system	Minor to Moderate. Irrigation system of two main canals is 75% complete.	**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. The EMMP developed will be approved by the BEO/Asia

5.4 Limitations

This assistance doesn't cover activities involving:

1. Procurement, use or recommendation for use of pesticides and of genetically modified organisms (GMOs).

2. DCA or GDA programs.

3. Procurement or use of Asbestos Containing Materials or other toxic/hazardous materials prohibited by US EPA.

5.5 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

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Confidential information redacted

Confidential information redacted

Appendix E: Site Photographs

Photograph E.1: Vegetation on Right Bank of Reservoir

Photograph E.2: Loose Material on Left Bank of Reservoir

Photograph E.3: Slopes and Slides on Left Bank of Reservoir

Photograph E.4: Slopes along the Right Bank of Reservoir

Photograph E.5: Slopes and Slides around the Reservoir

Photograph E.6: Lake, Dam and Spillway

Photograph E.7: Lake, Dam and Spillway

Photograph E.8: Dam, Spillway and Surge Tank Upstream View

Photograph E.9: Vegetation Submerged in the Reservoir

Photograph E.10: Spillway

Photograph E.11: Spillway Chute, Outlet and Downstream Works

Photograph E.12: Main Dam Spill Way and Satpara Nullah (downstream view),

Photograph E.13: Command Area along the Right Bank Canal

Photograph E.14: Command Area under the Left Bank Canal

Photograph E.15: Downstream View of Satpara Nullah through Skardu city

Photograph E.16: Powerhouse-1

Photograph E.17: Powerhouse-2 and Switchyard

Photograph E.18: Left Bank Canal near Powerhouse-4 Site

Photograph E.19: Proposed Site for Powerhouse-4

Photograph E.20: Construction Machinery and Vehicles on Dam Site

Photograph E.21: Meeting of Environmental and Social specialists with Project Staff (WAPDA and Contractors)

Photograph E.22: Meeting with Irrigation Contractors

Photograph E.23: Meeting with Agha Khan Rural Support Program

Photograph E.24: Discussion with Local Community

Photograph E.25: Meeting with Affected People of Satpara Village

Photograph E.26: Site for Sewage and Solid Waste Discharge outside Skardu City

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