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PAKISTAN

WATER AND POWER DEVELOPMENT AUTHORITY (WAPDA)

Dasu Hydropower Project

ENVIRONMENTAL AND SOCIAL ASSESSMENT

EXECUTIVE SUMMARY

Report by Independent Environment and Social Consultants

(Reviewed Draft)

January 2014

Contents

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List of Acronyms

AP	Affected persons
asl	Above (mean) sea level
BCM	billion cubic meters
CIIA	Cumulative and Induced Impact Assessment
CITES	Convention on International Trade in Endangered Species
CSC	Construction Supervision Consultants
DB	Diamer Basha Hydropower project
DCO	District Coordinating Officer
DHC	Dasu Hydropower Consultants
DHP	Dasu Hydropower Project
DRA	District Revenue Officer
EARF	Environmental Assessment Framework
EIA	Environmental Impact Assessment
ECP	Environmental Code of Practices
EHS	Environment, Health, and Safety
EMAP	Environmental Management Action Plan
EPA	Environmental Protection Agency
ESA	Environmental and Social Assessment
ESMU	Environment and Social Management Unit
ESS	Environment and Social Supervisor
FGD	focus group discussions
FSL	Full supply level
GAP	Gender Action Plan
GLOF	glacial lake outburst flood
GoP	Government of Pakistan
ha	hectare
HIV/AIDS	Human immunodeficiency virus/ acquired immunodeficiency syndrome
HSE	Health, Environment and Safety
ICOLD	International Commission on Large Dams
IEE	Initial Environmental Examination
IFC	International Finance Corporation
ILRP	Income and livelihood restoration program
IPCC	International Panel on Climate Change
KKH	Karakorum Highway
KP	Khyber Pakhtunkhwa

LA	Land acquisition
LLO	Low Level Outlet
M&E	Monitoring and Evaluation
MoE	Ministry of Environment
MoWP	Ministry of Water and Power
NCS	National Conservation Strategy
NEAP	National Environmental Action Plan
NEP	National Environmental Policy
NEQS	National Environmental Quality Standards
NGO	non Governmental Organization
NOC	No Objection Certificate
NTDC	National Transmission and Dispatch Company
OP	Operational Policy
O&M	Operation and maintenance
Pak-EPA	Pakistan Environmental Protection Agency
PATA	Provincially Administrated Tribal Areas
PEPA	Pakistan Environmental Protection Act
PKR	Pak Rupees
PMU	Project Management Unit
PRA	Participatory rural appraisal
R&D	Research and development
RAP	Resettlement Action Plan
RCC	Roller compacted concrete
SAP	Social Action Plan
SRMP	Social and Resettlement Management Plan
WAPDA	Water and Power Development Authority
WB	World Bank
WBG	World Bank Group
WCAP	Water Sector Capacity Building and Advisory Services Project
WEC	WAPDA Environmental Cell

1. Introduction

The Dasu Hydropower Project (DHP) is a major investment project proposed by the Government of Pakistan (GoP) with support of the World Bank to modernize and expand the energy sector of the country, while shifting from thermal generated electricity to low cost and high reward, clean generation of hydropower. The project is situated in remote mountainous terrain in the Upper Indus valley in the district of Kohistan, Khyber Pakhtunkhwa (KP) province in the north of Pakistan. The DHP has three major components: a) the main dam, powerhouse and its ancillaries, residential complex, and allied facilities; b) realignment of about 65 km long stretch of the Karakoram Highway (KKH); and c) transmission line (TL) for power evacuation from the powerhouse. Since the detailed designs for (a) and (b) above have been completed a comprehensive environmental and social assessment (ESA) has been carried out and presented through the main ESA report. For the transmission line, the planning and design of the alignment and towers has not been finalized yet. Therefore for (c) above only an Environmental Assessment and Review Framework (EARF) has been prepared which provides guidance on the subsequent detailed ESA, which will commensurate with the preparation of detail design of the Transmission Line. EARF is also presented as a stand-alone document. This Executive Summary report describes the potential environmental and social impacts of the DHP project. The environmental and social assessment (ESA) is an important tool for decision making. In the ESA the potential environmental and social impacts of the project and their possible mitigations are described and worked out into environmental and social management plans.

1.1. Background

The energy sector in Pakistan: Pakistan is suffering from an acute power and energy crisis which is primarily caused by an increasing gap between insufficient energy supply and an increasing demand for power. The demand for power in the country is still relatively low as compared with the industrialized world. However, in recent years the use of electricity is increasing with an estimated 7.6 percent per year, measured over the period 2001-2011. The supply has increased in the same period with only 3.5 percent per year, resulting in a shortfall of over 7,700 MW in 2011. Without an extra acceleration in the production of energy the gap between demand and supply is expected to increase to over 17,000 MW in the year 2029.

The Vision 2025 Program of WAPDA: In order to increase the hydropower generation capacity in the country, and meanwhile maintaining the water supply to the Indus irrigation system the Water and Power Development Authority (WAPDA) has prepared its "Vision 2025" program. The proposed project is an integral part of WAPDA's "Vision 2025" and the Power Policy 2013 of GOP. The objectives of the Power Policy 2013 is to improve electric power generation capacity, the revival of the country's economy by injecting cheap hydropower energy, and meet the future needs of Indus Basin irrigation system. The DHP is one of the priority projects in the Program. A feasibility study for this project was carried out in 2009 to identify the location of the project and to prepare preliminary engineering designs, cost estimates and a preliminary EIA. The detailed design is currently being prepared by an international consortium of consultants: the Dasu Hydropower Consultants (DHC). Financial assistance for study and design is given by World Bank under their Water Sector Capacity Building and Advisory Services Project (WCAP).

1.2. The Proposed Project

Location: The Dasu Hydropower Project is located on the Indus River at a site about 8 km upstream of Dasu Bridge near the small city of Dasu, the capital of Kohistan district in KP province (see **Figure 1**). At this site the river Indus flows in a deep and narrow valley (elevation 750 - 800 m asl) which is strongly incised into the lower Himalayan mountains with an average altitude of 2,000 to 4,000 m. The project area is accessible through the Karakorum Highway (KKH), which is the only road connection between Islamabad (at 350 km distance) and the north of Pakistan and China (Kashgar). About 74 km further upstream along the Indus another structure under the "Vision 2025" program is planned: the Diamer-Basha Dam.

The project: The DHP includes the construction of a 242 m high concrete dam in a gorge like valley of the Upper Indus River. Behind the main structure there will be a 73 km long reservoir (at full supply level of 950 m asl) with an average width of 365 m and a total surface of about 24 km². The water retained by the dam will provide sufficient "head" to generate electricity in an underground powerhouse, housing 12 turbines, each producing 360 MW of power. The total maximum generation capacity will be 4,320 MW. After full completion, the Dasu Hydropower Project is estimated to generate about 21,500 GWh of energy per annum. This would significantly alleviate the shortage of electricity in the country.

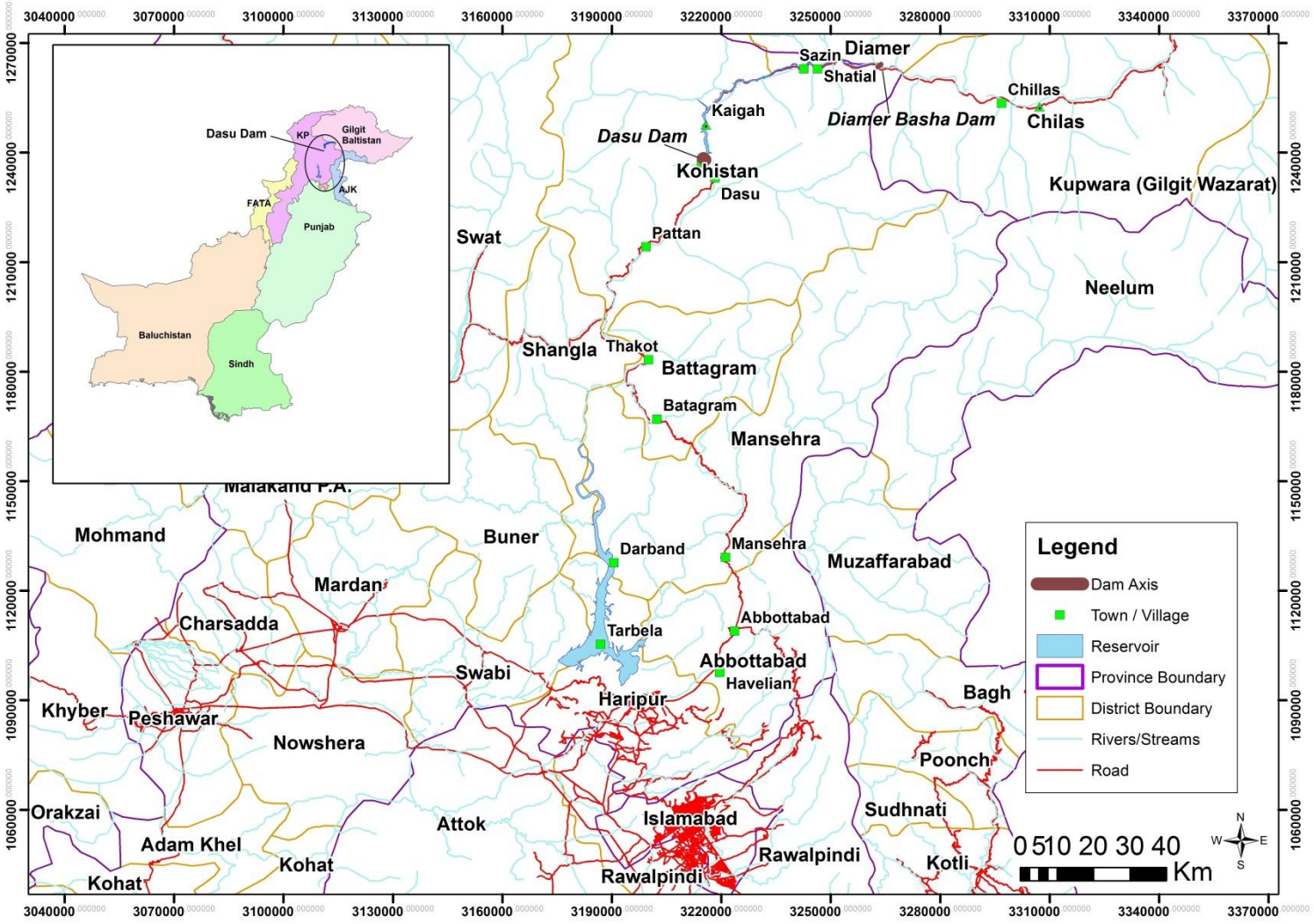


Figure 1: Location of DHP in Pakistan

Karakorum Highway and access roads: Apart from the hydraulic and electrical infrastructure needed, the project includes the realignment of about 62 km of KKH at a higher level due to submergence of the current road, including the construction of eight new bridges. Also about 13 km of a access road from Komilla town to dam site is foreseen, together with some 40 km of new access road along the right bank and one suspension bridge crossing the Indus at Kandia . Also included in the project is the construction of a 132 kV transmission line between Dubair grid station at some 45 km downstream of the project site. The line will provide the project and the residential colony with electricity during the years of construction and is included in the present ESA.

Transmission lines: Two 250 km long 500 kV transmission lines will be built to connect the Dasu plant with the main power distribution network near Gujar Khan in Punjab province. The construction of the long distance transmission lines is a separate project to be implemented by the National Transmission and Dispatch Company (NTDC). An Environmental Assessment Review Framework (EARF) for this component has been prepared. The EARF included a socio-economic survey and an impact screening in the area and consultations with the communities were held. The detailed Environmental and Social Impact assessment will be carried out in 2014- 2015.

Phasing of the project: The project will be implemented in four phases. Phase 1 (2015-2020) will include the construction of the main hydraulic structures and the installation of three of the planned twelve turbines. Three more turbines will be installed in each of the three successive phases: Phase 2 will be completed by 2022, phase 3 and 4 will be started after construction of the Diamer Basha and will be completed after four years. The total project investment is estimated at USD 7.65 billion over more than 20-year period.

1.3. The Environmental and Social Assessment

Studies and basic data: The Environmental and Social Assessment (ESA) is essentially based on field studies and data collected by the consultants (DHC) charged with the design of the project. During their review of the environmental and social reports (May 2012 – November 2013) the independent consultants developed a common approach with DHC in estimating and interpreting the potential impacts of the project and their possible mitigations. The continuous feed-back proved to be a very useful.

Contents of ESA and ESMP: After a description of the Pakistani legal and administrative framework and the applicable World Bank policies (chapter 2) a project description is presented in chapter 3, followed by a discussion of project alternatives considered (chapter 4). A description of the physical, biological and socio-economic environment is given in chapter 5. In chapter 6 several relevant issues such as risks of earthquakes, landslides and flooding are discussed, including the effects of climate change. Potential adverse effects of the DHP are described in chapter 7 of the ESA report. Potential cumulative impacts and concerns associated with other hydropower and non-hydro developments in the Upper Indus Basin (UIB) are presented in chapter 8. Possible mitigating measures to offset, reduce or compensate potential negative impacts of the project are included in the Environmental and Social Management Plan (ESMP) presented in chapter 9. This chapter includes also a description of the institutional aspects and responsibilities in the project. Finally, in chapter 10 an overview is given of all stakeholder consultations and activities for disclosure and access to information.

1.4. Composition of Study Team

Independent consultants: WAPDA engaged a team of two independent consultants - Mr. Reitse Koopmans, Mr. Mohammad Omar Khalid – to assess the environmental as well as social impacts of the project, to prepare the environmental and social management plan, and to prepare the main ESA report as well as this Summary ESA report. The independent consultants commenced working from the start of the project design around August 2011 and they were authorized to recruit/access professional expertise as required for carrying out the independent ESA. During the ESA process, the independent consultants regularly interacted with the DHC's design team providing technical advice and recommendations, carried out their own field visits, participated in the consultations, and conducted their independent analysis and impact assessment.

Social study team (DHC): The national members of the social and resettlement team included Maqsood Ahmed, Dr. Ramzan Chaudhary, Awais Hassan Khan (Resettlement Specialists), Anwar Fazal Ahmed, Arslan Tariq (Sociologist), Saima Raoof and Ujala Saleem (Gender Specialists), Rana Muhammad Saleem (Consultation Specialist), Ahmed Saleem (Communications Specialist), Noorul Hadi (Livelihood Specialist), and Dr. Ilyas Quershi (Public Health Specialist). The international experts included Dr Mohammad Zaman, Dr. Sunil Gonnetilleke and Dr. Haimin Wang (Resettlement Specialists), Dr. Iffat Idris (Social/Conflict Analyst), and Dr. Bernhard Eder (Public Health Specialist).

Environmental study team (DHC): The national environmental team members included Zafar Iqbal Chaudry and Mudassar Hassan (Environment Specialists), Dr. William George and Prof. Tahir Omer (Fish Experts), Dr. Sajid Nadeem (Wildlife expert), Dr. Rehmatulla Qureshi (Vegetation Expert), Prof. Ihsan H. Nadiem, Irshad Ahmad Soomro (PCR Specialists), Dr. Allah Bakhsh Sufi (CIIA Specialist) and Noman Saeed (GIS specialist). The international team members included Dr. Venkata Nukala (Lead Environmental Specialist), Malcolm Winsby (Aquatic Ecologist), Dr. Kashif Sheikh (Terrestrial Ecologist) and Dr. Masud Karim (Environmental Specialist- Climate Change).

International Panel of Experts: WAPDA has also engaged an international panel of experts (IPOE) consisting of renowned specialists including Mr Erik Helland-Hansen from Norway (environmental expert) and Prof Shi Guoqing from China (Social expert). These experts together with experts from various other disciplines have reviewed the design of the project including the environmental and social aspects. These experts have participated in three missions to Pakistan and had discussions with design consultants and WAPDA, paid site visits, reviewed the ESA reports and provided their respective comments, which have been addressed while preparing the present reports.

2. Policy, Legal and Administrative Framework

2.1. Applicable Legislation and Policies in Pakistan

Environmental Protection Act, 1997: The Act establishes the general conditions, prohibitions, and enforcement for the prevention and control of pollution and the promotion of sustainable development in the Country. It also describes and delineates the powers and functions of the Pakistan Environmental Protection Council, Pakistan Environmental Protection Agency (Pak-EPA), provincial Environmental Protection Agencies (EPAs), and Environmental Tribunals. In particular, the Act creates the authority for delegation of environmental management functions to the provincial EPAs. The requirement of conducting environmental assessment before commencing developmental projects stems from this Act.

Other Relevant Legislation in Pakistan: Other legislation and regulations relevant to the proposed project are listed below.

- Pakistan Penal Code (1860), deals with offences against public interests e.g. to control noise, toxic emissions and disposal of effluents;
- Pakistan Explosives Act (1894) provides regulations for handling, transportation and use of explosives used for quarrying and blasting of rock;
- Land Acquisition Act, 1894;
- Factories Act (1934), provides regulations for safe handling and disposal of toxic and hazardous materials by contractors;
- The North-west Frontier Province Wildlife (Protection, Preservation, Conservation And Management) Act, 1975;
- Protection of Trees Act (1949) prohibits cutting and logging of trees planted by the Forest Department along roads and canals;
- Pakistan Water and Power Development Authority Act (1958) authorizes WAPDA to develop water and power resources in the country through construction and operation of water storages and powerhouses and erecting electrical transmission lines;
- Antiquity Act (1975) protects antiquities and empowers the Government of Pakistan (GoP) to prohibit excavation and construction works in any area that may contain objects of archaeological or cultural historic value;
- Motor Vehicle Ordinance (1965) empowers licensing and other authorities to regulate traffic rules, speed and weight limits and vehicle use;
- KP Wildlife Protection, Preservation, Conservation and Management Act (1975) protects the province's wildlife resources directly and other natural resources indirectly. The act is particularly relevant for the Kaigah private game reserve (5000 ha community managed);
- Labor Laws: labor rights are provided in the Constitution of Pakistan; various acts and ordinances provide additional rules for working hours, minimum working age and conditions of employment;

- Highway Safety Ordinance (2000) includes provisions for licensing and registration of vehicles and construction equipment;
- Local Government Ordinance (2001) deals with enforcement of laws for land use, conservation of natural vegetation, air, water, disposal of solid waste and wastewater effluents, public health and safety;
- Project Implementation and Resettlement Ordinance (2001) safeguards the interests of persons/groups having to be involuntarily resettled due to land acquisition caused by a proposed project. The proposed Ordinance is supplementary to the Land Acquisition Act of 1894, as well as other Laws of Pakistan, and included in the Draft Resettlement Policy.

Regulations and Guidelines: The regulations and guidelines relevant for the present ESA study are listed below.

- Pak-EPA IEE and EIA Regulations, 2000
- National Environmental Quality Standards (NEQS), 2000, with updates in October 2010
- Guidelines for the Preparation and Review of Environmental Reports, 1997
- Guidelines for Public Consultations, 1997
- Guidelines for Sensitive and Critical Areas, 1997
- Policy and procedures for filing, review and approval of Environmental Assessments, 2000

Relevant National Policies and Plans: The national policies relevant to the proposed project and its environmental and social assessment are briefly described below.

- National Conservation Strategy (NCS), 1992, was adopted as the guiding environmental policy for Pakistan. A Mid-Term Review was undertaken in 2000. The Mid-Term Review concluded that the achievements under the Strategy had been primarily awareness raising and institution building, and that future initiatives should emphasize improvements in implementation capacity.
- The National Environmental Policy (NEP) was adopted in 2005 and provides broad guidelines to the federal, provincial, and local governments in addressing environmental concerns and cross-sectoral issues such as poverty, health, trade, and local governance. To achieve its policy objectives, the NEP directs the Ministry of Environment (MoE), and provincial and local governments to develop plans for its implementation.
- The National Environmental Action Plan (NEAP) was adopted in 2001 with the stated objective of alleviating poverty through environmental projects.

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

- Convention on Biological Diversity, Rio de Janeiro, 1992.
- United Nations Framework Convention on Climate Change, Rio de Janeiro, 1992.
- Vienna Convention for the Protection of the Ozone Layer, Montreal, 1987.
- Convention on Wetlands of International importance especially as Waterfowl Habitat, Ramsar, 1971 and its amending protocol, Paris, 1982.
- Convention on Conservation of Migratory Species of Wild Animals 1979.
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Washington, 1973.
- Convention concerning the Protection of World Culture and Natural Heritage (World Heritage Convention), 1972.
- International Plant Protection Convention, 1951.
- Kyoto and Copenhagen protocols on Climate Change.

2.2. Environmental Procedures

Environmental Impact Assessment: In accordance with the Pakistan Environmental Protection Act of 1997 (PEPA) and the Pak-EPA IEE and EIA Regulations, 2000, an EIA is required for hydroelectric power projects exceeding a generation capacity of 50 MW and with transmission lines with a capacity of more than 11 kV. The Dasu Hydropower Project will generate 4,320 MW, therefore an EIA for this project is mandatory.

EIA Approval: The owner of the project, i.e., WAPDA has submitted a preliminary EIA to the provincial environmental authority KP-EPA during the feasibility studies of the project. A formal approval of this report was received by WAPDA from the authorities on 23 November 2011. This approval is valid for three years and is extendable for periods of three years. On basis of the detailed design WAPDA has submitted in December 2013 the present detailed EIA report.

2.3. World Bank Safeguard Policies

The World Bank's environmental and social safeguard policies include the following:

Environmental Assessment (OP 4.01): The World Bank requires an environmental and social assessment for all projects proposed for Bank financing, in order to ensure that these projects are environmentally and socially sound and sustainable. All three main project components (i) the DHP project, (ii) the reconstruction of KKH and (iii) the construction of long-distance transmission lines have all been classified as "Category A" projects. This is because of the scope and size of the project involving large-scale construction activities on the untamed part of one of the largest rivers of the world, the Indus, with the potential possibility of affecting the safety and livelihood of the population living downstream and by blocking the main road connection to the North and to China: the Karakorum Highway. The environmental issues that need to be addressed are relevant both during construction and operation periods. In accordance with the requirements of OP 4.01, for all three project components environmental and social assessments have to be carried out, incorporating Environmental and Social Management Plans to mitigate or minimize all potential adverse environmental and social impacts.The Operational Policy is triggered

Natural Habitat (OP 4.04): There are no protected areas, wildlife sanctuaries or critical habitats in or near to the project area, with the exception of one community-managed conservation area situated at Kaigah. Some infringements in this reserve are expected due to road construction, reservoir inundation and quarrying activities. DHP moreover will change the fast flowing uncontrolled and sediment laden river Indus and the lower part of the valley slopes into a slow flowing narrow (300-400 m wide) and deep reservoir (150-200 m), which extends for about 73 km upstream. The construction of the dam will create a lacustrine and wetland environment in the reservoir area and impair the connectivity of the river by creating a barrier for the free movement of aquatic biota. Therefore the Operational Policy 4.04 is triggered.

Involuntary Resettlement (OP 4.12): For the development of project infrastructure, reservoir area and realignment of KKH an estimated 4,643 ha of land has to be acquired by WAPDA. This will result in the relocation of some 34 hamlets/small villages affecting some 767 households or 6,953 persons. A Social and Resettlement Management Plan has been prepared to guide the planning and implementation of compensatory measures, resettlement and restoration of livelihood in line with relevant Pakistani laws and World Bank OP 4.12.

Forestry (OP 4.36): the policy recognizes the need to reduce deforestation and promote sustainable forest conservation and management in reducing poverty. Pakistan has forests covering only 2.0% of its territory. The forested area decreases annually with some 2.2%. North Pakistan is covered for 29% by forests. These forests will not be directly be affected by the project. However after resettlement of the population at higher altitudes in the valley, the pressure on these high altitude forests will further increase due to increased agriculture and grazing activities, firewood collection and illegal logging. Degradation of forest resources and wildlife will increase. Hence this OP is triggered.

Safety of Dams (OP 4.37): The dam safety policy is triggered since the construction works include the construction of a high dam, with associated infrastructure and located in a mountainous area upstream of a densely populated valley further downstream. Most of the water of the Indus River originates from glacial melt. The structure is designed to withstand maximum floods that may be caused by glacial lake outbursts. The establishment of a Glacier Monitoring and Research Center that will support WAPDA's Planning Unit for monitoring and research in the Upper Indus Basin will be part of the project. Regular inspections together with instrumentation and monitoring will be included in a separate component of the project, as well as the monitoring of the movement of sediment, as well as an early warning system. An independent panel of experts will review the design and operational and maintenance aspects of the project, particularly the safety and early warning systems.

International Waterways (OP 7.50): The project is located on the Indus River which is an international waterway shared by India and Pakistan. Therefore the international waterways safeguard under OP 7.50 is automatically triggered and hence will require a riparian notification consistent with World Bank policy.

Physical Cultural Resources (OP/BP 4.11): The ESA study has shown that there are several important physical and cultural resources in the area including two valuable and beautifully decorated, 400 year old mosques and an extensive field of ancient rock carvings dating from Stone Age to Buddhist periods. These sites should be protected. Since the narrow Indus valley has been the only connection between the Indian subcontinent and China since pre-historic times the possibility of unexpected "chance finds" in the project area is high. Therefore procedures dealing with "chance finds" should be included in the bidding documents for the construction contracts.

Indigenous People (OP 4.10). This OP has defined indigenous people for the policy application as well as the planning the process to be followed if a Bank-funded Project affects indigenous people. In Pakistan, the World Bank has concluded through its operational experiences that only Kalash people in Pakistan meet the definition of indigenous people as in this policy. Since no Kalash people live in the Project area, this OP is not triggered.

Projects in Disputed Areas (OP 7.60): Projects in disputed areas may raise a number of delicate problems affecting relations not only between the Bank and its member countries, but also between the borrower and one or more neighboring countries. This OP is not applicable, since the project is not located in or near any disputed territory.

Access to Information: This policy sets out the Bank's requirements for disclosing and sharing information. The policy reaffirms the Bank's commitment to transparency and accountability in its activities for promoting development effectiveness and poverty reduction.

Environmental Health and Safety Guidelines: The IFC/WB Environment, Health, and Safety (EHS) Guidelines (1997) contain performance levels and measures for development of industrial projects that are considered to be achievable in new facilities at reasonable costs by existing technology.

WB Gender Policy: The WB Gender Policy aims to reduce gender disparities and enhance women's participation in the economic development of member countries. During the ESA, the gender aspects have been considered and women's participation has been ensured as far as possible while carrying out the stakeholder consultations. These aspects have been included in the Gender Action Plan and the Income and Livelihood Restoration Program prepared as part of the Social and Resettlement Management Plan (SRMP).

2.4. Compliance Status with Pakistani Legislation and World Bank Policies

The present compliance status of the project with Pakistani legislation and World Bank safeguard policies is indicated in **Table 1** below.

Table 1: Compliance of Project with GoP Legislation and WB Safeguard Policies

	Legislation/Policy	**Actions Taken to Comply**
GoP	Pakistan Environmental Protection Act, 1997	WAPDA received a No Objection Certificate (NOC) for the project from KP-EPA on 23-11-2011 based on the EIA prepared during the feasibility studies. No further approval is required from KP-EPA. WAPDA has submitted the ESA reports to in December 2013.
	EIA guidelines for Power Projects	The updated ESA is prepared and will be submitted to KP-EPA for review
	International treaties	Verification of protected sites, Red List and protection of vulnerable habitats
	Public information and disclosure	Public information centers will be established at Dasu on both banks. Executive Summary of EIA and RAP will be prepared in Urdu and will be available in the information centers along with other project information. A public disclosure meeting will be held in Dasu by DHP with the affected community. The EIA report will be disclosed on WAPDA's website.
World Bank	Early screening and Scoping	Scoping sessions were held through consultative workshops at Peshawar, Lahore, Karachi and Islamabad; and consultations at the affected villages.
	Participatory approach	Workshops, consultation meetings and focus group discussions were held.
	Integrate EA and SA	Natural environment, human health, social aspects, physical cultural resources are integrated in planning documents.
	Natural Habitats	Verification of protected sites and ecosystems, Red List and endangered flora and

	Legislation/Policy	Actions Taken to Comply
		fauna has been done.
	Risk assessment	Labor, health and safety risks were determined Environmental Code of Practices (occupational health, labor) will be included in tender documents; an Emergency Response Plan will be prepared by the contractor before commencing the construction activities.
	Climate Change and floods	Impact of increased snow-melt and climate change and effect on Indus floods were studied. Regional cumulative impacts have been studied. A Strategic Environmental Impact Assessment for the entire Indus Basin is on-going.
	Alternatives	Alternatives have been considered for without case, location of the project facilities, dam and water ways; dam type; power generation equipment and construction phasing.
	Pollution	Baseline survey of environmental quality has been carried out. Stricter Environmental standards were applied and Environmental Code of Practices (ECP's) is included in contract documents
	Physical and Cultural Resources	Verification with Department of Archaeology implemented Chance find procedure included in contract documents and a project archeologist will be on stand-by.
	Gender	Gender consultations were carried out during ESA. A gender action plan has been prepared.
	Public Health	A comprehensive study on public health aspects has been conducted and a Public Health Action Plan is prepared
	Consultation and access to information	Consultations have been held in all the affected villages and with the Jirgas. Stakeholder workshops were conducted in Peshawar, Lahore, Karachi and Islamabad. The EIA and RAP will be disclosed to the affected community in a public meeting. The executive summary reports will be translated in Urdu and will be made available through two Public Information Centers established at the project site. The reports will be made available in public libraries and would be available on WAPDA website. The ESA and its Summary would be sent to World Bank Info Shop.

3. Project Description

3.1. Background

Demand for electricity: Demand for power has been rising rapidly in Pakistan and is predicted to rise at an increasing rate in the coming years. The present situation is that there is now significantly greater demand for electricity than the installed generation capacity (20,600 MW). Currently there is an estimated shortfall of over 7,300 MW in winter and 3,350 MW in summer. Rationing of electrical power by frequent load shedding has been as high as 5,000 MW. This situation is causing serious economic losses to the country and could lead to an increasing risk of social unrest. Another major problem in the sector is the high cost of electricity generation. These have risen steeply over the last decades. Lack of investments in the capital intensive-hydropower sector has led to an increasing share of expensive and polluting thermal power plants. Consequently, despite huge hydropower potential in Pakistan, especially in the Indus Basin, hydropower share in the production has declined from 64 percent in 1970 to 32 percent at present (6,600 MW).

Power shortages: These result in long hours of load shedding, impacting households, industrial and commercial activities and influence the quality of life. It affects schools, colleges, clinics and hospitals, affecting shops and businesses, reducing sales and revenues and affecting industry, reducing productivity. It also deters investment. The financial impact of load shedding has been estimated at 3 percent to 4 percent of GDP, costing about USD 10 billion a year. This situation is causing serious economic losses to the country and is responsible for increased unemployment and poverty. In a number of occasions the frequent and prolonged power cuts have caused social unrest.

Government interventions: In an attempt to address the problems in the energy sector the Government of Pakistan (GoP) has initiated a number of policies and programs which are focused on efficiency improvement in production, distribution and delivery of electricity, introducing cleaner and cheaper technologies on different scales, including options such as demand side management and improvement of utilization efficiency to reduce transmission and distribution losses. GoP is already undertaking projects such as the World Bank funded Pakistan - Electricity Distribution and Transmission Improvement Project, and Asian Development Bank funded Energy Efficient Investment Program. However, these programs are often complementary to, rather than substitutes for large scale hydropower projects such as DHP.

Program for hydropower development: Studies to identify potential water storage and hydropower projects already started by WAPDA during the eighties The total identified capacity of hydropower was estimated at 46,000 MW. Nine of these projects were located in the Upper Indus basin. On basis of these studies WAPDA prepared its "Vision 2025" program in order to cope with the increasing water and power demands of the country. The program was approved by GoP in 2001. It includes an ambitious development program to construct hydropower plants that could generate an additional 16,000 MW. DHP ranked second on the priority list.

Feasibility study: A feasibility study of DHP was carried out in 2009 studying various alternative project sites near Dasu and determining the hydraulic and other infrastructure required for a project with generating capacity of 4,320 MW and an annual energy generation of 21,300 GWh. The current location and detailed designs are largely based on the results of the feasibility study.

3.2. Project Objective

The overall project objective is to facilitate a sustainable expansion of Pakistan's electricity generation capacity in order to bridge the increasing gap between supply and demand of electricity in the country. The project will also contribute to the country's strategy in moving away from high cost fossil fuel powered thermal plants towards low cost cleaner hydropower generation, with reduced greenhouse gas emissions. In this way the cost of electricity generation will be considerably reduced and foreign exchange will be saved by reducing fuel imports. The project would also support the strengthening of WAPDA in the preparation of future hydropower projects and build its capacity in managing Pakistan's vast hydropower potential.

3.3. Location of the project

The Dasu Hydropower Project is to be constructed at some 8 km upstream of Dasu Bridge near Dasu town in Kohistan District (Khyber-Pakhtunkhwa province). The site is about 74 km downstream of the projected Diamer-Basha Dam. The DHP is located in a remote and thinly populated mountainous area and is only accessible from Islamabad by GT Road and the KKH via Abbottabad-Mansehra-Besham-Pattan-Dasu. There is no river transport on the Indus or a rail link to the area. The nearest small airport is in Pattan. The Project area lies in a high risk zone for earthquakes. The lay-out of the project is shown in **Figure 2**.

3.4. Project Components

(a) Main Hydraulic structure. This component would primarily consist of the civil works required for the main structure in the Indus River and associated civil works to raise the water level and thus create energy for running the power generating turbines and generators. The structure will be designed to pass the probable maximum flood of 50,360 m^3/s safely and with openings/tunnels to flush the sediment coming from upstream. The arch-gravity structure will be constructed with roller compacted concrete (RCC). The height of the structure would be about 242 m above the foundation (full supply level at 950 m asl) and a length of the crest of about 570 m. This structure would allow an operational storage capacity of 0.82 billion cubic meters (BCM), between elevation of 900 m and 950 m asl and a dead storage of 0.57 BCM. At full supply level the reservoir will have a length of 74 km and an average width of 365 m, covering some 24 km^2 of valley bottom.

(b) Installation of power generating facilities and sediment control. At full development the Project will have two underground powerhouses, housing 12 turbines, each of them producing 360 MW of power. The powerhouses and transformer excavated caverns will be located on the left bank of the river. Four 2.2 km long tailrace tunnels will convey and discharge the water into the Indus River at a site some four km downstream of the main structure. It is envisaged to construct two large diversion tunnels (1.2 and 1.1 km long) on the left bank in order to divert the river whilst the main structure is under construction. The site of the main hydraulic structure will be protected by two cofferdams during construction. There will be nine low-level outlets in the main structure for discharging sediments and flood water together with two sediment expulsion tunnels on the right bank to be operated during the high flood period. In order to cope with the high floods during

summertime (May-September) there will be a spillway, consisting of a radial, frontal overflow with eight bays with a maximum discharge capacity of 36,800 m^3/s. The power generation facilities consist of intake structures with four power tunnels each of them connected to three power generating units of 360 MW. At full development the four power tunnels will serve 12 vertical shaft Francis turbines with a total installed capacity of 4,320 MW. Through underground tunnels the power will be transported to a power yard and further connected to the transmission network of NTDC.

(c) Preparatory and permanent works. These include the construction of new access roads on the Indus right bank, jeepable roads to some remote villages and two new suspension bridges over the reservoir. Residences, office buildings and a WAPDA colony including access roads, housing of staff and supporting facilities, will be built at a site not far from the tailrace outlet near Dasu and some 5 km from Dasu town. Temporary facilities like construction yards, workshops, labor camps will have to be constructed and sites for excavation, spoil disposal and stockpiling to be reserved. The required power (30 MW) during construction of dam and colony will be supplied from Dubair Khwar hydropower project near Pattan, through a new 45 km long 132 kV transmission line. The transmission line follows the KKH alignment between Pattan and Dasu through a scarcely populated and barren area, with few villages.

(d) Transmission line. For transmission and distribution of power two parallel running transmission lines will connect DHP with the 500 kV Grid Station at Pathar Garh in Punjab. The transmission line (TL) will extend over a distance of about 250 km and will traverse five districts of KP including Kohistan, Battagram, Mansehra, Abbottabad and Haripur before connecting to the Pathar Garh Grid Station. The National Transmission and Dispatch Company (NTDC) carried out a detailed study and have started preparation of the detailed design. The construction of the transmission lines classifies as a "cat A" project and therefore a separate social and environmental assessment will be made (consultants are being recruited). The ESA is expected to be completed in 2014. In the absence of a detailed ESA an Environmental Assessment Review Framework (EARF) has been prepared) for this component, on basis on a provisional corridor designed by NTDC for the transmission line.

Earlier NTDC developed a Master Plan for evacuation of power from 26 planned hydro power plants (HPPs) in the mountainous northern areas through International Consultants. This interconnection scheme is the basis of the National Power System Expansion Plan of Pakistan up to 2030. This plan assumed that the Diamer-Bhasha (DB) would be developed before Dasu. The power supply from the DB was supposed to meet the power demands of large demand centers such as Islamabad and Peshawar. The power from Dasu was planned to be transmitted to center like Faisalabad. The situation has changed now. Dasu is likely to come on line for DB and power from Dasu is to be used to meet the demand of centers like Islamabad. The Dasu Transmission line is still to be designed. The first credit would allocated funds for design of the Dasu Transmission Line. The construction would be done through subsequent IDA financing still to be mobilized. The transmission lines will be constructed during Phase I of the project (2014- 2020).

(e) Social and Resettlement Management Plan. The main element of the Social Resettlement Management Plan (SRMP) is the compensation of the affected people for lost assets, resettlement site development, assistance in relocation, livelihood restoration and development. In addition. SRMP also includes provisions to support communities in the project areas for their sustainable livelihood development and broader local area development. The SRMP includes a public health action plan to address possible health action impacts under the project and a gender action plan. The Social Resettlement Management Plans include both short-term income and livelihood measures during the construction phase as well as long-term measures that go into the post-construction phase for a period of 10 years.

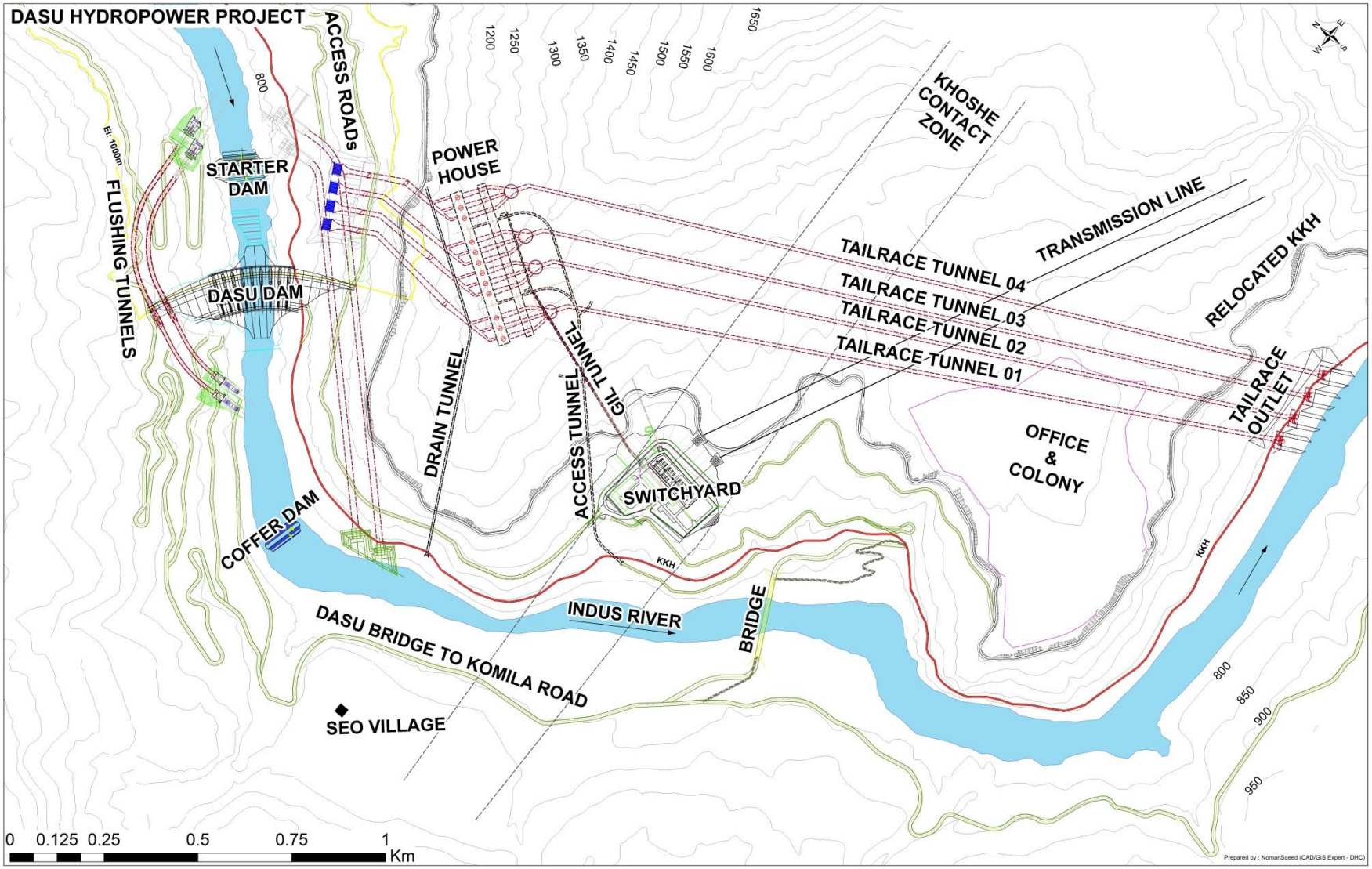


Figure 2: Layout of Dasu Hydropower Project

(f) Karakorum Highway. Another major element is the relocation of the KKH, since about 46 km of this road will be inundated by the reservoir. The realignment of the KKH is very critical to the project, since the traffic on the KKH should not be interrupted or affected by the project. The KKH is the only road connection and lifeline between Islamabad and the north of the country (Gilgit-Baltistan) and important for the trade with China. Daily about 3000 vehicles are passing including some 600 heavy loaded trucks. The road section which will be submerged by the reservoir has to be rebuilt at a higher level along the slopes of the valley. It will include a construction of almost 62 km of new KKH and 3 km of link road. This will be a major operation in difficult terrain. The work also includes the construction of new bridges, retention walls, culverts and access roads. The relocation operation is divided into two contracts on basis of priority implementation: (i) first, the construction of 15.6 km of new KKH and 3 km of link road; and (ii) the construction of 46.1 km of new KKH. The entire operation is expected to be completed between 2014 and 2016. The KKH component will be implemented by WAPDA.

(g) Environmental Management Plan. The environmental management plan (EMP) includes elements of slope stabilization, afforestation and watershed management in the upland areas along the reservoir and the reconstructed KKH, enhancement of the aquatic life and fisheries through reservoir management, preservation and protection of cultural property (petro glyphs) and unforeseen issues that need to be addressed during the project. Construction related environmental issues will be addressed in the construction contracts, thus cost of such measures are included in the construction cost. The EMP would include those issues, which are not or cannot be covered under the construction contracts.

(h) Glacier, watershed, sediment and river monitoring program. Since most of the water resources of the Indus originate from glacial melt, DHP includes also a component for monitoring and research on the Upper Indus Basin (UIB) glaciers and catchment areas. The program will support the establishment of a telemetric network in the DHP catchment area and will provide support to the Glacier Monitoring and Research Center (GMRC) initiated by WAPDA. Within the framework of DHP the institute will (i) undertake field investigations by establishing and running field stations in the UIB; (ii) carry out remote sensing and modeling studies; (iii) prepare forecasts for water security matters and flood control warnings for glacial lake outbursts; and (iv) establish a data management system to carry out data analysis and research. It would link up with the high altitude meteorological network, surface water hydrology and the WAPDA hydro-meteorological network. The sub-component would support works, equipment, consultancy, operations cost and technical assistance and training for establishment of the GMRC in the UIB during the entire project period.

(i) Construction supervision, monitoring & evaluation of project impacts. This component covers the cost of consulting and other services for project implementation, construction supervision and project management support. It also covers financial management, preparation of any additional designs, and bidding documents. The monitoring and evaluation (M&E) activities will provide continuous feedback to the GoP, Ministry of Water and Power (MoWP) and WAPDA on the Project's performance and impact of its various components. The monitoring would be carried out by independent M&E consultants. They would also supervise implementation of the SRMP and EMP and monitor and evaluate positive and negative impacts of the project.

(j) Project management support, capacity building, technical assistance and training. This component will support WAPDA in implementing project related activities, the establishment of a Project Management Unit (PMU), capacity building, operational cost and auditing, technical assistance and training activities. It would also support the strengthening of WAPDA's capacity in devising strategies to become a financially autonomous entity and an ability to develop and finance hydropower infrastructure with strong technical expertise and adequate internal control. Strategic studies will be supported to address technical, financial or management issues, mitigation measures, pilot projects and preparation of future projects that may be identified during project implementation and agreed upon with the Bank.

3.5. Phasing

The DHP will be developed in two stages, each consisting of two phases. During each phase additional power generating capacity of 1,080 MW (three turbines of 360 MW) will be installed. During Phase-1 (5 years, 2015-2020) the major hydraulic structures and related infrastructure will be constructed and one power tunnel including generating facilities for 1,080 MW of installed capacity. Also the relocation of the KKH will be completed. Another tunnel would be constructed during Phase-2, together with power generating facilities for another 1080 MW. Both phases of Stage 1 will be implemented simultaneously (2015 -2022). The Second Stage will include the construction of a third power tunnel and generating facilities for an additional 1,080 MW. Phase-3 and 4 would preferably be carried out after the development of Diamer-Basha dam. See also **Table 2.**

Table 2: Staged development of DHP in relation to Basha

	Stage 1		Stage 2	
	Phase-1	**Phase-2**	**Phase-3**	**Phase-4**
Works	Dam & three turbines	Three turbines	Three turbines	Three turbines
Total installed capacity in MW	1,080	2,160	3,240	4,320
Generation electricity in GWh	8,058	12,225	18,730	21,485
Start	2015		To be initiated after the completion of Basha	
Completion	2022 (first power after 5 years)		4 years after commencement	

Note:
Diamer Basha (DB) detailed design is ready and project is likely to be completed in 15 years;
DHP-Stage 2 will be started after the completion of DB, and would take four years to complete;
DHP Stage 1 will be completed in seven years; the first unit will start generating after five years.

Construction of this dam will provide sediment control in the upstream reservoir and consequently less need for sediment flushing at the Dasu site.

3.6. Project Cost

The estimated project cost is shown in **Table 3**.

Table 3: Overall Estimate of Project Cost (Million Dollars)

	Stage I		Stage II		
	Phase-I	**Phase-II**	**Phase-III**	**Phase-IV**	**Total**
Dasu Hydropower	2,796	599	638	656	4,689
Transmission Line	350	0	438	0	788
Social & Environmental Management	504	0	0	0	504
Total, US$ Million	**3,650**	**599**	**1,076**	**656**	**5,981**
Cumulative Installed Capacity, MW	1,080	2,160	3,240	4,320	4,320
Generation, GWh	8,058	12,225	18,730	21,485	21,485
Cumulative Economic Retrun at US¢ 10.5/kWh as cost of alternative generation excluding environmental benefits					
ERR (avoided cost method)	21%	25%	27%	27.5%	28%
Levelized Financial Cost, US¢/kWh					
At 5% discount rate (avg. cost of borrowing for GOP)	3.36	2.68	2.31	2.26	2.26
At 8% discount rate (WACC for WAPDA in USD)	4.84	3.80	3.28	3.20	3.20

4. Project Alternatives

4.1. Alternatives to the Project

Energy Scenario in Pakistan: Pakistan is suffering from an acute power and energy crisis, which is primarily caused by the increasing gap between the supply (increase 3.5%/year) and the demand for electricity (increase 7.6%/year. Moreover existing thermal power plants do not produce at their full capacity due to the lack of foreign currency needed for purchasing imported fuel (85% of oil is imported). Power shortages result in long hours of load shedding (up to 8 hrs/day), impacting households, industrial and commercial activities. The financial impact of load shedding has been estimated at 3 to 4% of GDP, costing about USD 10 billion a year and this is only expected to increase. This will have very negative social and economic impacts such as impeded economic growth, increased unemployment and poverty as well as social unrest.

Without Project Alternative: The "without project" alternative is not realistic, because Pakistan will build additional generating plants to eliminate power shortages. Indeed, given the increasing prohibitive costs of fuel oil-based electricity generation, development of Pakistan's hydro resources at a variety of scales represents the only reasonable prospect of eliminating these shortages. Indeed, until such time as power shortages are significantly reduced and system reliability increased the incremental output of Dasu would serve primarily to reduce these shortages – the benefits of which are largely the same as that of the "without project alternative" counterfactual: i.e., substituting grid electricity for diesel self-generation and kerosene for lighting.

Energy Efficiency and Demand Side Management: In Pakistan there exist a series of options such as demand side management and improved utilization efficiency, and reduced transmission and distribution losses that have high economic returns and are already being undertaken by various Pakistani organisations.. However, these are complementary to, rather than mutually exclusive substitutes for Dasu and they will be implemented regardless of whether Dasu is built or not.

Alternative Hydropower Projects: Pakistan has a large potential of renewable and clean energy resources in the form of hydropower. Out of an estimated potential of 46,000 MW so far only about 6,500 MW or 14 percent is utilized. The majority of the hydropower potential can be found in the Upper Indus Basin. Compared to various ongoing and planned hydro schemes in the country, DHP has the lowest cost per kWh generated and the least environmental and social impacts because of its nature (run-of-river).

Other Sources of Renewable Energy: Alternate renewable sources such as wind and solar power cannot be developed to a scale comparable to DHP since they will be three times more expensive than DHP. Both of these options need to be developed to the extent technically and financially feasible. They are complementary, but not substitutes for DHP. Moreover, from the perspective of mobilizing the necessary finance for the power sector, they do not compete for the same sources of finance: wind and small hydro can be 100% financed from local commercial banks, whose resources are simply not available for large hydro projects. It is not anticipated that, DHP would crowd out the ability of the GoP, Provincial Governments and/or private sector to finance small and medium scale investments in renewable energy.

Thermal Generation: Investing in hydropower development can provide additional generating capacity more cheaply and cleaner than any thermal alternative, with almost no long-term fuel cost. The domestic gas resources in Pakistan are limited, oil is mostly imported and exploitation of Thar coal is still under investigation. Development of hydropower potential can contribute in reducing the cost of electricity generation, reducing the sector deficit by injecting positive cash flow, saving foreign exchange by displacing imported fuel and reducing greenhouse gas emissions.

4.2. Site selection of main structure and hydraulic and electrical infrastructure

DHP was initially identified as a potential hydropower project in 1981 and the location of the project was projected about 7 km upstream of Dasu bridge. The feasibility study of DHP (2009) was carried out in the assumption that the Dasu project would be implemented after completion of the Diamer-Basha dam. In this study several locations between 3 to 9 km upstream from Dasu bridge were investigated. During the studies the initial six locations for the main structure were reduced (on geo-technical grounds) to three technically feasible alternatives. The final selection of the site was done after extensive consultations with the affected population. The selected site appeared to be technically and economically more feasible and had considerable lower environmental and social impacts, with lower needs of resettlement of people. The alternative made it also possible to preserve the attractive historic 400 year old mosque in the village of Seo, an important cultural and religious site. The alternative was widely supported by the residents from the area.

4.3. Alternatives for the type of structure

Three types of main structure were considered during the feasibility study, (i) a Roller Compacted Concrete structure (RCC), (ii) a Concrete Faced Rock fill structure and (iii) an Earth fill structure. The feasibility study recommended a RCC structure on basis of availability of construction material locally, lower cost and technical advantages. No significant differences in environmental impacts were expected between the three alternatives.

4.4. Alternatives for the lay-out of intake and tail race tunnels

Three different types of waterways (intake and tail race tunnels) were considered during the feasibility study. However this study didn't evaluate the stability of the various types of rock and the possible impacts of the presence of the Khoshe fault, a geological contact near to the proposed underground power house. The Khoshe

fault is not an active fault, with a weak or fractured rock structure. However its presence could possibly create water leakage and influence the design and construction cost of the tunnels. During detailed design four alternatives were studied. The layout for alternative 1, in which the power house is located upstream of the Khoshe fault, was worked out further during the feasibility study. The tail race tunnels are all crossing the fault, with possible negative impacts. In alternative 2 the powerhouse is located downstream of the fault. In alternative 3 any crossing with the fault is avoided, but the tail race tunnels are curved, which is a disadvantage. Alternative 4 is a slight modification of Alternative 1, in which the tail race tunnels are straight without any bend. This alternative is selected because of higher efficiency, since a straight tunnel has much lower head losses due to friction.

4.5. Alternative sources of construction material

Coarse aggregates*:* About 9.2 million ton of coarse aggregate will be required for the construction of the dam. Four quarries were identified on the left bank with suitable material and with easy access (along the old KKH that will be submerged after filling of the reservoir). After studies the quarry at Kaigah (8 km upstream of dam) was selected since (i) the quarry is located in the future reservoir area, thus avoiding additional land acquisition and resettlement, and (ii) enough level space is available for an aggregate processing plant and for storage of aggregates and transportation facilities (conveyor belt), and (iii) after filling of the reservoir the quarry will be covered with alluvial sediments, avoiding visible exposure in the landscape. All potential borrow sites are concentrated on the left bank side, since the right bank side of the Indus is very steep and susceptible for landslides and not suitable for quarrying and not accessible at an early stage of the project. After detailed studies it appeared that three of four sites were unsuitable due to insufficient space needed for installation of crushers and transport facilities. The site at Kaigah nullah remained as the only technically feasible alternative.

Adverse environmental impacts: The selection of this site may have consequences for the Kaigah Community-managed Game Reserve, which is bordering the old KKH and the quarry site. In the Game Reserve (5,000 ha) some limited trophy hunting is allowed. The site is managed by the community of Kaigah village, who have been trained in wildlife conservation management and who obtain an annual share of the sales of hunting licenses. During construction the operation of a quarry at Kaigah could negatively affect presence of wildlife in the area. The community also may suffer from loss of income, since hunters might stay away. These negative impacts however seem are considered to be unavoidable, since there are no realistic alternatives at hand.

Sand: About 5 million ton of good quality sand is required for construction. River sand is available in small quantities and is often unsuitable. Suitable sand deposits are located far way at some 80 km downstream (Maira) and 120 km upstream from Dasu (Chilas). Use of these deposits is expensive because of high transportation cost and would negatively affect the aquatic ecology of the Indus. For this reason it was decided to use manufactured sand from the Kaigah quarries. Kaigah is already selected for preparing coarse aggregates and the same facilities can be used for manufacturing fine aggregates.

Pozzolan: Natural pozzolan (a fine material to use in the concrete) is available in the area at three different sites. However all three sites have insufficient quantities of pozzolan and often from variable quality. Currently the replacement of pozzolan by manufacturing fine material from the aggregates is subject of further studies.

4.6. Alternatives for the selection of generating equipment

The feasibility study proposed to install eight turbines of 540 MW each for the generation of a total of 4,320 MW. These turbines are huge in size and difficult to transport. It appeared that the current condition of the KKH presents an important limitation to the selection of suitable equipment. A comprehensive study was made to find out the maximum weight and width of generating equipment, which could safely pass the KKH. This was tested during trial transports towards the Basha dam. Another factor which was considered was the possible influence of future changes in the flow regime of the Indus due to climate change. Three combinations of generating equipment were evaluated: (a) 8 units of 540 MW, (b) 10 units of 432 MW, (c) 12 units of 360 MW. Option (c) was selected as the most feasible option on basis of energy production and transportation requirements.

4.7. Alternative construction schedules

The DHP requires huge and committed investments. A staged development is the most practical way to achieve early power generation with relatively low investment cost (committed finance from World Bank). This approach could also facilitate in dealing with uncertainties in future investment. Both WAPDA and World Bank agreed on a two staged development of DHP, with each stage divided into two phases. The development of

stage two is assumed to be implemented after completion of the Diamer-Basha project construction, which will largely reduce the sediment load into the Dasu reservoir and thereby prolonging the life of DHP.

4.8. Alternatives for resettlement

Various alternatives for resettlement were discussed with the affected communities. After elaborate discussions a combination of various options will be selected, and the following two are the main options:

- **Option 1:** Community-based relocation close to the current settlements, but at a higher location, with site and services to be developed by the project. This option includes the possibility of a self-managed relocation in Dasu Tehsil or in Kohistan District, with additional compensation and benefits prior to relocation. About 90 percent of the community preferred this option.
- **Option 2:** Relocation to "down country" (outside Kohistan), with extra compensation and benefits prior to relocation. A minority of about 10 percent of the affected community preferred this option.

5. Description of Environment

5.1. Physical Environment

Definition of impact area and zone of influence: The direct impact area of DHP includes all permanent and temporary areas (the footprint) to be acquired for the reservoir and for construction works, housing areas, offices, camps and for realignment of KKH. Upstream of the dam the impact area also includes the left and right bank of the Indus, from the riverbed up to the full supply level of the reservoir at 950 m asl and higher to cover the resettlement areas up to 1500 m asl. At the right bank the impact area also extends to this elevation to cover the corridor (width 500 m) associated with the construction of 65 km KKH. The direct impact area of the project along the Indus river extends towards a point about 10 km downstream of Dasu bridge. Here the direct influence of the tailrace tunnels of the project is estimated to end and the flow pattern in the river will be "normalized". Also included in the direct impact area are the borrow areas needed for the project and the 45 km long corridor (width 100 m) in the Indus valley from Dubair Khwar to Dasu needed for the construction of a 132-kV transmission line are. The area of influence of the project is much larger and estimated to cover the Indus valley between Dasu and the Tarbela Reservoir and the KKH between Khunjerab pass and Hassanabdal. Also the 250 km long corridor for the main 500 kV transmission line between Dasu and Pathar Garh grid station in Punjab is included. The TL iFor the corridor of the line an EARF has been prepared indicating provisional environmental concerns, briefly described in chapter 7 of this summary.

Physiography: The area of Indus-Kohistan belongs to the lower Himalayas and consists in the project area of mountains between 2,000 and 4,000 m altitude. At some distance higher mountains can be found (> 5,000 m). The Indus has cut out a deep valley in the mountain piedmont plain. The river enters the impact area in western direction near Diamer, flowing through a relatively wide valley for some distance towards Shatial. Near Lootar the valley bends southward and forms a narrow gorge-like valley. From the mountainous hinterland small lateral tributaries and nullah's (small streams) are discharging water originating from rainfall and snow-melt snow into the main river. The Indus here is fast flowing and full of sediment. The area is characterized by low population density. In total there are 34 small villages or hamlets, 17 on the left bank (along the KKH) and 17 on the right bank of the Indus. Dasu –Komilla is the only somewhat larger town with about 7,150 inhabitants. Most of the area is heavy sloping and very rocky. There is hardly any level or gently sloping land. Along some of the nullah's cultivation is found, usually on terraced soils or on alluvial fans and old river terraces.

Climate: The area is characterized by a large variation in climatic conditions, strongly varying with altitude. In general the area has a low annual rainfall between 200 mm and 300 mm. However there is a strong increase in rainfall with altitude. It is not unusual that rainfall (often in the form of snow amounts to values of 1,000 mm at altitudes of 3,000 – 5,000 m. The summers are usually hot in the valleys (average day temperature of 36°C in August) and cold (average day temperature of -6 °C) in January. The area is not influenced by the monsoon and is lying in the rainfall shadow of the higher mountains. During winter the precipitation falls as snow. Generally the areas between 1,500 m and 5,000 m in the Upper Indus Basin are snow covered during most of the winter months. The areas above 5,000 m are permanently snow covered. Although annual precipitation is low at the valley floor there can be occasional but intense rainfall events, often with significant hydrological and geomorphological significance (erosion). Winds can be very variable in the project area and the dominant wind directions depend largely on the topography.

Geology: The project area is situated in the so-called Kohistan Arc Complex. This is an area of igneous and sedimentary rocks that was formed during the mid-Cretaceous period. The area lies near to the area where the Asian and Indian continental plates meet resulting in considerable thrusting, uplifting, tilting and plutonic

activity. In the project area mainly granulites and amphibolites can be found on both sides of the Indus. Near the main structure and powerhouses there is a major geological fault in the project area, which is not active any more: the Khoshe fault. This fault forms the contact zone between the granulites and the amphibolites and this fault plays an important role in the final layout of the underground rock chambers housing the powerhouses and the final design and type of construction of the tailrace tunnels. The riverbed itself consists of a mixture of glacio-fluvial deposits, terrace material and land slide materials. Higher on the slopes some terrace remnants are found with unconsolidated moraine (glacial) deposits.

Seismology: No earthquake monitoring was done prior to last century in the country. However, based on historical documentation, it is evident that the region was subjected to severe earthquakes. The epicenters of three well-studied earthquakes of magnitude 5.9 or above have been recorded near to the project site. Another smaller concentration of epicenters of recent earthquakes (2002- 2003) is located in the Raikhot area, north of the project. The epicenter of the heavy Kashmir earthquake of October 2005 (magnitude 7.6) was located at a distance of 90-100 km from the project.

Rock stability and landslides: The project area is characterized by steep and moderately steep slopes. The granulite and amphibolite rock slopes are susceptible to rock fall and block toppling. The stability of the slopes depends largely on rock properties, structural discontinuities, groundwater and earthquakes. Frequent landslides are not very common in the area. A few incidents with landslides during the rainy season were reported from Kandia. The area inside this tributary valley is rather susceptible for landslides. The soils in the area are loose and during heavy rainfall landslides and road blockage may happen.

Sedimentation: The Indus River carries a heavy sediment load due to the ruggedness of the catchment area and the strong erosional forces in the upper catchment area caused by deforestation and lack of protective vegetation cover. Another factor is the great variation between day and night temperatures. This may cause cracking and disintegration of rocks, erosion, and landslides on unstable slopes. Erosion materials in side valleys will be transported by melted snow towards the tributaries and will finally discharge as mud flows into the Indus. The river also derives sediments from vast alluvial fields and moraine deposits formed along its banks more upstream. The annual runoff is estimated at 67 BCM and 79 percent of the flow occurs between June and September. The annual sediment load at Dasu is estimated at 221 million ton.

Hydrology: The Indus flows from the Tibetan Plateau in westerly direction through India and is joined in Pakistan by four major tributaries: the Shigar and Shyok rivers in Baltistan and the Gilgit and the Astor rivers before reaching Dasu. During the last stretch before Dasu the Indus flows in a deep narrow channel with a steep gradient of 3.0 m/km and bends near Kandia in southern direction. The side slopes of the river are often without any vegetation and very rocky. Several lateral river valleys are found and some 14 nullahs flowing into the main river. The discharge of the Indus is characterized by a high flood (or summer) season from May to September and a low flood (or winter) season from October to April. By far the largest share (about 60 percent) of the Indus water originates from melting of snow and ice from the glaciers and ice fields of the Himalaya, Karakorum and Hindu Kush mountains. Approximately 80 percent of the water flows in the summer months (May to October); these flows carry the greatest load of sediments towards the Tarbela reservoir (Tarbela dam is the first downstream barrier in the Indus).

Ground Water: The groundwater table in the river valley is deep and limited to deeper aquifers. No confining layers are expected. The ground water depth near the main structure varies between 48 m and 68 m.

Flooding: A number of historic floods are known from the upper Indus catchment area. Floods occur because of the sudden blockage by one or more landslides of the Indus and the resulting overtopping and outburst of the river. Also heavy floods can occur when an ice barrier breaks or a glacial lake suddenly empties with an outburst flood creating havoc in downstream areas. Nearly 60 glacial lake outburst floods were reported since 1830. Other causes of floods are heavy and prolonged storms and intensive/ extreme glacier and snow melting.

Quality of surface and groundwater: The water quality of the Indus and its small tributaries has been investigated during the high and low flow season. Generally the water quality parameters are good to excellent and classify within the US-EPA's fresh-water standards. Turbidity as expected is high and exceeds the US-EPA's fresh-water standard limit at several locations in the project area. The iron concentration exceeded the US-EPA's fresh-water standard i.e. 0.01 to 1.4 mg/l at few places, which is probably caused by iron ore deposits in the neighboring areas. The concentration of boron exceeded US-EPA's fresh-water standard limit slightly at 4 sites out of 15 sampling sites, but this has no impact on human health.

Air quality: The parameters for fine dust such as PM_{10} (24 hours) were found to be within the Pak- EPA limit, however fine particulate matter ($PM_{2.5}$) at 50 percent of the investigated sites (mainly in residential areas along KKH) was found to slightly exceed the Pak-EPA's prescribed limits. The possible reason could be fuel burning

(coal, wood, and fuel oil), incineration (house and municipal garbage) or caused by traffic. The concentration of ambient gasses was found to be within the standard limits of Pak-EPA at all sites.

Noise pollution: Noise levels in the urban centers is relatively high and in most cases exceeded the Pakistan EPA standard limits. The noise levels at different locations were found in the range of 45-67 dB.

5.2. Biological Environment

Field Investigations: Field investigations on aquatic ecology were conducted during April and August of 2012 in the project area by Dr. William George (a former Director of WAPDA Fisheries Unit, who introduced fisheries in Pakistan) and Prof. Tahir Omer. The studies for terrestrial ecology were carried out over a period of 4 months with field investigations during July to September 2012 Dr. Kashif Sheik (a terrestrial ecologist and a former Pakistan IUCN Biodiversity Expert), Dr. Sajid Nadeem (wildlife expert) and Dr. Rahmatullah Qureshi (vegetation expert and associate professor at Arid Agriculture University, Islamabad).

General biodiversity: The mountain areas of Pakistan are home to unique wildlife and wilderness areas. Also the mountain reaches above DHP have a large biodiversity; but the Indus valley bottom (including the project area proper and the future reservoir area) is largely covered with scrub vegetation with its typical low biodiversity. From the wider area, 232 species of plants, 199 species of avifauna, 31 species of mammals and 18 species of reptiles and amphibians are recorded. Some 180 species of fish are known from the Indus and its tributaries; the number of fish species in the project area is unknown, but expected to be low. None of the plants are endemic or threatened; from the animal species the only threatened one sometimes visiting the project area is the Markhor.

Protected and sensitive areas: There are no designated national protected areas or forests or nature reserves in the project area. Inside the valley of the Kaigah nullah there is an officially recognized "private" game reserve of 5,000 ha demarcated by the KP Wildlife Department as Community Conservation Area and managed by the Kaigah community. The reserve, supported by WWF, is holding the largest population of Markhor in Indus Kohistan The reserve also provides protection to other mammals and a variety of bird species. Other sensitive areas within the project boundaries for Markhor sheep, Musk deer, Black bear, Tragopan, Monal pheasant as well as other rare species are located in Laachi nullah and Sazin Kot (Indus left bank) and Kandia Valley and an area opposite of Shori nullah (right bank). In all these areas, a high biodiversity is only found at higher elevations (above 1,500 m). However, the biodiversity of the mountainous ecosystems is under heavy stress from deforestation, firewood collection, overgrazing, over-hunting, over-harvesting of medicinal plants, soil erosion, use of pesticides, and weak law enforcement. On the downstream vicinity of the project area (some 50 km downstream of dam) is the Palas Valley (1400 km^2) an isolated undisturbed and pristine valley with unique flora and fauna. The current corridor of the transmission line is crossing this area. The valley houses the largest population in the world of Western Tragopan (classified by IUCN as vulnerable) and at least seven other species of rare birds. The Asian black bear is quite common. Natural forests and flora in the valley are unique and several new taxa of plants, unknown in Pakistan were recently discovered. The Palas Valley is listed as Important Bird Area (IBA) by Birdlife International and proposed as a potential UNESCO Biosphere Reserve.

Terrestrial ecosystems: The project area is located along the Indus River, which is flanked by desolate valleys and high mountain ranges. The terrain is rocky and barren in nature with scattered vegetation. Due to high wind velocity, white sandy particles are deposited on the valley bottoms and adjacent mountain slopes. The river beds are characterized by rocky outcrops with stony cliffs, large boulders and washed gravels. There is no littoral zone outside the tributaries (nullahs). There is extensive soil erosion along the steep slopes. The perennial flow of water from springs/streams and nullahs maintain the lifeline of the Indus River. In the valleys near the human settlements, there is frequent irrigation and cultivation along with deep soil depositions. The main part of the project area is characterized as a "mountainous dry sub-tropical scrub zone", covered by shrubs and typical for areas between 800 and 1,500 m. Wildlife does not reside here but they are reported to visit the area during winter in search of food when higher areas are snow laden. At lower altitudes, up to 950 m, the vegetation is dominated by *Artemisia maritima* and grasses. On foothills and intermediate slopes plots of mixed forest are encountered. Above 1,500 m, outside the project's key impact area, a variety of vegetation is found. These higher mountain zones play an important role in the summer livelihood (grazing, forestry, hunting, firewood) of the local community.

Field surveys and terrestrial species recorded: Biological surveys were carried out at selected stations within the project area. None of the recorded 232 floral species are endangered, rare or vulnerable (IUCN Red-List). A large number of the plant species are of economic or medicinal value for the inhabitants of the area. Most of the 199 recorded bird species reported are classified as "abundant and common". The Western-horned Tragopan is listed as "vulnerable". The Monal Pheasant and the Rufous-tailed Rock Thrush are classified as "rare", and the

Grey-necked Bunting and White-bellied Redstart as "scarce". From the wider project area 31 mammal species are reported. Most of these are confined to the mountain tops at higher altitudes (>2,000 m), outside the project impact area, and they rarely visit the Indus riverine habitats. Two of these species are reported "critically endangered": the Common Leopard and the Caracal. The Eurasian otter is reported from the Diamer Basha area. Eighteen species of amphibians and reptiles are reported from the project area. The current state of knowledge about northern Pakistan insect biodiversity is very inadequate. During the surveys, 39 species of wetland birds were observed.

Community Conservation area: The Community Conservation Area of Kaigah Nullah, supported by WWF, was holding the largest population of Markhor in Indus Kohistan during the 2005 census (150 individuals). There are signs of poaching and deforestation causing damage to the core habitat of this species.

Aquatic ecosystems: Physical geological, meteorological and hydro-biological conditions vary substantially along the river. The uppermost section of the river flows east-west in the mountain peak zone for about 950 km before it reaches the Dasu Project area. The catchment in that area is mountainous and characterized by towering peaks covered with snow and glaciers. The river is mainly fed by melting of mountain snow; flow is high during summer and contribution from rainfall is very small. Physico-chemical conditions of river water changes between the summer and winter seasons. During summer, river water is very turbid and carries a high sediment load. Throughout the region gorge walls are very steep with little vegetation. Several river tributaries (nullahs) join the river between Basha and Dasu.

Aquatic ecological surveys and species recorded: In the project area, two limited aquatic ecology surveys were carried out; in addition some data from earlier studies and from literature were collected. Ranges of parameter values were: water temperature 15-24°C; conductivity 63-149 µS/cm; calcium carbonate hardness 30-110 mg/l; dissolved oxygen 4.8-7.4; and NO_3 0.20-1.20 mg/l. During summer season the river contains maximum sediment load (sand, clay and silt). The sediment load of the river water plays an important role in the existence and distribution of fish and other aquatic life. Vegetation is scarce; only the banks of some nullahs show patches of vegetation (herbs, shrubs and trees). Fifty-nine species of phytoplankton were identified in plankton samples from stations upstream of the proposed dam site, and thirty-five in samples from downstream stations. Composition of phytoplankton is indicative for oligotrophic to low-mesotrophic water.

Fish: Fish diversity in the Indus is low compared to other major rivers. 177 fish species are reported from the Indus River system, including 12 exotic species. This is substantially lower than in other major rivers in Asia. Five species of fish are recorded in the project area. The first of two sampling trips (6 persons, 10 days) yielded only 25 fish, and the second one 50, belonging to four species. The main reasons for poor fish diversity are the long torrential upper courses in the Himalayas, glacier fed water and high sediment load or low mean discharge rate of water. Fish sampling for the Diamer Basha Hydropower Project (2006) yielded 14 species, but also this can be considered low, probably due to high-altitude tributaries, low water temperature, high water velocity, low benthic productivity and long stretches of gorges.

Fish species: Most species in the project area are members of the carp family (Cyprinidae) and loach family (Noemachcilidae). The piscifauna is dominated by endemic genera of the sub-family Schizothoricinae (snow carps or snow trouts: *Plagiostomus*, *Esocinus and Labitus*) and one genus of the sub-family Noemacheilidae (*Triplophysa*) and one species of the Sisoridae family (the catfish Glyptosternum reticulatum). These genera inhabit torrential and swift streams and rivers of the mountain region and have evolved morphologic features adapted to these habitat conditions. Plagiostomus is the dominant fish species in Dasu area representing more than 75% of total fish catch and other two species of snow carp represent about 15% of total fish catch. None of these species are listed in IUCN Red List. Mahaseer is other important cold water fish species of Indus (long distant migrant and endangered), but its habitat starts about 70 to 80 km downstream of the damsite.

Habitat of snow carp: In the project area fish found mainly in the tributaries, while in the mainstem they are found near the confluences during low flow season of winter. Tributaries with snow carp fish habitat on the upstream side of the dam site are Kandia, Tangir, Darel, Kaigah, Summar, and Goshali. While tributaries on the downstream side with snow carp fish habitat are Sieglo, and Jalkot. Snow carps thrive in the snow fed river habitat of clear, shallow water of stony substratum with an average depth from 0.5 to 3 meters, and river flows with low to high velocities (0.5 to 1.5 m/s). Average temperature requirements are 4 to 20 ^{o}C and dissolved oxygen requirements are 8 to 12 mg/l. Snow carps are bottom feeders and mainly feed on peryphyitic algae and diatoms.

Migration of snow carp: Snow carps are short distance migrants. In the project area, they migrate within the tributaries, not along the mainstem Indus. During April to September (spring and summer, high flows), they prefer upstream head waters habitat at higher elevations. During September to April (low flows and winter),

they prefer lower elevations and confluence zone with Indus. The triggers for migrations are high flows, high sediment load and low temperatures. During spring, when flows started increasing in the rivers due to melting of snow, the fish migrate upstream from April and May (within tributaries) due to high flows and turbidity at lower elevations. During autumn, when the temperatures are starts to drop at higher elevations, the fish migrate downstream from September and OctoberThe construction of the Tarbela dam played an important role in the decline of Himalayan Snow Carp and Mahaseer populations together with increased fishing pressure. These species feed on flowing water food organisms that do not thrive in stagnant reservoir water. Mahaseer is reported to ascend the Indus River to Besham and above and to spawn in Allai Khwar which has been described as the last upstream safe-haven for the species..

Spawning of snow carp: Female fishes spawn in two seasons, one in September-October and other in March - April. Sexually matured snow carp (when they reach 18-24 cm length, at the age of 2-3 years) spawn in tributaries in clear water (along stream banks, backwater pools and near confluences of other tributaries and Indus) on gravelly/stony ground or on fine pebbles at 10-30 cm depth. Low water currents of 0.5- 1.5 m/sec, pH 7.5, dissolved oxygen concentration of 8-12 mg/L and gravel sizes of 50-60 mm are the optimum conditions for spawning.

Fisheries: There is no regular fisheries management in the Dasu area and no fish farming. Local people fish as a part time activity, not as commercial fishermen. Very few persons sell their catches, but use fish for home consumption. There are no fish processing or storing centers in the project area, nor any fish shops or fish markets. Fish catches from the Indus help to meet protein requirements of local people, since meat is expensive. Limited financial resources compel local people to undertake fishing. Fishing in the project area is not supported or assisted by government or non-government agencies.

Bird Migration: The migration of waterfowl occurs in north-south direction and vice versa. The birds breeding in central and northern Siberia migrate to various destinations in Pakistan, crossing the Karakorum, Hindu Kush, and Suleiman ranges, and following the Indus valley and plains down to the Indus delta. This flyway of waterfowl and migratory birds is a corridor of international importance, the so-called "Indus Flyway" or "International Flyway No 7". Large numbers of waterfowl and birds like teal, pintail, mallard, gadwall, white-headed duck, houbara bustard and Siberian crane follow the Indus on their way towards the wetlands of southern Sindh, which are the most important major wintering grounds of migratory waterfowl. The 100 km long Tarbela reservoir is known as a staging ground for migrating birds. Dasu reservoir will further enhance the habitat availability for resting of migratory birds. However in the absence of feeding grounds in the vicinity of the Dasu project there will be hardly any winter migrants resting longer than one day in the project area.

5.3. Social and Economic Environment

Kohistan district: The word Kohistan literally means land of mountains. The district is one of the most isolated and the least developed districts, not only in Hazara Division but in the entire country. In the past, during the rule of the Wali of Swat, Kohistan was united with the area west of the watershed between Indus and Swat rivers. Swat is situated to its west, Chilas, Darial and Tangir on the northern side and Naran, Kaghan and Alai valley form the southern and eastern border. Dasu is the headquarters of the district. The district consists of three tehsils: Pattan, Palas and Dasu. The Indus flows through Kohistan and divides it socially and culturally in left and right bank. The KKH forms the lifeline between this isolated and remote district and the populated areas down country. Dasu lies at 350 km distance from Islamabad and about halfway between Islamabad to the Chinese border at Khunjerab Pass. The KKH is the main transportation and trade link between China and Pakistan.

Demography Kohistan is predominantly inhabited by Dardic and Pashtun tribes since ancient times. In history the region has been invaded and contested by Persians, Greeks, Scythians, Kushans, Turks, Mughals, and the British. The total population of Kohistan amounted to 477,000 people in 2008, of which 55 percent were male and 45 percent were female. The entire population is considered to be rural, since there are no major cities in the district. Almost all inhabitants are Muslim and belong to the Hanfi Sunni Sect. The population density is low with 63 persons per km^2, with a male/female ratio of 1.24. The average household in 1998 consisted of 6.4 persons. Population growth is very low: between 1981 and 1998 the average annual growth was below 0.1 percent. The national growth rate over the same period amounted to 2.7 percent.

Education and literacy: The literacy rate in Kohistan (measured over people above 10 year) is low with only 30 percent, compared to the national level of 57 percent. Low enrollment rates and even lower completion rates of primary schools are assumed to be the prime cause for the low literacy. Gender disparity in education, health and employment is a prominent and widespread feature in Kohistan society. Almost all social indicators show

considerable gender gaps. Most obvious is the field of education, with a sizable gender gap in literacy and enrollment rates as compared to national statistics.

Health situation: The health situation in the district is very poor, especially in the remote valleys at some distance from the KKH. There are only few Basic Health Units in the area. Maternal and child mortality rates are very high; around ten percent of the children die before their fifth birthday. The people in the area are particularly vulnerable to diseases due to high mountain conditions and remoteness as well as their poverty and chronic malnourishment. The problem becomes especially pressing during winter. In the cold months the prevalence of respiratory infections and other dangerous communicable diseases tends to increase sharply. This is why interventions are needed especially in winter.

Economy and employment: According to the 1998 Census Kohistan had the country's lowest scores in terms of socio-economic development indicators. The proportion of the population that was working and employed was 26.4 percent, equivalent to 70.5 percent of the total labor force. Of those employed, 72 percent were self-employed, 11 percent worked as employees and 17 percent were unpaid family helpers. Livestock holding with agriculture (mainly subsistence farming) is the main source of income, together with some income obtained from forest products. There is hardly any flat or gently sloping cultivable land. Small terraces have to be built on steep slopes to grow one crop per year (mostly wheat) at altitudes above 1,200 m and double cropping (predominantly wheat, maize and some rice) is possible on the lower valley terraces. Livestock holding with goat, sheep, cattle, bullocks and some poultry is the main activity and more important than farming, due to the scarcity of cultivable land. Families are in principle pastoralist and most of them migrate during summer to higher altitudes in search of pastures and a cooler climate. The seasonal migration between the winter residences at the valley bottom and the higher summer residences at elevations between 1,500 m and 3,000 m is typical for the area. Most of the affected households in the project area have three homes and land for agriculture at three different places - one near the Indus River, one in the middle elevations and one in the very high elevations near the glaciers for extreme summers. As they migrate seasonally between the low elevation areas in the valley and the high elevations, their economic activities are spread between low and high elevation areas.

Land tenure and land use: Almost all land in the area is uncultivable and consists of rock outcrop, gravelly scrubland, rock land, steep rocky slopes with boulders, rock fragments and shallow soils and other so-called waste lands. Forests are found at higher altitudes on both sides of the Indus. Some agriculture is found on river terraces, high moraine terraces and on alluvial fans along the small streams (nullahs). On most of these lands small terraces have been built, which form an intricate pattern on the slopes. Because of the scarcity of cultivable land, there are many disputes over land, forests, and even water (streams), some of them long lasting. Traditionally the land was not permanently allotted to any individual or tribe and all the tribes owned all communal land in Kohistan. The tribes used to rotate their lands every five to ten years. However, after 1960 all the tribes decided to allot the lands on a permanent basis. At present all the land is divided among the tribes and most of the land is allocated to individuals. Nonetheless, there is no formal or regular system of land tenure in the entire district. Likewise, there are no land titles or records due to lack of cadastral maps.

Agriculture and local irrigation: Despite the scarcity of cultivable land in the district, people practice some agriculture where it is possible. Most of the farming is subsistence farming, with the purpose to grow wheat, vegetables and other crops for home consumption and as fodder. Very few crops are grown for the market. The district is by far not self-supporting. Wheat and rice has to be imported from "down country". The kharif (summer) crops are grown in high altitude lateral valleys which remain very cold in winter. Both kharif and rabi (winter) crops are grown in the lower valley slopes and along the banks of the Indus, wherever land is available. Dominant crops grown in the district are maize, wheat and rice. Pulses such as peas, red beans, vegetables and potatoes are grown on a smaller scale. Irrigation is not systematic, but some "wild" irrigation is found at places where mountain streams easily can be tapped and utilized. Almost all the valleys have gushing streams (nullahs). The lands along the bank of streams, which can be commanded, are being irrigated through small channels constructed by the people. In some areas land is also irrigated from springs.

Fisheries: Fishing activity is very limited in the project area. Fishing in the project area is not supported or assisted by government or non-government agencies. Local people fish as a part time activity (about 12 percent of households) mostly for domestic consumption: fish density (and thus yields) is too low to support full-time jobs. Very few persons sell their catches. Fishing will be carried out mainly in the tributaries.

Seasonal migration: Migration during the yea is wide-spread in the project area, since most people are primarily transhumant agro-pastoralists. Livestock holding offers the opportunity to utilize the extensive grazing areas at high altitudes and therefore is common. During summer there is sufficient fodder and grassland

to find for the extensive herds of cattle, goats and sheep. In view of the scarce availability of cultivable farmland agricultural farming is restricted to the alluvial fans and river terraces at the lower (750 - 1,200 m) and middle altitude (1,200 - 1500 m). Subsistence farming is carried out in order to produce enough grain, meat and milk to satisfy the household demands of people and livestock. Usually people commence to migrate to higher elevations in May and stay there during summer, in their summer residences situated at a higher level on the mountain. Around mid-October the families start moving back towards the river valley, where they remain during winter. Winters can be severe. Often there is shortage of sufficient fodder for livestock, particularly during late winter when crop residues from previous season are exhausted. Cattle are often undernourished. Most people have two or more summer residences at higher altitudes, usually one at the middle level (1,200 - 1,500 m), see Figure 3, often with some farmland and other houses at higher elevations around 2,000 m or higher, where the grazing areas are found. Out-migration from the area is limited to those persons who leave the area in search of (temporary) labor opportunities in towns like Abbottabad, Mansehra, Rawalpindi and Swat. Entrepreneurs often migrate temporary to downstream areas, where there are more opportunities for business. People who seek higher education often leave the area during their studies, sometimes for good.

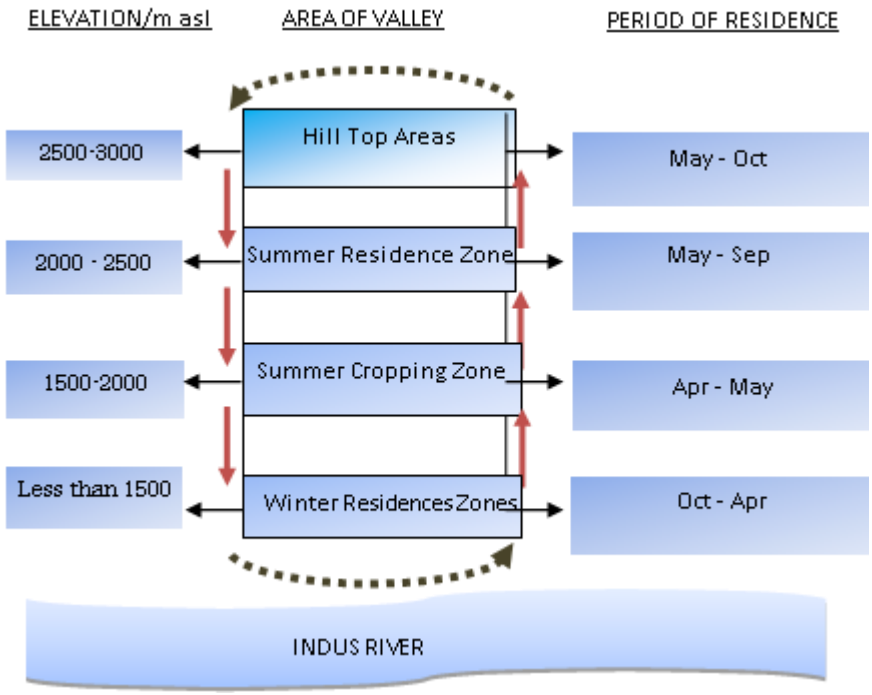


Figure 3: Seasonal Migration Patterns Involving Various Elevations

5.4. Social and Cultural Aspects

Customs and traditions: The tribal people of Kohistan have a social structure which is rooted in strong traditions and local customs. People consider themselves different from the majority of Pakistani population, especially, with regard to ancestry. Religious leaders have a large influence. Due to their influence and the remoteness of the area daily information (television, radio, newspapers) is very limited and only available for few people. Information disseminated by imams is considered to be more reliable. Printed material is hardly used, because of the low literacy. Outsiders are not always welcome in the area. There is often a certain sense of suspicion that people from elsewhere bring modernity and a hidden agenda of social change, which could be detrimental to the prevailing religious and cultural practices. Especially NGOs are not welcome.

Social structure and role of women: The social structure is based on the extended family pattern. The family includes the household of the parents (including grandparents, uncles etc) together with the families of the married sons. The authoritative head of the household (usually the father or the eldest brother) has the responsibility and authority to make decisions on behalf of the entire extended family. Kohistan has a highly patriarchal society in which women are absent from public life. Girls and women usually have hardly any opportunity for education or work outside their homes. They do not participate in politics and have no say in decision-making, even within the household. Purdah is strictly observed and women are rarely seen outside. They work at home caring for children, men and livestock. Collecting firewood and doing farm work belongs

also to their tasks, but this is done within the confines of purdah: only in restricted areas of the farm and the forest, where no men will be allowed. Polygamy is common and permission of previous wives before marrying another wife is seldom sought. Men still make every effort to prevent women from being influenced by the outside world. Televisions and dish antennas have become slightly more common, but watching of TV is restricted to rooms with access for men only.

Tribal systems and leadership: Kohistan is divided by the Indus into Indus Kohistan on the right bank and Hazara Kohistan on the left bank. Both parts have their own history, culture and language. In both parts different tribes are living in the valleys of the tributaries of the Indus. Main tribes are the Manzar and Money on the right bank of the Indus, while the Koka Kheil, Manik Kheil and Darram Kheil live on the left bank. Generally a sub-tribe includes the population of two or three villages. A sub- tribe is traditionally headed by a tribal head or *malik*. In every village or sub-tribe there is at least one *malik*, but often people informally give this title to other respected elderly people as well. The *malik* takes decisions on behalf of the village community with involvement and consultation of the notables of the village and the tribe. Issues beyond the level of the *malik* are resolved through the jirga process described below.

District administration and traditional governance system: Kohistan is since 1976 a district administered under the Provincially Administrated Tribal Areas (PATA) in KP province. The district practices the local traditional governance system, which is accepted by the provincial government and in accordance with federal laws. The district administration involves the *maliks* and conducts *jirga*'s for local decision-making and resolution of disputes, as well as project administration. A *jirga* is a committee of elders representing all parties to a problem or issue which deliberate and decide on village or inter-village or inter-tribal problems and issues. *Jirga's* are constituted at different levels and are convened to resolve a particular issue. In the case of a family dispute the *jirga* will be formed at family level; if the dispute is at village level a village *jirga* will be formed and for tribal questions a tribal jirga will be formed. Inter-tribal affairs will be including the involvement of *maliks* from the different tribes. In resolving issues which require legal interpretation *jirgas* at tehsil or district level will be convened, which will include the District Coordinating Officer (DCO) or his representative.

Land tenure and titles: In the specific requirements of the DHP project, given the absence of a cadastral data and land records, the establishment of land tenure and acquisition are completed with the help of the local communities, *maliks* and the *jirga* system. With the help of this traditional and accepted system, the District Collector will map and determine land titles for compensation purposes. The traditional system will be also useful during the project implementation to organize participatory planning and monitoring and for establishing a grievance redress mechanism process.

5.5. Physical Cultural Resources

Pre-history and history: The Indus valley in pre-historic and historic periods has always been the only connection between China and the subcontinent on the other side of the Himalayan and Karakorum mountains. Traders, armies and caravans have used this single road through the dangerous and rugged terrain following the Indus River. The over 50,000 rock drawings and inscriptions found over a stretch of more than 100 km give evidence. There is proof that part of Alexander the Greats' Greek army has passed northwards. The area also witnessed the rise and fall of the Buddhist culture (1st – 9th Century) for which evidence is found at many places in Kohistan. In the 8th – 12th Century the road was known as Silk Road, the main artery of trade and exchange of culture and goods between China, the Indian Subcontinent, the Middle East and also Europe.

Various Physical Cultural Resources: A number of Physical Cultural Resources (PCRs) are present in the study area. They are the following: (i) rock carvings near Shatial, (ii) two about 400 year old historical and beautiful decorated mosques at Seo and Seer Gayal, one of them (Seo) will remain, but is very near to the construction area, and the other smaller mosque at Seyal will be submerged by the reservoir and should rebuild at a higher place to safe the historic building (iii) older and more recent graveyards and (iv) moveable artifacts. The rock carvings around Shatial will not be submerged, but they are rather unique for the Buddhist period and should be saved. They are unprotected now and endangered by threats by developments related to construction works and other activities of the project. Since another 30,000 of these engravings of often older periods (up to 5000 year BC) will be lost due to submergence from the Diamer- Basha reservoir, it is important to realize that after completion of both Basha and Dasu project the rock carving cluster near Shatial is the only site where petroglyphs are found in the original condition without any compromise with their authenticity. Therefor these sites should be preserved

6. Other Relevant Issues

6.1. Risk of earthquakes

The Dasu project site is located in a zone with high seismic activity, classified as 'Serious Seismic Danger Zone'. From historical documentation there is sufficient evidence of earthquakes in Kohistan in the past. For the design of DHP the records of all earthquakes in a 150-km-radius of the dam were collected from different international and national sources. This resulted in a list of 2115 recorded earthquakes with a magnitude of more than 3.0. The epicenters of three well-studied earthquakes of magnitude 5.9 or above, all situated within 100 km from the dam site were analyzed in detail. All these data were used to prepare a seismic hazard assessment for the project, resulting in a set of safe dam design parameters. The dam design is in accordance with the international standards (International Commission on Large Dams - ICOLD) for dam construction in an earthquake zone of class VIII. According to these standards the dam is considered to be safe under strong earthquake action. In the seismic hazard assessment also the risk of reservoir-triggered earthquakes was considered. A committee of international experts recruited by WAPDA finally reviewed and approved the dam design. This was done in accordance with World Bank Policy OP 4.37 Safety of Dams. A seismic monitoring program will established at the dam site for continuous seismic monitoring.

6.2. Risk of landslides

Landslides are common and natural phenomena in the mountain slopes along the KKH. Natural landslides can occur due to lubrication of rock support structure by rainfall or by water seepage. The use of explosives to break rocks may cause vibrations which easily can trigger a landslide. Earthquakes and tremors can also trigger landslides. Landslide-prone areas near the project site and reservoir have been identified and mapped. Any blasting activities required in these areas should be controlled and contained within a limited area. As much as possible explosives with a low intensity should be used. Extreme care would be exercised to protect workers and the public from the dangers of sudden landslides, which may occur during excavation and blasting works. Particularly during monsoon periods there might be increased risk of such incidents.

6.3. Risk of flooding

Although the risk of flooding in the Indus Basin might increase in the coming years due to rising air temperature, shift in rainfall pattern and increased melting of glaciers in the upstream regions, the risk of flooding and related damage in the area is low. Large floods as occurred with the unprecedented catastrophic flood events in July 2010 are not very likely to occur, since the Upper Indus Basin is outside the influence of the monsoon rains. Most of the Indus water results from snow and ice melt. Moreover the Indus valley is narrow with steep slopes. The riverbed is always cut into the embankments and therefore no flooding will occur. However erosional forces may undermine the embankments occasionally resulting in loss of land and deposition of sediment elsewhere downstream in or along the riverbed. Floods in the northern areas of Pakistan, including the upper part of the Indus catchment are not exclusively associated with extreme rainfall events, but they can also occur after landslides and creation of river-dams and subsequent flood waves. However these flooding events are usually restricted to tributary areas and may have impacts on the upper Indus valley. Formation of river dams can occur through landslides, but these events are rare. More often rivers are blocked by an ice dam from glaciers. A lake is formed behind the glacier and through overtopping or collapse of the natural dam a sudden outburst flood can occur, sometimes with devastating results. About 60 North Pakistan glacial outburst floods have been reported since 1830. Recently (2010) there was a huge landslide in the Hunza Valley, which blocked the Hunza River and eroded away a considerable length of the KKH near Ata- Abad and created a lake which is still there. This event caused many problems for the local population and affected the road connection and trade with China. On 27 February 2012 the obstruction was removed by blasting resulting in a sudden flood wave, which was even recorded in Dasu (rise in water level of 2.4 m after two days).

6.4. Climate change

During the last decade substantial research is carried out to study the effects of long-term climate change on precipitation, air temperatures and droughts. Some of the main conclusions of these studies are:

- between 1980 and 2005 the frequency of heat waves (T >40º C) has been increased in north-western Pakistan. It is expected that there will be more frequent periods with extreme drought;
- based on predictions in scenarios of the International Panel on Climate Change (IPCC) estimates have been made by the Pakistan Meteorological Service of the increase in maximum daily temperatures, which ranges from 2.8º C to 4.2º C in the year 2080 for northern Pakistan;

- more heavy rainfall events during monsoon season will occur over north-western Pakistan instead of over the north-east of the country. Some models calculate 25 percent more rainfall during monsoon. As a result, areas along the western rivers of the country (Indus and Kabul) will be more vulnerable to flood episodes similar to the one experienced during 2010;
- water availability might increase considerably (during kharif) but not when it is required for agriculture in the plains (end of rabi season);
- a shift has been observed in the rainfall pattern with monsoons starting 1-2 weeks earlier and winter rains confined towards February.

Recent studies have been concentrated on the effects of glacial melt. Major issues to be investigated are amongst others: (i) the importance of the contribution of snow and glacial melt on the hydrology of the Indus; (ii) the observed changes in the extent of the glaciers; and (iii) the effects of climate changes on the amount of melt-water.

From the studies it has been concluded that glaciers in the Himalaya and Karakorum are receding faster than happens in any other part of the world. From digital terrain models and satellite observations it might be concluded that the reduction of the thickness of ice in the Western Himalayan glaciers ranges between 0.50 to 0.90 m per year, although in some areas in the Karakorum an extension and increase of glaciers has been reported. In a likely scenario of global warming based on IPCC predictions the reduction of the share of melt-water in the Indus discharge has been estimated at 8.4 percent. However this could be (over) compensated by an expected increase of precipitation in the downstream areas (in the NW of the country) which are under influence of the monsoon.

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

In view of the importance of these data for developing reliable and accurate knowledge of the basin hydrology and on future water availability of the Indus River it is recommended that the current project contributes to the following three components: (i) establishing a Telemetric network in the UIB; (ii) support to WAPDA's Glacial Monitoring Program including glacial studies, satellite monitoring and studies into the effects of glacial outbursts.

6.5. Greenhouse Gasses Emissions

The net greenhouse gas (GHG) emission for DHP has been estimated using the Guidance Note of World Bank for Greenhouse accounting for Energy Investment Operations, ver. 1.0, June 2013. Total project emissions of DHP was estimated at 2.11 million ton CO_2 equivalent (total emissions from reservoir: 0.073 million tons; emissions from land clearing and civil works: 0.103 million tons; life cycle emissions: 1.772 million tons; and emissions from energy use in construction: 0.158 million tons). The project emissions compare very favorable against the baseline emission of the nearest least-cost alternative (combined cycle gas turbine) estimated over 50 year, generating a total baseline emission of 225 million ton CO_2 equivalent. The net emission of DHP is thus estimated at minus 223 million ton CO_2 equivalent..

7. Potential Impacts and their Mitigations

7.1. General

Most direct and significant negative impacts of the project are caused by the loss of existing physical infrastructure and land that will be flooded by the reservoir and by the need to resettle an estimated 6,953 people living in 34 small villages/hamlets in the lower parts of the Indus valley to higher altitudes on the mountain. Much land is needed for the location of project facilities, staff quarters and housing. Other adverse impacts will be mainly of temporary nature during the construction However, the permanent presence of the Dasu hydropower plant, including all its facilities and permanent presence of WAPDA employees and their families will drastically change the life and the social and economic structure of the local communities in the area. The overall positive impact of the project which is the installation of 4,320 MW of additionnal hydropower generating capacity will be experienced countrywide. It will provide a major boost in energy production in Pakistan in an environmental friendly and clean manner with minimal carbon emission.

7.2. Impact Assessment Methodology

Potential environmental and social impacts were identified on basis of the earlier feasibility study (2009) and the focus group discussions and stakeholder consultation workshops which were held in Peshawar, Lahore, Karachi and Islamabad. The significance of potential impacts was assessed using the following criteria:

Impact Magnitude. The potential impacts of the project have been categorized as major, moderate, minor or negligible based on consideration of the parameters such as: i) duration of the impact; ii) spatial extent of the impact; iii) reversibility; iv) likelihood; and v) legal standards and established professional criteria.

Sensitivity of Receptor. The sensitivity of a receptor has been determined based on review of the population (including proximity / numbers / vulnerability) and presence of features on the site or the surrounding area. Each detailed assessment has defined sensitivity in relation to the topic.

Assigning Significance. Following the assessment of magnitude, the quality and sensitivity of the receiving environment or potential receptor has been determined and the significance of each potential impact established using the impact significance matrix shown below in **Table 4**.

Table 4: Significance of impact criteria

Magnitude of Impact	Sensitivity of Receptors			
	Very Severe	Severe	Mild	Low / Negligible
Major	Critical	High	Moderate	Negligible
Medium	High	High	Moderate	Negligible
Minor	Moderate	Moderate	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

7.3. Summary of Assessed Impacts

The project's potential impacts and their significance have been assessed using the methodology described in Section 7.2 above. A summary of these impacts and their significance is presented in **Table 5**.

Table 5: Potential Impacts and their Significance

Impact	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
Environmental impacts during Pre-construction:						
Changes in physiographic and Landform	All phases	Mild	Major	Moderate Adverse	• Develop and Implement a landscape plan in the project footprint areas	Low Adverse
Change in land use (7,800 ha) and acquisition of 4,643 ha of land by project	Pre-construction, Construction	Severe	Major	Major Adverse	• Compensation for lost assets of affected households and persons according to eligibility matrix of Resettlement Action Plan	Low to moderate adverse
Loss of natural vegetation and trees	Pre-construction, Construction	Mild	Minor	Moderate adverse	• Planting of native trees near resettlement villages and along roads • Promote the use of alternatives for fuelwood • Plan for rejuvenation of forests at higher altitudes	Low Adverse
Inundation of 400 year old mosque in Seer Gayal	Pre-construction, Construction	Severe	Medium	High adverse	• Disassembling and rebuilding of mosque at higher resettlement village	Negligible
Impact of increased traffic and transportation on KKH	All phases	Severe	Medium	High adverse	• Traffic Management Plan, including awareness raising and safety measures	Low to moderate adverse
Inundation of 52 km of KKH -	All phases	Very Severe	Major	Critical	• Realignment and construction of 62 km of new KKH at higher level	Negligible
Loss of bridges and access roads connecting villages on right bank	All phases	Severe	Major	High adverse	• Building of a new suspension bridges over the reservoir and construction of new access roads along the right bank	Negligible
Adverse impacts on Kaigah Community-led Game Reserve	All phases	Severe	Major	High adverse	• Study, selection and implementation of minimum two community-led conservation activities in the DHP sub-catchment areas • Supporting and promoting conservation activities in Kaigha game reserve • Compensation of community for any losses from sales of hunting permits during construction stage	Low to moderate adverse
Social impacts during Pre-construction:						
Land acquisition of 4,643 ha for the project	Pre-construction and construction	Severe	Major	High adverse	• Prepare and implement Resettlement Action Plan; temporary lease of land needed for construction facilities	Negligible
Resettlement of 767 households, totaling 6,953 people	Pre-construction and construction	Severe	Major	High adverse	• Compensation, resettlement and livelihood restoration of affected households/persons according to Resettlement Action Plan	Low to moderate adverse
Relocation of shops/commercial establishments	Pre-construction, Construction	Mild	Medium	Moderate adverse	• Compensation for lost assets and commercial enterprises. • Assistance and livelihood restoration of affected persons	Low to moderate adverse

Impact	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
					according to RAP	
Loss of civic amenities -	Pre-construction, Construction	Mild	Medium	Moderate adverse	• Rebuilding of civic amenities by project	Negligible
Loss of 143 ha agricultural land and 280 ha grazing land	Pre-construction, Construction	Severe	Medium	Moderate adverse	• Compensation for lost land, crops and fruit trees according to Resettlement Action Plan • Agricultural, Livestock and Fisheries Development Plan	Low to moderate adverse
Increased pressure on high altitude forests and grazing areas	All phases	Mild	Medium	Moderate adverse	• Forest Management Plan, including forest rejuvenation	Low adverse
Impacts of construction of 132 kV power supply line for Project and Colony	Pre-construction Construction	Mild	Medium	Moderate adverse	• Compensation of owners of land; • Avoiding residential and agricultural areas and dense forest • Reduction of health hazards for community and workers	Negligible
Generation of sustainable employment	Construction and Operation	Mild	Medium	Moderate beneficial	• Fixed quota for local workers and technicians • Vocational training; Monitoring of labor rights, workforce composition, working and living conditions	Major beneficial
Increased economic activity	All phases	Mild	Medium	Moderate beneficial	• Establishment of new businesses and commercial enterprises; Local employment	Moderate beneficial
Environmental impacts during Construction:						
Increased traffic on KKH and Local Access roads	Construction	Severe	Medium	High adverse	• Traffic Management Plan, including awareness raising and safety measures	Low adverse
Impact on river habitat due to construction activities and drying of river section between two coffer dams	Construction	Mild	Medium	Moderate adverse	• Control of waste water and sediment releases to river • Water quality management protocols in ECPs • Studies to improve aquatic baseline data; monitoring	Low adverse
Fish entrainment and mortality	Construction and Operation	Mild	Minor	Low adverse	• Protection measures at inlets of tunnels to deter movement of fish	Low adverse
Potential risk of pollution of air, noise, soil and water resources by construction works -	Construction	Medium	Medium	Moderate adverse	• Pollution Prevention Plans to be prepared by Contractor • ECP plan by contractor	Negligible
Risk of pollution from solid waste and waste effluents	Construction	Mild	Medium	Moderate adverse	• Waste Management and Effluent Management Plan • ECP by contractor	Negligible
Loss of land in disposal areas	Construction	Low	Minor	Negligible	• Re-use plan for rock material • Disposal Area Restoration Plan	Negligible
Impact from quarry and borrowing activities	Construction	Mild	Medium	Moderate adverse	• Controlled blasting and compliance with ECP • Quarry and borrow area Restoration Plan	Negligible
Impacts of noise and dust from construction, traffic and use of explosives	Construction	Severe	Medium	High adverse	• No blasting during night time • Awareness raising and grievance mechanism	Negligible
Increased risk of landslides	Construction	Severe	Medium	High adverse	• Permanent monitoring in construction areas • Preventive measures in high alert areas • Emergency Preparedness Plan	Negligible
Impacts from increased human activities on flora and fauna	All phases	Mild	Minor	Low adverse	• Use of non-wood fuel for cooking and heating; • Improvements to community forestry management	Negligible

Impact	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
					• Code of conduct for workers and employees • Awareness raising to workers and protection of flora and fauna	
Risk of water pollution of storage tanks in reservoir area	Construction	Mild	Minor	Low adverse	• Removal of oil tanks and other potential sources of pollution from reservoir area	Negligible
Shortages in local water supply and sanitation in residential areas	Construction	Mild	Medium	Moderate adverse	• Drinking Water Supply and Sanitation Plan to be prepared by Contractor independent from local domestic services	Negligible
Disturbance of visual landscape and natural habitats	Construction and Operation	Mild	Medium	Moderate adverse	• Landscaping plan; Establishing nurseries; • Plantation of trees	Negligible
Social Impacts during Construction:						
Safety hazards due to increased traffic especially for children and elderly people	Construction and Operation	Severe	Medium	High adverse	• Traffic management plan addressing general access • Safety and security actions and procedures to protect local community	Low adverse
Social unrest due to influx of about 12,000 in-migrant workers	Construction and Operation	Severe	Major	High adverse	• Awareness campaign • Develop Migration Management Plan • Grievance mechanisms to address complaints	Negligible
Lack of respect of cultural norms and values by work force	Construction and Operation	Mild	Medium	Moderate adverse	• Awareness campaign; Code of conduct for workers; • Grievance mechanism	Negligible
Reduced safety and health risks by interaction workforce with local residents	Construction and Operation	Mild	Medium	Moderate adverse	• Public Health and Safety Plan • Safeguards and awareness raising against communicable diseases.	Negligible
Increased load on local services and supplies	Construction	Mild	Medium	Moderate adverse	• Contractor to procure camp supplies in a manner not affecting availability of essential commodities.	Negligible
Increased risk of accidents, unsafe working conditions and health risks for workforce	Construction	Mild	Medium	Moderate adverse	• Emergency Preparedness Plan; Contractor follows IFC Performance; Standards on Labor and Working Conditions; Safety training for workers	Negligible
Environmental impacts during Operation & Maintenance:						
Inundation of 1829 ha of terrestrial habitat on steep valley slopes	Operation	Mild	Medium	Moderate adverse	• Promotion of conservation of natural habitat in Kaigah and other suitable areas (Kandia, Laachi, Sazin kot) • Further studies on terrestrial baseline (see Annex C, Main ESA) during pre-construction/construction and design of additional offset measures if required • Monitoring programs	Low to moderate adverse
Impact on 571 ha of aquatic habitat along Indus and its tributaries in reservoir area	Operation	Mild	Medium	Moderate adverse	• Developing of fish hatchery with native snow carps for stocking fish in the affected tributaries and reservoir • Monitoring of spawning areas • Monitoring programs	Low to moderate adverse
Impacts of first filling of reservoir on safety of people and livestock and stability of slopes	Operation	Severe	Major	High adverse	• Awareness campaign and warning signs; • Slow rate (1 m/day); • Permanent monitoring of slopes	Negligible

Impact	Phase	Sensitivity	Magnitude	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
Barrier effect to fish migration	Operation	Mild	Minor	Low adverse	• Compensatory fish hatchery • Study fish migration; establish baseline data;	Negligible
Reduced water flows between dam and tailrace (4.4 km) during low flow season	Operation	Very Severe	Major	Critical	• Release of 20 m3/s of environmental flow from dam and 222 m3/s from tail race • Downstream monitoring and adjustment of flows if required.	
Impact on downstream and aquatic habitats and fish due to changes in water flows and quality (temperature, DO, sedimentation)	Operation	Mild	Minor	Low adverse	• Monitoring of downstream water quality and aquatic habitats	Negligible
Impact of sedimentation on reservoir area	Operation	Severe	Medium	High adverse	• Yearly flushing after 10-15 years of operation • Will be reduced after completion of Basha dam	Low adverse
Impact of daily reservoir operations during base load operation	Operation	Mild	Moderate	Moderate adverse	• Fisheries Management Plan • Monitoring and study	Low adverse
Impact on downstream fish during flushing operation	Operation	Severe	Major	High adverse	• Flushing during high flow season (not in low flow/winter) • Develop ramp down criteria (5-10 cm/hr) • Monitoring DO and temperature in reservoir and de-stratification or simultaneous release of water from lowleve outlets and spillways if required. • Downstream monitoring of fish, habitats and sediments	Low to moderate adverse
Impact on downstream fish due to changes in hydrological flows due to peaking operations	Operation (Post Basha)	Mild	Medium	Moderate adverse	• Continuous operation of one turbine • Using remaining flow for peak operation	Low adverse
Risk of bird collision and electrocution with transmission cables	Construction and Operation	Mild	Medium	Moderate adverse	• Maintaining 1.5 meter spacing between energized components and grounded hardware; covering energized parts and hardware; • Installing visibility enhancement objects such as marker balls, bird deterrents, or diverters	Low adverse
Social impacts during Operation & Maintenance:						
Loss of employment for construction workers	Operation	Mild	Medium	Moderate adverse	• Vocational training for operational and maintenance • Preference for local construction workers in other WAPDA Upper Indus projects	Low adverse
Reservoir fisheries will create large number of employment opportunities	Operation	Severe	Major	High beneficial	• Fisheries Management Plan • Employment of local people	Beneficial

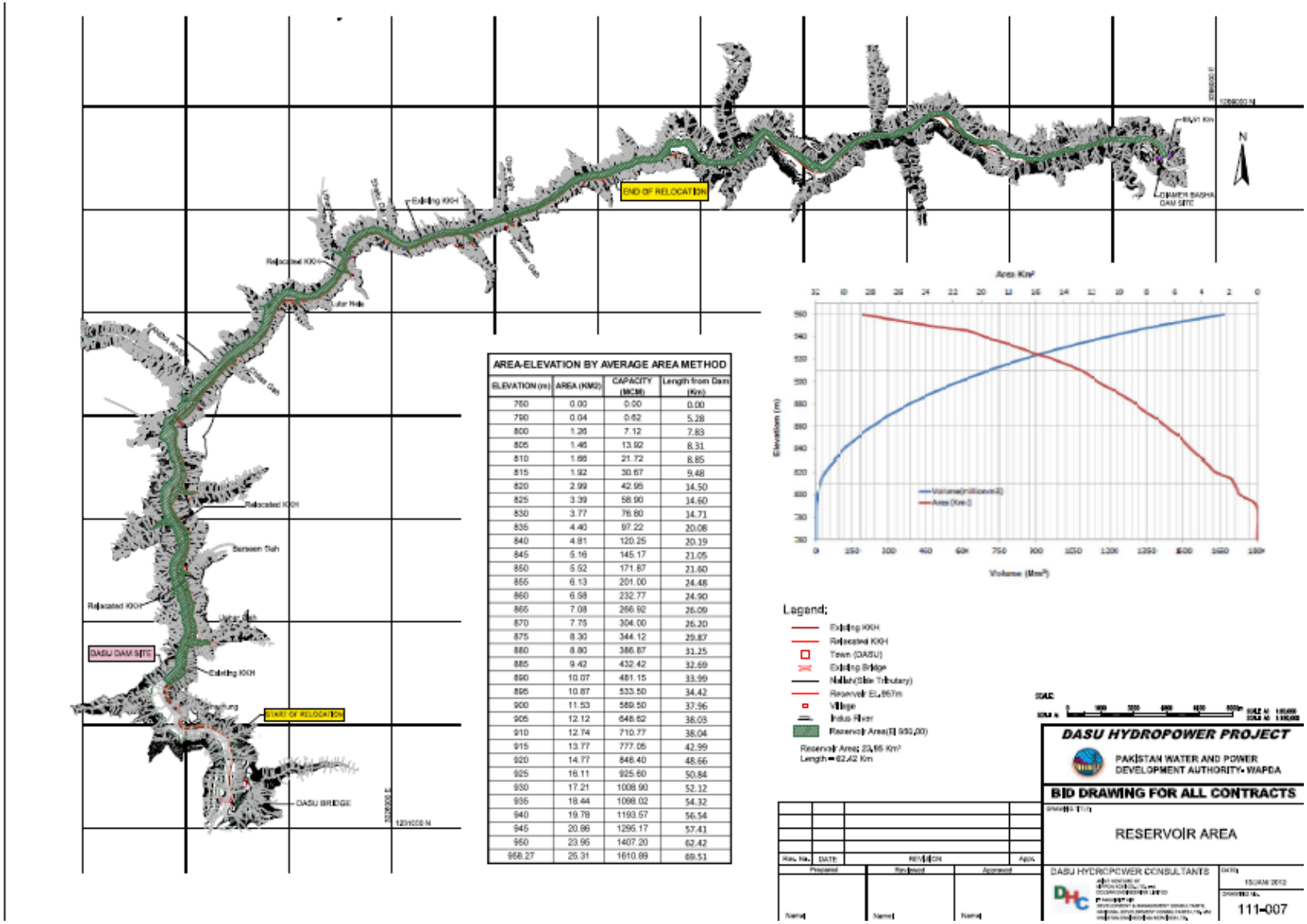
7.4. Environmental Impacts during Pre-construction Stage

Change in physiography: The character of the Indus River and its valley bottom will change from a fast flowing uncontrolled sediment-laden river with steep rocky slopes into a narrow controlled water reservoir (average width 365 m) and extending for about 73 km upstream at full supply level (fsl) (see **Figure 4**). In lateral valleys of tributaries and nullahs (small streams) the reservoir penetrates several km inland and is expected to develop new natural hot-spots at the confluence of snow-fed small streams with the main water body. Farm lands on terraces along these minor streams, including small hamlets up to a level of 957 m, will be flooded by the reservoir. The reservoir will have a depth between 100 and 175 m near to the dam. The reservoir is expected to rapidly decrease in size to only 8-9 km in 15 year after commissioning of the Dasu dam (provided Basha dam is not commissioned in that period). Most of the reservoir (except last 9 km before dam) is expected to develop into a shallow relatively fertile freshwater swamp with riparian semi-aquatic natural vegetation and a main gully carrying Indus water in the low flow season. During high flow season most of the reservoir bottom will be inundated for most of the period, providing opportunities for spawning of fish (e.g. carp). Downstream of the main structure the topography of the lower slopes of the valley will drastically change through excavation and blasting in order to create level terraces (154 ha) to establish construction yards, offices, camps, housing area and disposal areas for the project.

Change in land use: Natural and semi-natural habitats, mainly consisting of steep rocky slopes and some farmland and grassland on river terraces and alluvial fans along the Indus will be inundated and changed into a lake with generally very steep slopes. The total area covered by the reservoir is about 2,400 ha in size. Around 425 ha of farmland on terraces, grazing areas and some orchards will be flooded and disappear into the reservoir. The loss of natural and semi-natural habitats, both with limited biodiversity is relatively minor and will be partly compensated by the natural development of a lacustrine and partly wetland environment with potential for fisheries and some tourism development. The loss of farmland will be compensated under the resettlement framework and where available alternative new agricultural lands will be reclaimed at higher altitudes. Compensation for lost assets of affected households and persons has been indicated in a detailed eligibility matrix which is part of the Resettlement Action Plan (RAP). Livelihood restoration (short-term and long-term) for those affected by loss of land is a major issue.

Loss of natural vegetation and trees: For the project some 21,000 trees will have to be cut, including some 2,982 fruit and medicinal trees, most of them growing in the villages and along roads. Bushy vegetation and scrubs are usually developed on the steep slopes of the Indus valley. Trees should be cut prior to the flooding of the reservoir area. Small bushes and other vegetation can be left to be inundated. Loss of trees and natural vegetation will have an effect on the collection of firewood. Selling of fire wood is an important source of income for the population of the project area and a common practice along the KKH both in winter season (heating and cooking) but also in summer season (cooking). People will move to higher places in order to collect firewood. It is expected that the Project will attract about 9,000 in-migrants. This influx will create a huge demand for firewood due to increased energy requirements for cooking and heating during winter. This is expected to increase the pressure on forest resources at higher altitudes. Mitigation of the loss of trees is included in the eligibility framework and will also be compensated by planting trees (at a rate 5:1) near the new resettlement sites and along roads. The Project will also support the local government to establish a market for the supply of non-timber fuels such as LPG for cooking and heating in order to reduce the pressure on firewood. At higher altitudes a project plan for afforestation and rejuvenation of forest should be planned. This should start with a forest and wildlife management study which should be implemented during the construction phase of the project.

Impacts on physical and cultural resources in project area: The 400 year old historic mosque in the village Seer Gayal will be flooded by the reservoir, together with the houses of the hamlet. In consultation with the local community it was agreed that the wooden structures will be disassembled, transported and reassembled at a higher altitude at the new location of the village. Also 16 graveyards spread over the valley will be submerged by the reservoir. With the various communities alternative proposals for mitigation were discussed. Most communities preferred to leave the graves at the place of burial. Other cultural resources that will not be submerged but should be protected against adverse impacts from the project are the burial ground in Seo, which is near to the disposal areas and the cluster of petro glyphs (rock carvings) near Shatial, which is part of a much larger field of 50,000 rock carvings extending from Shatial over more than 100 km towards the bridge of Raikot. This is one of the largest fields of rock art in the world, with carvings dating from Stone Age (9^{th} millennium BC to Buddhist period.



AREA-ELEVATION BY AVERAGE AREA METHOD

ELEVATION (m)	AREA (KM2)	CAPACITY (MCM)	Length from Dam (Km)
780	0.00	0.00	0.00
790	0.04	0.62	5.28
800	1.26	7.12	7.83
805	1.46	13.92	8.31
810	1.68	21.72	8.85
815	1.92	30.67	9.48
820	2.99	42.95	14.50
825	3.39	58.90	14.60
830	3.77	78.80	14.71
835	4.40	97.22	20.08
840	4.81	120.25	20.19
845	5.16	145.17	21.05
850	5.52	171.87	21.60
855	6.13	201.00	24.48
860	6.58	232.77	24.90
865	7.08	266.92	26.09
870	7.75	304.00	26.20
875	8.30	344.12	29.87
880	8.80	386.87	31.25
885	9.42	432.42	32.69
890	10.07	481.15	33.99
895	10.87	533.50	34.42
900	11.53	589.50	37.96
905	12.12	648.62	38.03
910	12.74	710.77	38.04
915	13.77	777.05	42.99
920	14.77	848.40	48.66
925	16.11	925.60	50.84
930	17.21	1008.90	52.12
935	18.44	1098.02	54.32
940	19.78	1193.57	56.54
945	20.86	1295.17	57.41
950	23.95	1407.20	62.42
958.27	25.31	1610.89	69.51

Figure 4: Reservoir Area

Impacts due to increased traffic and transportation: During design stage and during mobilization of the contractor traffic along KKH and in the twin city of Dasu-Komilla will increase and this will boost up even further as soon as construction has started. This will lead to congestion at certain places like main street, central markets and bus stops. Apart from congestion there will be increased air pollution and noise at these places. This might result in friction with shopkeepers, hotel/restaurant owners and general public. Road safety will decrease and risk of accidents will increase. In order to be prepared for this situation a transportation and traffic management plan should be prepared by the contractor in cooperation with WAPDA and the local authorities. This plan should include a plan for a by-pass road along the main markets of Komilla. In total about 13 km of by-pass roads are foreseen.

Inundation of 52 km of KKH: Around 52 km of the Karakorum Highway (KKH) will be submerged by the reservoir. This part of the road lies between Dasu and Shatial. A new alignment will be constructed at a higher level on the left bank of the Indus. A total of 65 km of highway will have to be constructed, including 10 km of bypass road downstream of Dasu and a link road of 3 km. Five new bridges in the KKH will have to be constructed crossing nullahs and small streams. About 45 ha of land will have to be acquired for road construction purposes.

Loss of access to villages: Two suspension bridges over the Indus connecting both river banks and some secondary access roads on the right bank will be lost. As compensation for these losses a new suspension bridge near Kandia and a total of 35 km of new access roads will have to be build, all at a higher level of the right bank of the Indus. A new jeepable track of 18 km will provide access to the villages in Kandia valley. All new settlement sites should be provided with good access roads. Other existing facilities for pedestrians to cross the river, such as foot bridges and cable cars should be replaced by appropriate alternatives.

Impacts on Kaigah Community-managed Game Reserve: This Private Game Reserve is bordering the old KKH. There will be infringement of the reservoir into the reserve (size 5,000 ha) and some 51 ha will permanently be affected by submergence. The construction of the new KKH will also affect some 31 ha of land from the reservoir for road construction. Moreover during construction a large quarry will be developed at the border of the reserve (in future reservoir submergence area) where the old KKH is crossing the Kaigah nullah. Use of explosives and regular quarrying and excavation will produce noise and vibrations that may disturb wildlife in the area when they visit lower elevations (mainly during winter). Animals might stay away from lower elevations when disturbed and move to safer places higher up into the mountains. Hunters might also stay away. Controlled and optimum blasting and regular monitoring should done in order to comply to international standards to avoid impacts on wildlife. There might be loss of income for the community, since their management activities are paid from a share of the sales of hunting permits for trophy hunting. The impacts on people, wildlife and hunting activities should be strictly monitored and compensation should be paid for the losses of income during quarrying and crushing activities in the area (estimated 2.5 to 3 years) and the construction activities for the KKH (estimated 7 to 8 months) in the reserve. The community will be consulted and involved in promoting and strengthening ecological conservation measures in the game reserve. Identification and development of minimum two community-led wildlife conservation reserves should be included in the Forestry and Wildlife Management Study, mentioned above.

7.5. Social Impacts during Pre-construction Stage

Land acquisition for the project: A total of 4,643 ha of land will be acquired for the project. This includes 2,778 ha for the reservoir (which is land below the 1,000 m contour), 174 ha for physical project infrastructure and 205 ha for construction of roads (KKH and access roads). In the area to be acquired apart from natural wasteland some 425 ha of agricultural land are included, consisting of farm land, grazing areas and orchards. Family income from land in terms of crops, fodder and forest products will be lost. This will require proper compensation measures, resettlement at higher altitudes and assistance including livelihood restoration. Agricultural compensation is rather problematic since new cultivable lands at higher altitudes are extremely scarce and generally low in fertility. New sources of employment and living have to be sought. According to inventory surveys and a census, a total of 767 households consisting of some 6,953 persons, more or less equally divided over both river banks will be affected by the project and will have to be resettled above 1,000 m or elsewhere. A Resettlement Action Plan (RAP) has been prepared to address and mitigate the impacts on the affected households. The objective of the plan is to restore the income and livelihood conditions of the people to at least pre-project level. The households affected will not only receive cash compensation for land based on rate basis negotiated by the District Collector with the affected communities/Jirgas for land, structures and other assets, but also will be given additional assistance for relocation, re-employment and

livelihood restoration. Temporary leasing of land might be needed for the period of construction for installing of construction facilities such as batching plant, construction workshops, labor camps and borrow areas.

Relocation of inhabitants of 34 hamlets: The footprint of the project will affect 34 hamlets and villages, each of them often consisting of not more than 25 to 30 houses. A total of 923 structures will be lost of which 83 percent are residential structures. Given the past experience of resettlement in Pakistan and the Dasu project context in particular, the Project has adopted a community based relocation strategy to sites in upper elevations. In this approach the community will be relocated to sites of their own choices at higher elevations and is characterized by: (i) community decision making with regard to site layout and civic amenities to be established;(ii) site and services development at project costs; (iii) subsidized plots for each affected family of the concerned community settling on higher elevations; and (iv) shifting and reconstruction grants as per the entitlement matrix. The approach for community preferred sites was well received (90%) and considered practical by the jirgas, as well as at stakeholder workshops. Only a limited number of affected households (10%) want to move on their own to other places in Kohistan and as far as Mansehra and Abbottabad mentioning their kinship links in those places and/or availability of cheaper land for resettlement, including more job prospects in the cities. This may be a feasible option on household basis. These choices and responses will be further confirmed at the implementation stage. This will be a dynamic process. While maintaining the main thrust, Dasu Project Management and team will adapt a flexible and open attitude towards people's requests and continue to explore potentials options. But all resettlement options, requests and agreement will be subject to careful technical assessment, review, consultation and agreement with the concerned communities.

Relocation of 50 shops and commercial establishments: Most of the commercial enterprises affected by the project are located on the left bank of the Indus, near to the KKH. The commercial enterprises on the right bank usually consist of residential houses with a small shop as annex. Compensation and/or resettlement assistance is worked out in details in the RAP and the Resettlement Framework.

Loss of civic amenities: A survey of 27 villages out of 34 villages revealed that there are 31 existing mosques, 7 schools, 2 basic health units, 3 community centers and 17 graveyards, next to facilities for drinking water supply and irrigation, and latrines. Most of the affected villages have direct access roads from KKH (left bank) or internal access roads (right bank). The RAP has provisions for reconstruction of these civic amenities at new sites in upper elevation as desired by the communities, including the provision of electricity.

Loss of 425 ha of farm land, grazing area and crops: About 600 families that are presently involved in terrace agriculture will lose their crops in the lower valleys and along the banks of the Indus River. . However, many have lands in high-altitude lateral valleys where crop production is possible during the warmer summer season. The combination of summer and valley crops is sufficient for family consumption requirements (there is no local market).. Many farm families focusing on limited terrace cultivation will continue with crop cultivation at higher elevation. Livestock herding on higher altitudes during summer will continue, but the winter part of this activity, along the river embankments will cease after the construction of the dam project. In order to mitigate these adverse developments an adequate livelihood restoration program has been developed i n order to sustain and improve agriculture and livestock herding. Simultaneously, new opportunities such as reservoir fisheries development, a forestry management program and provision of temporary employment and additional income in clearing of vegetation and trees in the reservoir area, and other social development activities have been designed in the RAP and EMAP.

Increased pressure on high altitude grazing area and forests: Resettlement of 767 families above 1,000 m altitude will mean that pressure on the mountain zone between 1,000 and 1,500 m and higher will increase. Especially the grazing areas and forests around 2,000 m are currently already under pressure, resulting in deforestation, erosion and decrease of flora and fauna. The pressure will certainly increase as a consequence of the project. As mitigating measure the implementation of a forestry management project is planned, with the objective of regeneration of forest and grazing areas at higher altitudes. This project could be implemented within the framework of the livelihood restoration program.

Impacts of the construction of the 132 kV power supply line to project and Colony: The construction of 45 km of transmission line for power supply of the project during construction will require that land should be acquired for the footprint of the 233 towers of the line. Total land acquisition is low (about 1 ha) and no resettlement is expected. There may be other impacts such as crops, trees, structures and restriction on the use of the corridor lands. Detailed impact surveys will be carried out and compensation plans will be prepared following the project resettlement policy framework already developed as part of the SRMP.

Generation of employment in the region: Currently only 26 percent of the population is employed, most of them are self-employed in agriculture or livestock holding or as small shopkeeper. From those working about 17 percent works as unpaid family helper. Only 12 percent is working as employee. The project offers good opportunities for local residents to apply for employment as unskilled and skilled construction worker. Within the construction contracts the contractor(s) would have to attract local workers and technicians on basis of agreed quota. Construction works could offer at least for a period of 10 years many opportunities for unskilled workers and technicians. There will also be employment opportunities for office staff, administrative and logistic functions and in transportation. Important for sustainable livelihood restoration is that sufficient vocational training and skill development is provided. A pro-active program to this end is already started by WAPDA**:** local youths are receiving a six-month vocational training in various lines of work to prepare them for guaranteed jobs in the project construction work. Establishment of vocational training centers for men and women will be part and parcel of the project resettlement plans. After the construction phase there will be other opportunities for more permanent functions within the project operation and maintenance. All these new opportunities for work for local residents could boost employment and improve the social and economic position of the population. This will be a major and significant positive impact of the project.

Increased economic activity: The considerable influx of people during all phases of the project (up to 12,000 during construction) will considerably stimulate the local economy, by involving local businesses and village level enterprises. New opportunities for local businesses, suppliers, hotel owners, shopkeepers and the transportation sector will be created. All these developments will stimulate the local economy in the district.

7.6. Environmental Impacts during Construction Stage

Increased traffic on KKH and local access roads: The KKH is the life line of northern areas and it is the only highway connecting China and the north of Pakistan with the rest of the country. About 2,590 vehicles per day including 200 heavily loaded trucks are currently using the KKH for transportation of goods. During construction of the project it is estimated that daily 200- 300 extra trucks, needed for the supply of construction materials, will make use of the KKH. Additional project vehicles using the KKH and exceptional heavy transports of turbine sections may cause traffic congestions and safety hazards. The access road to the project along the busy Komilla bazaar and those from borrow areas and to deposition sites are also expected to create traffic problems and safety hazards. To mitigate these problems the contractor will be required to prepare a Traffic Management Plan in close cooperation with the Project Management Unit (PMU) and the local authorities. This plan should include safety measures, traffic control measures, provision of by-passes at busy places and provisions for repair of damage caused by project vehicles.

Impact on river habitat due to construction activities in the river: At the damsite coffer dams will be placed upstream and downstream of the work areas to keep the river bed dry for about 980 m length to facilitate construction of the dam. Aquatic biological production will be eliminated from approximately 980m of stream length, part of which (the dam footprint) will be removed for the life of the dam. Pre-construction and construction activities have potential to adversely affect aquatic biota by release of high concentrations of sediment, fuels/oils and other toxic compounds, and solid waste and use of explosives. High sediment loads will be produced during placement of the coffer dams and again when water first passes through the work area after completion of dam and plunge pool construction. Sediment concentrations above natural levels can cause mortality of biota directly; for fish, damaged gills and sediment clogging of gill chambers eventually leads to death. Measures proposed in ECPs to protect the water quality will mitigate potential effects on fish.

Entrainment and Mortality of fish: The construction of Indus water diversion tunnels where high water velocities may develop will have impact on fish. Fish trying to move downstream in water conduits such as diversion tunnels, powerhouse intake tunnels, lower level outlets and spillways will potentially be subjected to high levels of mortality and injury. Inlets will have to be protected either with electric or acoustic methods to prevent fish from being caught by the flow.

Potential risk of air, soil and water pollution: During construction there is a high risk of accidental spills and leakages that may occur from fuel and oil tanks, vehicles and machinery and storage of chemicals used in construction areas, yards, batching plants, quarry areas, worker camps, residential areas and from storage sites. These spills can pollute soils and contaminate surface water and groundwater in the area. Air pollution may occur by emissions from construction related traffic and machinery. A Pollution Prevention Plan should be prepared prior to the start of the work. Proper baseline data should be collected. Moreover the contractor(s) should implement the measures prescribed in the Environmental Code of Practices (ECP), which will be included in the contracts. Contractors should take appropriate measures to avoid and contain any spillage and pollution of the soil and water resources both upstream and downstream of the dam. Construction equipment

and vehicles should be well maintained, so that emissions are minimal. Dust generation from construction sites would be restricted as much as possible and water sprinkling would be carried out as appropriate, especially at those places where earthmoving, excavation and blasting will be carried out. Air quality would be properly monitored, especially near the population centers and WAPDA colonies. Detailed ECPs are included in the main ESA volume.

Potential loss of land in disposal areas: With the construction of tunnels and underground chambers for housing the powerhouse and switch yard facilities huge quantities of rock will have to be excavated and brought to the surface. It is estimated that the quantity of rock to be excavated will be 10.25 million m^3, excluding the excavations from KKH. Around 7.2 million m^3 will be generated in the first phase. Part of the excavated rock can be used as concrete aggregate provided the fragmented rock meets the quality standards needed for the work. Mixing with fresh quarried rock is possible. In order to reduce the amount of rock to be disposed, excavated rock can be used in the project for different types of infrastructural works, including road construction. The remaining spoil will be disposed in designated and safe disposal areas. A re-use plan for excavated material and a spoil disposal plan should be prepared in advance.

Impacts from borrowing activities: A number of borrow areas will be used for the project. Some are near to the project, but others are located at considerable distance outside the district. Some 16 million ton of fine and coarse aggregates will be needed for the construction of the main hydraulic structures. Most of it will come from a quarry at Kaigah and transported by conveyor belt to damsite. Kaigah nullah is the location of a Community-managed Conservation area. The area and its wildlife may receive partly unknown adverse impacts from the quarrying activities. Controlled blasting in compliance with international standards on vibration should be strictly followed during the period of use of the quarry, including regular monitoring All other construction materials like steel (50,000 ton), cement (600,000 ton), and fuel (300 million liter) will have to be obtained from "down country" and transported by truck along the KKH to the project. Detailed studies will have to be done to assess the impacts of all borrowing activities for the project in the region. A borrow area restoration plan should be developed.

N**oise and dust generated by construction works, increased traffic and use of explosives**: It has been estimated that at least 20,000 ton explosives will be used for excavation of tunnels and rock chambers and for construction of the main structure and the road. Apart from noise produced by blasting and drilling operations a lot of noise and dust will be produced by excavation equipment, other machinery, concrete mixing, and traffic from trucks and vehicles. The city of Dasu-Komilla and the village of Seo are very vulnerable for increased noise from traffic. Noise levels may exceed the national standards. Noise of explosions and ground vibrations will be common during excavations. At low to medium levels, ground vibrations and air blasts can result in community annoyance. At higher levels this could lead even to structural damage on buildings. Continuous monitoring of noise levels is essential, as well as continued consultations with the affected communities.

Increased risk of landslides: During construction there is an increased risk of landslides and collapse of slopes. Landslides are natural and common phenomena in the project area and along the KKH. Landslides in freshly-cut slopes can occur due to lubrication or saturation of rock support structure by rainfall or by water seepage. The use of explosives to break the rock will have the capacity to generate vibrations which can trigger a landslide. Landslide- prone areas in the project area have been identified and classified on basis of potential risks. Any blasting activities in these areas should be controlled and contained within defined limits. Pro-active measures should be developed to stabilize and protect slopes and to protect workers safety. Access would be restricted during the periods that slope stability is not yet entirely secured and guaranteed by proper safety measures such as rock bolts, anchors, safety nets and gabion structures. Permanent monitoring by the contractor is required.

Impacts of increased human activities on flora and fauna: Human activities during construction will strongly increase in the area with the influx of 5,000 construction workers and technicians, suppliers and business men and followers. The population increase will create a huge demand for firewood due to increased energy requirements for cooking and space heating during winter, and will finally increase the pressure on community forest resources. Contractors should provide non wood fuels such as LPG to the construction staff for cooking and heating purposes and the project should support development of LPG market in Dasu. The project will also support the improvements required for community forestry management. A forestry management study is proposed during preconstruction stage of the project to identify and develop forestry management opportunities. The population increase will also cause a strong pressure on the local environment by increased pollution, noise, disturbance, hunting, poaching and fishing. For the work force these impacts

such as disturbance and poaching can be reduced by the Contractor by introducing and enforcing a Code of Conduct and raising of awareness on protection of flora and fauna.

Risk of water pollution from storage tanks: Through the conversion of the Indus valley into a reservoir the available oil tanks and underground storage containers (chemicals, lubricants, pest control agents) will be submerged, with the risk of serious pollution of the water of the reservoir. Those potential sources of pollution should be identified and removed during the construction period and prior to the first filling of the reservoir.

Risk of pollution from solid waste and waste effluents: Large construction works are generating large quantities of excess materials from construction sites (concrete, steel cuttings, discarded material) and wastes from field camps and construction yards, including garbage, recyclable waste, food waste, and other debris. In addition small quantities of hazardous waste will be generated from maintenance activities, contaminated soil, oil filters and other waste products. The contractor will identify suitable sites for disposal of hazardous and non- hazardous waste. The selection will be done in consultation with the PMU and the local municipal authorities. Protocols and measures will be prescribed in the ECPs to be included in the contracts with the contractors. Siting of any fuel and hazardous material storage sites, including refueling facilities, asphalt plants and construction yards are to be located minimal 100 m from the banks of any streams and at least 500 m away from any residential areas, cultural or archaeological sites.

Shortages and/or negative effects on local water supply and sanitation: The influx of large numbers of workers, technicians and staff employees and their families will require well-organized drinking water supply and sanitation facilities. Various stakeholders might draw from the same available groundwater resources. A Drinking Water Management Plan, based on separate water supply and sanitation for the work force, will have to be prepared by the contractor. In designing such a plan it is important to maintain and safeguard the water supply and sanitation facilities for the local population.

Disturbance of visual landscape and natural habitats: The project will drastically change the visual landscape at the site of project and especially at places where slopes have been excavated for construction of roads and project infrastructure, at disposal sites and in borrow areas. Proper landscaping will have to be done and an overall Landscape Plan will have to be prepared, that will be worked out in more detail for the area where the project infrastructure is located. Also landscape plans for the residential areas and the offices should be developed to create a good living and working environment. Tree planting should be well organized and where possible vegetation and natural habitats will have to be restored or newly created.

7.7. Social Impacts during Construction Stage

Safety hazards due to increased traffic for children and elderly people: The construction activities can potentially impact the residents of Dasu-Komilla and along KKH, particularly the movement and safety of school children. In addition, due to increased use of trucks and other vehicles on the narrow roads in the project area and the access roads pedestrians, particularly elderly people and children will be more exposed to dangerous situations, which may lead to traffic accidents. A Traffic Management Plan will be implemented that will aim at ensuring access to residential areas, and preventing of unsafe situations, especially near schools, housing areas, construction areas, camps and offices. There will be appropriate medical services and a facility with the capacity to treat emergency cases and trauma patients.

Social conflict due to the influx of workers and in-migrants: The project construction will bring significant changes in the lives and livelihoods, including new opportunities for employment and income for the local people. The development also attracts thousands of new in-migrants to the project area. Through the influx of workers, business people and followers the population of Dasu-Komilla will increase more than three times within a few years. Unless properly managed this sudden influx of people could create negative aspects such as an increased crime rate, tensions and social conflicts between the various groups. In order to prevent such problems the project will develop a pro-active approach by working out a Migration Management Plan, even before arrival of the first in-migrants. In this plan detailed solutions for a number of key issues will be prepared including issues regarding housing and accommodation, food security, local infrastructure, community health, labor contracts, employment and business opportunities, security, integration and cultural understanding and community and area development. In this Plan procedures and rules will be worked out by the PMU in close cooperation with the contractors and local authorities.

Respect of local cultural norms and values by work force: Workers coming from different parts of Pakistan may have norms and values in social behavior and religion that differ from those of the resident population. This situation will be addressed by an awareness campaign implemented in the beginning of the construction phase. The contractors would be aware of the possibility and risks of miscommunications

between local residents and workers, a situation which easily could lead to social unrest. This would be prevented by raising awareness and implementation of a Code of Conduct for the workers.

Reduced safety and adverse effects on health situation: The influx and accommodation of a large work force will result in increased concerns for the safety of local population particularly women and children. These concerns would be addressed by raising awareness of the associated risks for the local population. The awareness campaign will also be aimed at the risk of interaction between the resident population and the construction work force, including the spreading of sexually transmitted diseases.. Apart from awareness raising and prevention the medical health facilities in the project area will be facilitated to deal with such incidences. Measures to this end are included in a Public Health and Safety Plan that will be implemented.

Increased load on local services and supplies: The project area is situated in a remote area far from the main population centers of the country. Especially in the beginning of the project there will be a limited presence of shops, markets, service providers and suppliers of commodities. With the presence of a considerable work force in the area there could be shortage of supplies for the resident population. This potential impact would be mitigated by requesting the contractors to procure their supplies in a manner not significantly affecting the availability of essential commodities in the area for the residents.

Increased risk of accidents for workforce: The rough terrain and difficult work conditions in some parts of the area will need extra attention from contactors and project management for the increased risk of accidents, unsafe working conditions and health risks. This is especially true for underground work in tunnels and caverns, but also during excavation and construction work. The contractors should follow closely the IFC Performance Standards on Labor and Working Conditions. Special attention should be focused on safety training for workers to prevent and restrict accidents and on the knowledge how to deal with emergencies.

7.8. Environmental Impacts during Operation and Maintenance

Inundation of 1800 ha of terrestrial habitat: The flooding of reservoir will cause submergence of about 1800 ha terrestrial habitat, which consist of mostly steep sloping barren land covered with rocks and boulders with sparse low shrubs and Artemisia vegetation at places. The same habitat is present at higher altitude. No mitigation or compensation is needed.

Impact on 570 ha aquatic habitat of the Indus and Indus tributaries through the creation of a reservoir. The character of the river Indus, and its valley bottom will change from a fast flowing uncontrolled sediment-laden river with steep rocky slopes into a narrow controlled water reservoir (average width 365m) and extending for about 73 km up stream at full supply level of 950m. In lateral valleys of tributaries the reservoir penetrates several kilometers inland. About 570 ha of river and tributaries will be subject of biotic and abiotic changes caused by the reservoir. Reservoir ecology will not be typical of a natural lake environment and will undergo rapid reduction in size caused by rapid sedimentation. Water velocities along the length of the reservoir will generally be lower than in pre-reservoir river conditions. Although reservoir features will be lake-like, surface water velocities will be high compared to most lakes and storage reservoirs. The relatively high water velocities suggest that conditions may be mainly compatible for riverine fish species, particularly along the reservoir shoreline. Spawning areas in the in the tributaries will be submerged and it is expected that new natural hot-spots will be developed at the confluence of tributaries with the main water body. Maintenance of spawning areas and developing fish hatchery for production of native snow carps (snow carp hatcheries are already established in India and Nepal) and stocking of fish in the tributaries, reservoirs is recommended to compensate the loss of habitat and reservoir fishery production. Further studies are recommended during construction and operation stage to establish detailed baseline data on aquatic ecology to develop additional offset measures and research on hatchery development.

Impacts of first filling of reservoir on safety of people and livestock and stability of slopes: Upon completion of the main structure the reservoir will be filled at a slow rate in the low flow season. For only one to two days (until the water level reaches the Low Level Outlets (LLO) there will be no water release from the dam. The water level rise is expected to be around 1 m per day. This slow rate is maintained in order not to destabilize the slopes of the valley and to prevent landslides. In periods with more inflow into the reservoir than needed, the water level rise will be controlled by opening the LLO in the main structure. Maintaining a relatively slow rate of filling will also help to reduce the potential hazards for people living or herding cattle in the area and for livestock. People in the area should be warned timely for the risks and there should be a ban on entering the future reservoir area. The entire first-filling operation will take about two months. During the entire period of filling the flow from the reservoir to the Indus downstream will be reduced. Since the operation is implemented in the beginning of the high flow season, the 2% reduction in the annual water flow needed for filling of the reservoir is not expected to affect the downstream water flow and irrigation

requirements. Once after the full supply level (950 m asl) is reached the LLO will be closed and whatever additional water is coming into the reservoir is diverted through the intake tunnels to the powerhouse and after power generation released through the tailrace tunnels. At this stage the run-of-river operation is reached, which means that the flow downstream reflects the natural flow conditions of the river. The impact of first filling of the reservoir and the subsequent operation of the plant on the hydrological regime of the river are minimal. During the high flow season (May-September), when water will enter the reservoir at a rate greater than the water diverted through the power inlets, the additional water will pass over the spillway.

Barrier Effect on Migration of Fish: By constructing the main structure in the Indus a barrier in the river will be created, which will impair the ecological connectivity in the river, including the movement of biota and the migration of fish. Fish production in the Indus River within the project area is low, the main reasons being the fast torrential stream, the cold, glacier-fed water, the high sediment load, and the low trophic level of the water. No long distance migratory fishes are present in the project, that could be affected by the dam. Snow carp migration is within the tributaries and hence will not be affected by the dam. Further studies will be carried out (during pre-construction/construction) to strengthen the existing knowledge on fish biology and ecological baseline for the Indus corridor between Basha and Tarbela in order to better interpret and mitigate actual impacts of DHP and to be able to prepare adequate offsetting measures on fish and fisheries of other hydropower projects in the UIB such as the Diamer-Basha dam.

Reduced water flows between dam and tailrace: The reduced water inflow in the river section of 4.4 km length between the main dam and the tailrace outlet can potentially cause significant impacts on the aquatic fauna and overall ecology of the river in this reach. However due to a favorable profile of the riverbed, a section of 3.2 km length upstream of the tailrace could permanently receive water from backwater flow of the tailrace. Only 1.2 km of river below the main dam is critical for drying up during the low flow season. Sieglo stream joins in this section and brings about 0.5 m^3/s flow during low flow season. Maintaining a minimum environmental flow downstream of the dam could mitigate potential impacts on aquatic habitat and fauna on this river section including confluence with Sieglo, especially in the period between December and April. Two approaches were followed in developing environmental flows – one on the experience of Ghazi Barotha hydropower project located on Indus on the downstream of Tarbela and other on meeting requirement of aquatic habitat. Ghazi Barotha has a 54 km of dewater section between barrage and tailrace and it is being compensated by 28 m^3/s, which is found to be adequate through a 5 year monitoring program by WAPDA Environmental Cell. In DHP, an environmental flow of 20 m^3/sec from the dam and 222 m^3/sec from the tailrace is recommended. These environmental flows will maintain a depth of 0.5 m and velocity of 2 m/s at Seiglo confluence which is adequate to maintain winter habitat of snow carps. On average, the recommended environmental flows (242 m^3/s) in most of the dewatered section will represents 44% of average winter flows and 72 to 95% average winter wetted perimeter. A downstream environmental effects monitoring program will be put in place to enable assessment of changes in ecological components and adjust the environmental flows if required.

Impact on downstream fish due to changes in water flows and quality: Generally water quality in reservoirs will be deteriorated to thermal stratification and depletion of dissolved oxygen at deeper levels. Average water retention time (residence time) in the reservoir (volume/flow per unit time) is an important determinant of the extent of the change in water quality. Generally, long retention times in the reservoir will affect the reservoir water quality through changes in dissolved oxygen, eutrophication and thermal stratification. Average water retention time in Dasu reservoir will be very short varying from 1 to 6 days during high flow season, and about 19 days during low flow season. The impacts on water quality are estimated to be minor due to these short retention times. The changes may occur over short distances downstream of the dam, but are not expected to have significant adverse effects. Changes in downstream sediment quantities are not expected to negatively affect downstream aquatic resources and may favor species that will benefit from reduced amounts of sand and gravel in seasonal deposition and scouring cycles. About 97 percent of the sediments occur in Indus basin during months of high flows of June to September during which water passes through spillways, low level outlets and turbines and hence some of the fine sediment will be continued to carry out downstream and sediments will continue to enter through tributaries located downstream of the dam. Major tributaries immediately below the dam site are Sieglo at 1.5 km and Jalkot at 9 km distance. A downstream environmental effects monitoring program will be put in place to enable assessment of changes in ecological components.

Impact of sedimentation on reservoir area: Annually some 200 million ton of sediment is entering the reservoir area. After completion of the Dasu structure the reservoir will be filled and flow velocities in the reservoir are strongly reduced causing most of the sediment to be deposited in the reservoir. The coarser sandy

sediments will settle near the upper reach of the reservoir and the finer sediments will settle in the middle and lower reaches. This sedimentation will reduce the reservoir storage capacity over the years to come. Without flushing of sediments, it is expected that the inlets of the LLO and power intake will be blocked in 20 to 25 years. The storage volume of the reservoir will then be reduced by more than 80 percent and the length of the reservoir will be about 10 km (at fsl). To prolong the life of the reservoir (at least to 40 years) it is estimated that annual flushing should start after 15 years. For the first 15 year period the impact of sedimentation on potential development of commercial fisheries is expected to be minimal, provided that stocking of the reservoir is carried out with suitable native non-migrating fish species adapted to the circumstances in the reservoir. The situation can be compared with the situation at the Tarbela reservoir. Habitat conditions along the 73 km length of the reservoir (at fsl) will be characterized by a transition of the fast-moving river-like flow in the upstream end of the reservoir (water velocities ranging from 0.6 to 3.1 m/sec) towards a deep slower moving flow (0.02 to 0.14 m/sec) in the downstream end. Water velocities along the length of the reservoir will generally be less than pre-reservoir river conditions. The relatively high water velocities suggest that conditions may be mainly compatible for riverine fish species, particularly along the reservoir shoreline.

Impact of flushing on fish production in the reservoir during base load operation of plant: The current plan is to use the reservoir for base load generation during the first stage of the project, estimated at 15 years. After this period the reservoir should be flushed annually during one month (mid May-mid June) when discharges of the Indus are high. Flushing is most effective in the high flood season. During flushing operation the water level in the reservoir will be lowered from 950 m asl to 830 m (level of the low level outlets).This will be achieved at an estimated rate of 3 m/day and takes about 40 days. After this lowering period the flushing of sediment will be carried out during 30 days. When the gates in the dam are closed the water level in the reservoir will start to rise with an average of 4 m/day and will reach FSL some 30 days later. The whole operation will take about 100 days (1 April -10 July). In this period it is expected that specific fisheries management is required to sustain the population of fish in the reduced reservoir area during flushing, possibly followed by re-stocking afterwards. There are considerable uncertainties with respect to expected losses of fish harvest during flushing and the appropriate mitigating measures. These issues have to be studied into more detail in the Fisheries Development and Management Program.

Impact on downstream fish during flushing operation: The potential impacts on the downstream during flushing operations are turbulent habitat conditions, release of high sediment load and altered water quality from the reservoir. Flushing events should not occur earlier than the planned early summer period to prevent possible adverse effects outside the intended timing window especially during the winter low-flow period. Release flows during flushing should be within limits of historical flows for the season over which flows will be released (currently planned for mid-May to mid-June). As explained earlier, the impacts on water quality in the reservoir are estimated to be minor due to these short retention times. However, if low oxygen conditions are evident during monitoring prior to flushing a lead-in period may be required whereby the lower-level outlets are used to draw out low oxygen-concentration lower-elevation water in combination with spillway releases to provide adequate oxygen concentrations in water downstream of the plunge pool. Adequate ramp-down rates should be recommended (tentatively recommended as 5-10 cm/hr, measured at tailrace outlet) and can be refined using monitoring results. Upon completion of flushing during reservoir refill, downstream flows should be released through low level outlets.

Impact of daily reservoir operations during peak production: After commissioning of the Diamer-Basha project (expected in 2037) DHP will depend on the guaranteed water releases from the Basha reservoir. During this stage it is possible to operate the Dasu plant as a peaking facility during 4 -6 hours per day to cover the peak demand for electricity in the country. There will be a daily storage-release cycle during the winter low-flow period, with strong fluctuating water levels. During storage/peaking operations (in Stage 2) the situation will be totally different compared to the run-of-river operation of the facility. In this case there could be periods of no inflow in the river below the tailrace outlet during the low flow season. Downstream habitat and biota will be significantly adversely affected as a result of the daily retention of water in the reservoir, in order to cover the needs for peak power generation. Potential effects on aquatic resources and fishing activity could extend downstream over substantial distances (depending on minimum environmental flow adopted). However it appears doubtful that potential effects would extend to the south end of Tarbela Reservoir (approximately 200 km downstream) where the commercial fishery is located. As mitigation measure it is recommended to operate at least one turbine continuously releasing 242 m^3/s at the tailrace. This discharge is then equal to about 10% of the average annual flow of the Indus at Dasu and 44% of the average the winter flow. This amount can be adjusted based on the monitoring of impacts on aquatic ecology. During peak hours the additional flow can then be used for power production.

The risk of sudden flow surges has also been studied, since these may considerably affect the aquatic ecology downstream. The possibility for tailrace surges occurring after up-scaling of the number of turbines operating simultaneously have been studied. From these studies it appeared that water level rises for different scenarios are relatively modest and that sudden surge waves downstream of the tailrace outlet are not expected.

Impact on downstream fish due to changes in hydrological flows due to peaking: Though DHP is recommended to operate as base load plant throughout its life time; it could be operated as peaking plant after construction of Basha during low flow season. The surges associated with peaking operation would likely cause rapid downstream displacement of fish and other biota (including fish-food organisms) holding in residual pools and channels during the 18 hour storage-period (when downstream flow would be negligible). Smaller fish sizes, would be most susceptible to this effect. This effect would continue to occur along Indus until inflow from major tributaries join Indus. It is recommended to operate at least one turbine and use additional water for peaking operation. This will ensure release of 222.5 m^3/s from tailrace. In addition, an operational protocol to be designed to soften the rapid water level and flow variations due to peaking and thereby reduce the downstream impact, a fixed start and stop procedure shall be implemented. This will include: (i) each turbine goes from zero to full level in two or three equal steps separated in time by a few minutes. When a second turbine is started, the same procedure will be followed for each turbine in order. The same procedure will be followed when reducing the load. The start and stop procedure can be further adjusted with the monitoring results

Risk of bird collisions with transmission cables: The Indus valley is a major fly-way for bird migration. Huge flocks of migrating birds follow the Indus valley fly-way twice a year in autumn and in spring passing the narrow Indus valley. Especially for birds with a large wingspan such as storks, cranes, herons and birds of prey there is a risk of bird collision with transmission cables. Bird collision and electrocution are the major impacts of transmission lines. Design of transmission line should maintain 1.5 meter spacing between energized parts and hardware components and grounded hardware or, where spacing is not feasible, covering energized parts and hardware and installing visibility enhancement objects such as marker balls, bird deterrents, or diverters.

7.9. Social Issues during Operation and Maintenance Stage

Loss of employment for construction workers: Local construction workers and technicians may lose their jobs at the end of the construction works and this may lead to unemployment for local residents. However most workers and technician have had good opportunities to develop skills and get work experience during the project. For many of these experienced workers there will be possibilities to be recruited for follow-up projects which are: (a) the successive follow up projects under stage 2 of DHP (phase 3 and 4), (b) the construction of the Diamer-Basha dam and (c) possible other major works further upstream. WAPDA could develop a preferential system for local workers with good qualifications and experience at the end of the construction of stage 1. Construction workers could also qualify for positions in maintenance and operational activities. It is important that the vocational training program for the various categories of workers will be continued together with the implementation of the Social Assistance Program.

Development of reservoir fisheries could create employment: Based on experience from Tarbela, it is estimated that there could be potential for development of reservoir fisheries in the Dasu reservoir. For optimum exploitation of new fisheries opportunities a specific fisheries management program will have to be developed. Implementation of such a program would substantially increase the employment opportunities in the area as well as the nutrional status of the population.

7.10 Potential Impacts identified in EARF for Transmission line

Potential impact of Transmission Line on Palas Valley: The EARF identified the crossing of the TL through Palas Valley as a potential environmental impact, to be studied in greater detail during ESA.The 500 kV transmission line will run over a distance of about 250 km and will begin at the Dasu Hydropower plant. The line will follow the Indus valley between Dasu and Pattan. From there, the corridor proceeds through the lower Palas valley and passes the districts of Battagram, Mansehra, Abbotabad, Haripur passing east of Tarbela Dam towards Pathar Garh, situated near Hasan Abdal in District Attock, Punjab. Out of total 250 km about 200 km is mountainous terrain with rocks, and covered with natural and planted forests. Only the last 50 km towards Pathar Gharh is relatively flat or slightly sloping terrain with cultivated lands and barren areas. The crossing through Palas valley could be environmentally sensitive, since this area is an IBA (Important Bird Area) declared by BirdLife International. Palas valley is also known by its rich biodiversity and is considered to be an environmental hotspot. In the EARF the NDTC has been recommended to consider

various alternative routes for the TL. These alternatives should be covered under the ESA to be undertaken by NTDC later in 2014.

Potential impacts of Transmission Line on bird migration along Indus Flyway: The EARF prepared by consultants assigned by NTDC identified as another potential impact of the routing the interference of the selected TL- corridor with the well-known Indus Flyway, or Bird Migration route no 7 along the Indus. Part of the line follows the Indus valley between Dasu and Pattan, in an area where the Indus valley is rather narrow with steep mountains on both sides reaching 2,500 – 3,000m. The Indus Flyway follows the narrow valley and especially large flocks of waterfowl, geese and ducks, cranes and herons are passing there twice a year on their way from Siberia towards their wintering grounds situated in Sindh, Indus Delta and along the coastline of the Arabian Sea, and vice-versa. To assess and better understand the interference of the corridor with the migrating birds and the risks of large scale bird collision, an Avian Risk Assessment study is proposed in the EARF. As the planning and design of the TL is at its initial stages of preparation, detailed analysis of alternatives and impact assessment should be carried out by the ESA team assigned by NTDC, which will commensurate its work when the detailed design of the project is awarded to the consultants.

8. Cumulative Impact Assessment framework

8.1. Background

WAPDA's Vision 2025 Program: A cumulative impact assessment framework has been prepared on basis of WAPDA's Water Resources and Hydropower Program: "Vision 2025" prepared for planning of development of water and hydropower resources in the Indus Basin. Central in the assessment is the sequential development of DHP and Basha Project in relation to the operation of the Tarbela Dam,which presently is the most upstream located hydraulic structure in the Indus. From here the water is divided over the Indus Basin Water System (IBWS) mainly for agricultural use in the fertile plains of Punjab and Sindh, which is the bread basket from Pakistan.

Strategic Sector Environmental and Social Assessment (SSESA): Recently the Ministry of Water and Power of GOP contracted an international consortium of consultants with financing from the Water Sector Development Project (WCAP) funded by World Bank to undertake a SSESA. The study has the objective to look at the whole Indus Basin for sector wide environmental and social considerations including cumulative impacts to help prioritizing investments in hydropower and storage development projects. The study would provide recommendations on developing a mechanism for monitoring and evaluating the environmental and social performance of storage and hydropower projects in Pakistan. The study is at an advanced stage of completion.

Temporal and spatial boundaries: These boundaries have been based on Vision 2025 program, which includes the development of DHP (2015-2022, phase 1 and 2) and development of Diamer- Basha (operational in15 years from now). The assessment framework has been concentrated on potential cumulative impacts arising out of water resources and hydropower projects likely to be developed within the next twenty years both on Indus main stem and its tributaries. Non-hydro developments are not very likely in this mountainous and rugged terrain belonging to the lower Himalayan and Karakorum mountain range. The only likely large scale development within this period could be construction of a new expressway or a railroad to improve access to the North of Pakistan.

8.2. Context of DHP

The Indus Basin Water System and the Tarbela dam: To meet the increasing food production demands, Pakistan has been expanding the surface water supplies to the Indus Basin Water System (IBWS) over time by capturing more water from the Indus and its other rivers.Within the framework of the Indus Basin Water Master Plan the Tarbela Dam was developed during the seventies of the last century. The main purpose of the dam initially was to supply irrigation water to the densely populated agricultural areas in Punjab and Sindh. For the project 120 villages along the Indus were submerged and a total of 96,000 persons had to be resettled and 33,200 ha of land to be acquired. At present the Tarbela dam is the most upstream constructed hydraulic structure controlling the Indus waters and supplying irrigation water to the IWBS, including generation of power.

Post-Tarbela developments: Canal diversions after completion of Tarbela initially reached as high as 105 MAF. However, they have declined in recent years due to reduced storage of Tarbela reservoir because of sedimentation and several other factors such as the state of the infrastructure and a sequence of dry years. The 2001-2010 average canal diversions have now been reduced to 94.5 MAF, and the reduction is primarily in the *rabi* (winter: October-March) season by about 8.6 MAF. This is because the diversions are close to the full potential that can be supplied. Also declining water storage capacity of the reservoirs directly affects the flow for irrigation during winter period due to the siltation problem. Further increase is only possible with heavy investment in storage dams on the Indus River, many of which are very controversial for domestic political reasons, especially inter-provincial conflicts over allocation of water and timing of releases.

Increased water stress: In the second half of the twentieth century, Pakistan successfully overcame major water resources challenges and made great achievements – tackling the issues resulting from the 1947 partition of the subcontinent and division of the Indus waters, as well as from extensive water-logging and salinity. Today Pakistan has the largest contiguous irrigation system in the world. However, Pakistan once again faces numerous water-related challenges. These challenges are increasing water stress, with limited additional water resources that can be mobilized, coupled with the looming threat of climate change.

Development of groundwater: Pakistan has also utilized its groundwater resources, which are recharged by the surface water system. Since the 1980s, the groundwater aquifers have supplied increasing amounts of water for irrigation in areas underlain by fresh groundwater. In Punjab, about an equal amount of irrigation water comes from groundwater wells. This resource is now reaching its limits and further withdrawal is not possible without serious groundwater mining and extraordinary costs for pumping.

Indus-water related impacts downstream from Tarbela: From 1900 onwards, as development of the IBWS proceeded and extraction from the river steadily increased, the delta and coastal zone began to receive lower volumes of water, thus changing the characteristics and ecology of the area. Decreased water flows in the Indus River have caused serious adverse environmental and social impacts in the delta and the coastal zone. These impacts include the loss of mangrove forests, decreased fisheries, deteriorated water quality, and sea water intrusion. All of these factors have a direct bearing on the livelihood and wellbeing of the local population. These effects are being mitigated through the implementation of a number of programs aimed at improving water management in the delta, the provision of drainage and revival of some of the lakes using better quality drainage water and various livelihood programs. Some of these programs are supported by the Bank.

The Indus in Sindh: The Indus in Sindh not far from the delta, flows on silted up bed, like many mature rivers in the world. The embankments for flood protection were constructed after 1901. These embankments are placed about 10 miles apart, starting from the Guddu Barrage to the sea. The Indus meanders between these embankments. The original delta is on the left side of the river. Here irrigated agriculture is possible by diverting and using water from Kotri Barrage, the last barrage in the river. Thus the Indus Delta has seen a continuous change in its hydrology and ecology over one hundred years, but the impacts have become more pronounced as the canal diversions upstream increased.

Mitigations measures: Since 1990 the Government of Sindh has carried out a number of major projects including:

a) **The interprovincial Water Accord of 1991:** has a provision for ecological flow to be released downstream from Kotri Barrage, however this is not strictly followed. Water is generally released in years of floods and extraordinary quantities go down to the sea, whereas in other years flows are close to zero.

b) **Preparation of a Master Plan for the Left Bank of Indus, Delta and Coastal Zone**: Under the Sindh Water Sector Improvement Project (WSIP), the World Bank is assisting the Government of Sindh (GoS) to prepare a regional master plan to address the flooding issues and provide proper drainage to the area on the left bank of the Indus, including the delta and the coastal zone. This occurs through appropriate structural and non-structural measures, such as measures for retention and/or safe disposal of drainage, storm and flood water; and improvement of wetlands in the delta area and in the coastal zone, recognizing their environmental importance and considerable economic potential for local communities. Four phased studies are being carried out.

c) **Sediment Management Plan for the Indus Basin and Tarbela**: Under the Water Capacity Building Project (WCAP) the World Bank is assisting the GoP and WAPDA to get a better understanding of sediment management in the Indus basin and in Tarbela reservoir. This would help to develop plans for movement of sediment downstream once the reservoir is filled. The downstream area is already seeing the

impact of increased sediment flow since the amount of sediment deposited into the Tarbela reservoir is decreasing.

d) **Improving Irrigation Efficiencies**: With increasing population and development, the water demand in the Indus Basin is expected to increase. In future, substantial quantities of water can only come from reducing the losses in the irrigation system, which are now about 35-40 percent. A substantial part of the losses are in the watercourse command (over 40 percent) and the rest are fieldlosses. To address these issues, the Bank is assisting the Government to start an irrigation productivity improvement program under which watercourses would be improved to reduce delivery losses and introduce high efficiency irrigation systems such as drip irrigation. The program started in Punjab and is being expanded to Sindh and other provinces. The results in Punjab are very encouraging.

e) **Plans for Storage Reservoirs in IBWS**: Pakistan has already raised the level of the Mangla dam on the Jhelum River. This provides about 2.9 MAF of additional storage. However, this is much less than the combined storage losses due to sedimentation in the Mangla and Tarbela reservoirs. More options for increasing storage are studied, including a storage dam in the Jhelum River. However, as noted above, building large dams is a very contentious issue in Pakistan as well.

f) **Sind Coastal Area Development**: Community organisations have been implementing the Sindh Coastal Area Development (SCAD) program under the WB funded PPAF-II and PPAF-III projects and financed by the Pakistan Poverty Alleviation Fund (PPAF). These projects address the specific problems in isolated coastal areas in the districts of Thatta and Badin, which are prone to regular natural and man-made disasters resulting from seawater intrusion, floods, cyclones resulting in destruction of livelihoods and widespread poverty and vulnerability.

8.3. Expected developments in the Upper Indus Basin

Shift in focus of water policy planning: The development of the Indus River system has the potential to provide the long term solution for the water and electricity sector and growth of the Pakistani economy. However, the aim of developing the Indus River needs to be shifted from merely storing and increasing water supplies towards developing water and hydropower resources and maximizing returns to these investments in the water and electricity sector. Given the rapidly industrializing economy the contribution of water and hydropower has to be valued appropriately rather than merely assigning higher priority to water storage as it was the case when Mangla and Tarbela dam were constructed. The focus therefore is now moving to the main Indus where maximum amount of water is available, especially since the waters of Chenab and Jehlum are fully utilized. On the Indus River the same water can be used through a cascade to maximize benefits of storage and hydropower generation.

Indus Cascade development from Tarbela to Diamer-Basha: The first step in this long term plan is to develop the segment of Indus Cascade between the Tarbela Dam up to Diameter-Bhasha (DB) and exploit all the water and hydropower resources in this segment, followed by investments further upstream. This segment has an annual water flow of about 60 billion cubic meters (BCM) and an elevation drop of about 700 meters between upstream of DB to the Tarbela reservoirs. At this stage, this segment is planned to be developed by four major structures in the Indus River going upwards from Tarbela Dam, Thakot, Pattan, Dasu and Diamer-Bhasha. This part of the cascade (see figure 1.2 in Main ESA report) can be developed over the next 15-20 years, providing about 17,000 MW of newly installed capacity and 75,000 Gwhs of annual generation at round 4-5 cents/Kwhs (at the installation time that would reduce overtime when debt servicing is completed) and 10.7 BCM of storage capacity for water. This in the long term can change the fuel mix favoring hydropower and has potential to bring the cost of electricity down.

Expected development until 2025: An overview of the HP projects scheduled until 2025 is given in **Table 6.** DHP (Run of River) and Basha (storage) are major hydropower projects, whereas the minor HP projects along the tributaries are much smaller and usually also Run of River projects or sometimes small storage dams. DHP has a limited reservoir (24 km² only) with the only objective to generate hydropower (base-load and potentially peak-load in the future), whereas Basha has the objective to improve the storage capacity in the IBWS and to alleviate flood damage of the Indus River next to generating electricity.

Table 6: HP projects in the Upper Indus Basin (WAPDA Vision 2025)

	Project	Location	Storage (MAF)	Capacity (MW)	Completion date
1.	Diamer Basha [1)]	Diamer	8.10	4500	2028
2.	Dasu [1)]	Dasu	RoR	4320	2020
3.	6 Minor HP Projects	Besham-Pattan	RoR	1606	2011-2017

Status: [1)] Ready for construction

Objectives of Diamer Basha Project: The objective DB dam is to improve significantly the storage capacity in the stressed Indus Basin Water System (agriculture and environmental flow) and generate over 18,000 GWh of cheap and clean (due to the renewable nature) energy to the National Power Grid. Main national benefits of the project will comprise:

- Enhanced water storage capability of the Indus River System by adding about 7.9 BCM of live storage at a time when the on-line storages will have lost over one-third of original capacity of about 19 BCM;
- Increased useful life of downstream Tarbela reservoir by about 50 years (together with development of DHP) through trapping large amount of sediments;
- Optimization of water and power benefits through conjunctive operation with Tarbela reservoir;
- Alleviation of flood damages of the Indus, particularly in the reach Kalabagh to Gudu;
- Providing about 18,100 GWh of energy per annum from its installed capacity of 4,500 MW;
- Enabling about 1100 GWh of additional generation at Tarbela due to conjunctive operation of two reservoirs.

Sizeable addition to other two existing hydropower projects of Ghazi-Barotha and Chashma due to routing of additional water provided by storage at Diamer Basha will be possible in future. Besides the above national benefits, a major 'trickle-down effect' of the project will be significant improvement in socio-economic conditions in Gilgit-Baltistan.

Baseline conditions: The baseline conditions in Basha project and DHP are largely comparable. Both projects are situated in the same agro-ecological zone along the Indus valley at few km distances of each other. The smaller hydropower projects along the Indus tributaries are also found in the same zone, but at some 35 – 60 km distance downstream of Dasu. The projects downstream from Pattan are situated in an area which receives more rainfall and has well developed vegetation and natural forests along the tributaries and on the slopes. The area forms a transitional zone towards the zone downstream from Besham-Thalkot where the influence of the monsoon begins (Battagram- Mansehra) with much more rainfall and more agricultural development.

8.4. Cumulative impacts and trends to be expected.

General: DHP in combination with other proposed hydropower and storage projects has the potential to cause significant cumulative and induced impacts on physical, ecological and social resources in the UIB.
Most of the expected cumulative impacts relate to hydropower development, since this is the only major structural development in the area. Influx of migrants and business men will be lower in Dasu since there is hardly any suitable place to accommodate large numbers of people and commercial business. In the Basha area there will be more physical space for small industries and commercial establishments to develop. A major limitation for any economic development is the poor condition of the KKH between Thalkot and Rajkot bridge (the only lifeline to the outside world), which situation is constraining further economic and social development of the area. So far there are no plans to reconstruct this road section which is in difficult terrain and frequently blocked during days. The impacts on biodiversity and wildlife and the trends and concerns identified in DHP and DB are similar.

a) Impacts on hydrology and water availability
Impacts from DHP: The operation of DHP as a run-of-river facility used for base load power production will essentially not change the hydrological regime of the Indus downstream. No change in the Indus flow between Dasu and Tarbela is expected. The downstream flow will only slightly be reduced during the first-filling of the

reservoir. Even when this happens in the low flow season (February – March) there will be sufficient water discharged through the low level outlets and diversion tunnels to downstream areas. During yearly flushing operation, which will start only after 15 years of operation the water in the reservoir will be lowered for free flow through the Low Level Outlets of the dam during one month to flush the sediments. In case the Basha dam is constructed by that time flushing is only needed after 30 years. For the rest of the time the Run-of River flow will be maintained. Impacts of the change in flow therefore will be almost negligible.

Impacts from DHP and Basha: With the construction of Basha, which dam has storage volume of 7.9 MAF the storage capability in Tarbela reservoir could considerably be increased by 42 percent during the low flow season, when this water is released into the system (**see Table 7**). This could alleviate the water shortages for irrigation downstream of Tarbela in the beginning of the kharif season, which is a crucial period for development of the summer crops in Punjab and Sindh. This impact will be very beneficial for irrigated agriculture in the plains and could compensate for the losses in the ecological flow (often used for agricultural purposes), which could be a beneficial development downstream. The change in river hydrology for different scenarios has been determined in a hydrological study for Basha dam carried out by WAPDA in 2012.

Table 7: Percent of change in river hydrology downstream of Tarbela under different hydropower and storage scenarios

Hydropower / Storage development scenarios	Low flow (Oct - March)	Early kharif (Apr-May)	High flow (Jun-Sep)
1. Dasu + Tarbela	0	+10	-1
2. Basha + Tarbela	+42	+9	-11
3. Basha + Dasu + Tarbela*)	+42	+19	-12

Note: *) Through optimizing the operation of the three dams

b) Impacts on flooding: Storage of water in the reservoirs will attenuate the floods and save the downstream communities properties and lives. GLOFs are a serious threat and these are to be better managed to protect the hydropower infrastructure and community. Currently there is no early flood warning telemetry network available on the upstream of Dasu. In 2010 there was a huge landslide in the Hunza Valley, which blocked Hunza River and eroded away a considerable length of Karakoram Highway (KKH) near Attabad and also created a lake, which is still there. With conjunctive operation of Tarbela, Diamer Basha and Dasu reservoirs, combined flood regulating capability of these dams will significantly increase. For individual 10-daily flows it was assessed that a maximum of about 60% reduction could be expected downstream of Tarbela.

c) Impacts water availability and ecological releases at Kotri barrage: A system integrated study conducted by WAPDA showed that impacts from the completion of DHP and DB and optimized management of Tarbela could even be felt downstream of Kotri, especially during low flow season and in early kharif as shown in the **Table 8**

Table 8: Impact in percentages of water availability and ecological releases downstream Kotri under different hydropower/storage scenarios

Hydropower / Storage Development Scenarios	Low Flow (Oct - March)	Early Kharif (Apr-May)
1. Dasu	0	+1
2. Basha + Tarbela	+14	+1
3. Basha + Dasu + Tarbela *)	+14	+2

Note: *) Through optimizing the operation of the three dams

DHP alone will have no effect on water available for use downstream of DHP powerhouse outlets or downstream of Tarbela during the winter low flow period and will increase water availability slightly during early Kharif for the years when flushing takes place. But with Basha a increase of 14 percent available water is possible during low flood season, which water can be used to maintain the ecological flow towards de delta.

d) Impacts on sediment transport: Annually about 200 million ton of sediment are flowing into the DHP reservoir. Sand will be trapped but most of the suspended silt will pass the turbines and the spillways/LLOs in Dasu. Without flushing it is expected that the Dasu reservoir will be filled in 20-25 year. Once the flushing

commences after 15 year (assuming Basha is not completed) about 27 percent of the annual sediment inflow would be trapped and 73 percent would be flushed through the flushing tunnels and LLO. This will have an impact on the composition of the sediments (relatively more fine fraction) reaching downstream areas, with possibly some changes in the aquatic ecology. The reduction of the sediment quantity and composition as a result of the construction of DHP is not expected to have an impact on the water quality of the Tarbela reservoir. The construction of Basha will have a considerable beneficial impact on both Dasu and Tarbela reservoir. The Basha reservoir with a large storage volume will then act as a sediment trap and the inflow in Dasu reservoir will be reduced to 46 million ton of sediment (mainly fine fraction). The cumulated impacts of both Dasu and Basha together will have a considerable positive impact on Tarbela reservoir and may extend its life with another 50 years (15 years due to the retention of sediments in Dasu and 35 years due to retention in the Basha reservoir.)

e) Water Use: Downstream of Tarbela, there will be increased water availability during the low flow season and transition period of Early Kharif. The enhanced supplies downstream of Tarbela reservoir, in tandem operation with Basha and Dasu reservoirs, in low flow period is expected to increase irrigation supplies by 14% on average. Upstream of Tarbela, community drinking water and irrigation supplies are expected not to be affected since they are drawn mainly from tributaries, but may be affected by smaller tributary projects.

f) Impacts on aquatic ecology, fish and fisheries

Downstream of DHP: Fish movement from the tributaries to Indus confluences is common during low flow season in winter. Due to release of high water flows from Basha reservoir in winter, there will be a potential effect on the fish habitat near the confluences and movement patterns between tributaries and the Indus. This will also affect the availability of fish for local consumption. By constructing major structures in the Indus barriers will be created, which will impair the ecological connectivity in the river. However, no barrier effect on fish migration is expected since no long distant migrant fish species, such as Mahaseer, are present anymore in this section of Indus between Basha and Besham. Due to long storage time of water in the Basha reservoir, the water quality (dissolved oxygen content and temperature) in the reservoir will be affected. Release of these waters could have a potential impact on fishes in the downstream areas.

Reservoir areas: Formation of reservoir changes biotic and abiotic conditions in the submerged Indus and tributaries. In the reservoir areas the changes in the flow velocity, the water quality (less turbidity, higher temperature, and more light) is expected to change the aquatic ecosystem considerably. The riverine ecosystem will be converted into a more lacustrine aquatic habitat. These changes will affect the fish habitat and spawning sites of the tributaries and Indus. However, there could be opportunities for development of reservoir fish species due to improved water quality and reduced currents in the reservoir area. The negative impact on loss of fish habitat can be compensated developing of fish hatchery with native snow carps and open water stocking in the affected tributaries and reservoirs; and maintenance of spawning areas. These measures will also create new opportunities for employment of local community resettled people. Development of a new lacustrine habitat in the reservoir area could be valuable especially in combination with the lateral tributaries of the Indus, where melt water streams flow into the reservoir. These places could develop into important spawning areas for fish.

g) Impacts on forestry and biodiversity: The construction of both DHP and the Diamer-Basha project may have a significant cumulative and induced impact on the high-altitude natural forests and wildlife of the area. There will be large influx of many thousands of people including construction workers, operational staff, and business people together with their dependents and over a period of 25 to 30 years. They will settle in the main urban centers in the area around Dasu/Komilla and Chilas. The construction of new resettlement sites for both projects at higher altitudes will also increase the population pressure of the rural population at higher elevations particularly on forest resources and wildlife including a whole range of rare and endangered plants and fauna. As a result there will be more collection and commercial trade in fire wood and herbs, illegal deforestation, logging, reclamation of land for agriculture and other activities. Illegal practices such as poaching, trapping and hunting will increase.

h) Impacts on resettlement, livelihood and income: For Basha Dam project and DHP the nature of the social impacts is largely comparable, although social impacts are larger than in Dasu. DB requires the resettlement of considerably more people than DHP and more land is to be acquired for the project. Impacts on trees felling, loss of land and commercial establishments are larger since the DB project is planned in a part of the Indus valley, which is much wider and more densely populated with more commercial activities than in the Dasu area. The impacts of resettlement, loss of land and assets are shown in **Table 9.**

Table 9: Social and cultural impacts of DHP and DB

Indicators	Basha Dam Project	Dasu Hydropower Project
Location	Diamer and Kohistan District	Kohistan District
Affected Population	28,650 people will be affected due to project interventions.	6,953 affected persons will be dislocated requiring relocation
Households	4,310 from 31 villages	767 from 34 villages
Land needed for project construction	Total estimated land acquisition of 15,150 ha,	A total of 4,643 ha of land will be affected
Trees	Loss of estimated 525,775 trees both fruit (283,964) and non-fruit (241.811) varieties.	An estimated 21,000 trees of various species and sizes will be lost
Commercial activities	453 commercial units/objects comprising of public buildings and sites and services	197 commercial structures will be affected due to project interventions.
Vulnerable	A total of 100 people socially vulnerable people	There are 10 families of Soniwal (nomad) tribe living in project area and several disabled and female-headed households
KKH	Submergence of about 94 km of existing Karakorum Highway (KKH) on the left bank	Submergence of about 46 km of existing Karakorum Highway (KKH) on the left bank
Suspension Bridges	7 suspension bridges are being affected.	2 suspension bridges are being affected.
Ethnic Minorities	There are 500 families of Soniwal tribe living in project area (nomads extracting gold).	There are 13 families of Soniwals living in project area.
Cultural heritage	Submergence of 30,367 rock carvings forming part of the cultural heritage	A 400-year old mosque at Seer Gayal village on right bank would require relocation
In-migrants and social Issues	Several thousand in-migrants and construction workers will move in creating cultural conflict and disruptions in community life	Deterioration of social and community life due to in-migration from other areas of Pakistan and foreign construction workers
Gender impacts	Women have lower status, very limited access to education and health due to seclusion. The poor suffer even more from malnutrition. Many pregnancy related death; lack of access to medical centers. Disruption of life due to loss of land and access to resources.	Women have a lower status and publicly "invisible." As a result, mobility is restricted .The loss of land, houses and forests due to the project will have significant impacts on the women.

i) Impacts on Physical Cultural Resources (DB): A large field of pre-historic and historic rock drawings and inscriptions (50,000 rock drawings and 5000 inscriptions can be found at 30 sites on both sides of the Indus between Shatial and Raikot bridge (near Astor) spread over a distance of more than 100 km. The rock art dates from Stone Age (8-9th millennium BC) to Buddhist and Islamic periods and is internationally known as the "guest book of the Silk Route". Over 30,000 of these engravings will disappear into the future Diamer Basha reservoir and will be covered by silt. During almost 40 years archeologists of the University of Heidelberg in Germany have worked in the area and studied the rock-art clusters stretching out over the entire distance of 100 km along the Indus. Currently the researchers are involved in a project to document all these engravings and rock-art, which is unique in the world. There are plans to save the most valuable pieces from inundation by the Basha reservoir and to display them (copies or pictures) elsewhere in a safe place.

The site of the rock carvings around Shatial will not be submerged by DHP, but these pieces of rock art are not protected and endangered by on-going developments from construction works and other activities along the KKH. Since this part will be the only remaining in-situ part from the entire field of almost 100 km of petroglyphs it is recommended that DHP is assisting in saving the in situ objects from further destruction and vandalism, by assisting the KP Department of Archaeology and Museums to acquire the land, provide proper fencing and protection measures, including some infrastructure for visitors of an information centre in Shatial and possibly a museum in either Chilas or Gilgit.

j) Transportation: One of the most critical social impacts of the development of DHP and DB is that both projects draw heavily on the only existing road along the Indus, the Karakorum Highway. Not only the population in Kohistan and Diamer is strongly dependent from this road, but also the population of major towns such as Gilgit, Hunza and in Skardu and the rest of the province of Gilgit-Baltistan (population > 1.0 million). For an estimated 2 million people the KKH is the only lifeline with the outside world. The road which was built during the sixties by the Pakistan Army with Chinese assistance is for most of the sections between Thalkot and Raikot bridge in a very poor shape and narrow. The section runs through very difficult terrain and belongs to a very dynamic and challenging environment for building roads. Average speed for cars is between 25- 30 km/hr over most of this section. The road is narrow (8-10m wide) and in poor shape. Frequently the road is blocked by landslides after rainfall or minor earthquakes. Closure of the road is common, not only for one or two days, but often for a week or more. Currently the section between Khunjerab pass and Raikot bridge is upgraded to highway standards with the help of Chinese contractor.

However with the construction and operation of in mega hydropower projects like Basha and Dasu the status of the current road conditions is absolutely prohibitive for simultaneous or overlapping construction and development of these projects. Population in the rural areas of Kohistan and Gilgit-Baltistan is accustomed to endless delays and has learned to adapt since they have ever lived as self-sufficient farmer or livestock holder. However for the population of the major city centers the delays mean that they are entire isolated from the rest of the world during many days or weeks in the year. Under the current plans devloped for DHP and Basha the reconstruction of 175 km of new KKH is foreseen. The new alignment will be improved, but this will be only for the early phases of development (5-10 years). It is very essential that GOP is preparing plans and seeking assistance for upgrading the KKH for all sections to real highway standards. WAPDA could play an intermediary role in these developments and could bring this to the attention of responsible authorities and planning commissions.

8.6 Mitigations to be implemented under DHP

Improving ecological data base on Upper Indus valley: Since DHP is the first in the row of mega-projects to be developed under WAPDA's Vision 2025 Program with relatively low environmental impacts and social impacts including low numbers of affected households and resettlement as compared to other mega-project, it is recommended to strengthen the respective data bases on ecology (both aquatic and terrestrial), biodiversity and on fisheries and forestry. Most ecological information in the UIB area dates from the last century and very few reliable field data have been collected in recent years. One of the reasons for this lack in information is the remoteness of the area and the difficult terrain conditions in the absence of access roads and accommodation. However with remote sensing and GIS techniques a lot of recent spatial information can be collected and institutions in Pakistan like WWF/IUCN, the Islamabad Herbarium and other institutions have facilities and expertise needed for implementing field surveys and studies to verify and collect reliable field data. It is suggested to concentrate under DHP on establishing a reliable data base and information system for the entire Indus Valley between Raikot bridge and Tarbela, including the tributaries, which could also be used for detailed planning and preparation of the other hydropower projects along the Indus River.

Early Flood Warning and Climate Monitoring Program: For safety of public, improved management of flood waves and safe operation of DHP and other hydropower projects in the country, it is imperative to have an early warning system for early flood warning in the major catchment areas of the project. The existing flood telemetry network in the Indus basin comprises 45 automatic rain and river level recording stations. There is no existing flood monitoring station in the DHP catchment. Hence it is recommended that the existing network is extended to the upper catchments of the River Indus including DHP. This component will include installation of River Level sensors (pressure transducers), temperature sensors, and Rain sensors (Tipping Buckets) at flood warning sites and hooking them with reliable telecommunication system, i.e., Meteor burst communication system. In total the installation of 18 telemetry stations is recommended in the upper catchment areas of the Indus. The works will be executed by the Hydrology & Research Directorate, under the administrative control of the Chief Engineer, Hydrology & Water Management, WAPDA. The operation and maintenance of the project will be handed over to Hydrology and Research directorate WAPDA after implementation, which is scheduled to be completed in one year. New staff will be hired and after proper training, they will be used for operation and maintenance of augmented network in conjunction with old staff.

Integrated Watershed Development Studies: At higher altitudes (> 1500 m) a number of forest plantations will be established where forest could be rejuvenated. This will be done at selected places on both sides (left and right bank) of the reservoir. Communities can play an important role in planting and managing these plantations. There is experience with this type of social forestry elsewhere in the region. In addition, a comprehensive study will be undertaken under DHP, with the objective to determine the forestry status and trends in areas between 1,000 and 2,500 m in the Indus District of Kohistan, Pakistan, to develop a general ecological management plan for sub-catchment areas of DHP, and to develop detailed community-led ecological management plans for at least two sub-catchment areas, focusing on sustainable forest management and conservation management of wildlife. The study will be carried out by a qualified organization (e.g. IUCN or WWF) with experience in ecological and forestry management.

Fish Hatchery and Stocking: A fish hatchery for production of native cold water fish species, snow carps and stocking of fish in the tributaries, reservoirs and downstream Indus is recommended to compensate the loss of fish habitat on the downstream and to address potential downstream impacts. This requires maintenance of an onsite fish hatchery of snow carps for the production of the targeted numbers of fingerlings from hatchery and hauling of the fish fingerlings for open water stocking in the river. Fish hatcheries for snow carps are so far not established in Pakistan, but are existing in Uttaranchal, India (Garhwal Himalaya) and Nepal (Kali Gandaki A, Plkhra, Trishuli and Godavari). However, further studies and investigations are required for detailed understanding of snow carp biology before developing a full scale hatchery. In addition, a fisheries development and management plan in cooperation with the KP Fishery Department will be prepared and implemented for the Dasu reservoir.

Physical Cultural Resources (PCR) Protection Plan: DHP will support KP Archaeological Department to (i) procure 25 acres of land for acquisition of land, in which rock carvings are located, (ii) fence the area, (iii) provide fiberglass sheds; (iv) develop tourist facilities and (v) documenting the importance of rock carvings and their translations. A detailed plan for this has to be worked out together with the various stakeholders, including the Heidelberg University and the KP Department for Archaeology and Museums.

8.5. Summary of major environmental and social concerns

A summary of the main environmental and social concerns of cumulative impacts is given in 10. The evaluation is based on the assumption that DHP (phase 1 and 2) is implemented in the period 2015- 2022 and that electricity from this project is generated as from 2020. Diamer Basha project will be commissioned after 15 years from now and then starts generating electricity. Meanwhile in the period until 2025 all minor hydropower projects in the tributaries have been completed and are under operation.

Table 10: Summary of environmental and social concerns of cumulative impacts

Feature	VEC	Major Concerns
Physical environment		
Surface water	Water quality	Risk of pollution Indus water & nullahs
	Water levels in reservoir areas	High water level fluctuations due to peaking and storage operations (not RoR)
Biological environment		
Fish	Loss of connectivity	Migrant fish (long distance) will disappear; Pressure on local migratory fish
	Loss of habitat	Loss of spawning areas of fish (Indus, nullahs)
Biodiversity	Natural forests	Pressure on forests (illegal logging) by influx of workers & in-migrants
	Wildlife	Increased poaching, hunting and trapping
	Natural habitats	Degradation by increased overgrazing, firewood collection, gravel/ sand extraction etc

		Lack of reliable data on, terrestrial and aquatic ecology, wildlife and forests
Social/cultural environment		
Social behavior	Influx of migrants	Lack of respect for cultural norms and traditions local population
Health & Safety	Population health	Reduced safety and health risk by interaction in-migrants with local population
KKH	Access to area	Frequent blockage and poor maintenance KKH → isolation
PCR	Archaeology	Loss of famous rock art sites by inundation and/or vandalism

9. Environmental and Social Management Plan

9.1. General

Various categories of mitigating measures: The Environmental Management Plan (EMP) and the Social and Resettlement Management Action Plan (SRMP) include various categories of mitigating measures. These are measures that can be grouped into three categories: (i) mitigating measures considered during detailed design by adopting alternative options at detailed design; (ii) mitigating measures included and worked out by the contractor(s) on basis of the EMP and an Environmental Code of Practices (ECP) enclosed in the Contract Documents, and (iii) mitigation measures and enhancement in SRMP.

Inclusion of EMP and SRMP in Contract Documents. In order to make contractors fully aware and responsible of the implications of the EMP and to ensure compliance, it is recommended that environmental measures will be included in the tender documentation. The contractor must be made accountable through contract documents and/or other agreements of the obligations and importance of the environmental and social components of the Project.

Payment milestones: would be linked to environmental performance, measured by completion of the prescribed environmental and social mitigation measures. Contractors would be trained how to join forces with the executing agency, project management unit, supervising consultants and local population for the mitigation of adverse impacts of the project. For effective implementation of the proposed mitigation and monitoring measures they would attract trained and experienced environmental management staff.

9.2. Environmental Management

The following plans will be prepared to manage and mitigate/reverse potential adverse environmental impacts:

Landscaping and Replanting Plan will be prepared by a qualified landscape architect to replace or compensate the vegetation and trees lost during land acquisition and resettlement of villages, clearing of construction sites and other areas needed for construction activities such as borrow and disposal areas, batching plants, workshops and other facilities. Tree species to be selected would be natural or semi-natural species adapted to the local (micro) climate and predominant soil conditions in the area. Establishment of a nursery will be considered as part of the Forestry Rejuvenation Plan for upland forest resources.

Borrow and Disposal Area Restoration Plan for restoration of borrow and disposal areas would be prepared by the Contractor. This Plan would aim at restoring as much as possible the original natural situation of these sites by various measures (refill, leveling or smoothening) and removing all not-natural artifacts such as equipment parts, sheds. The plan would be approved by a landscape architect assigned by WAPDA.

Pollution Prevention Plan will be prepared and implemented by the Contractor on the basis of the Environmental Code of Practices (ECP) and IFC/WBG EHS Guidelines (1997) which will be part of the bidding documents. The Plan will be submitted to the environmental monitoring team/ WAPDA Environmental Cell (WEC) for their review and approval before contractor mobilization.

Waste Disposal and Effluent Management Plan will be prepared and implemented by the Contractor on the basis of the ECP and IFC/WBG EHS Guidelines (1997), which will be part of the bidding documents. The Plan will be submitted to the environmental monitoring team/WEC for their review and approval before contractor mobilization.

Drinking Water Supply and Sanitation Plan: Separate water supply and sanitation provisions will be needed for the labor camps and workshops in order not cause shortages. A Plan will be prepared by the Contractor on basis of the ECP, which is part of the bidding documents. The Plan will be submitted to the environmental monitoring team/WEC for their review and approval before contractor mobilization.

A Traffic Management Plan will be prepared by the Contractor after discussion with WAPDA and local authorities responsible for roads and traffic. The Plan will be submitted to the environmental monitoring team/WEC for their review and approval before contractor mobilization.

An **Emergency Preparedness Plan** will be prepared by the Contractor after assessing potential risks and hazards that could be encountered during construction. The Plan will be submitted to the Supervision Consultants/environmental monitoring team/WEC for their review and approval before contractor mobilization.

In addition, a **Public Health and Safety Plan** will be prepared and submitted to environmental monitoring team/WEC for their review and approval.

A **Forestry Management Plan:** The forest areas above 1,500 m are already being exploited in an unsustainable manner: harvesting only. It can be expected that this type of exploitation will increase since it is one of the few potential sources of income for the increasing population, whereas the project-induced move up mountain will result in additional stress on forest resources as well as on wildlife. In order to maintain a healthy forest ecosystem modern management will have to be introduced, including planning of felling and rejuvenation (including nursery activities). Preparation of a Forestry Management Programme by forestry consultants and in cooperation with the Forestry Department is urgently required. Implementation of such programme would also create a relatively large number of jobs for forestry activities proper (including a nursery) and for enforcement of regulations. The plan needs to be finalized before the end of 2014; it would include sustainable logging systems, rejuvenation schedules, nursery, manpower implications (forestry staff, guards) and a sound financial system to make the plan self-sufficient.

A **Fisheries development program.** The Dasu reservoir, measuring 2,400 ha, could produce a minimum of 500 tons of good quality fish with a value of some 150 million PKR (US$ 1.5 million), provided that a thought-through fisheries management program is introduced, together with its required infrastructure (hatchery, landing facilities, ice factory, craft and gear, laboratory, training facilities). Suitable commercial fisheries could provide at least 1,250 long term livelihood opportunities (based upon an average monthly income of 10,000 PKR) and it will improve the nutritional level of the local communities. The project, in cooperation with the Fishery Department will have to engage a reservoir fisheries specialist to prepare the program, preferably before the end of 2014.

9.3. Social Management

Income and Livelihood Restoration Program: The income and livelihood restoration program (ILRP) has been developed with the aim of improving or at the least restoring to the earlier level the livelihood of all displaced households/persons. In preparing the program the impact of dislocation on livelihoods and adversely affected income was given due consideration. In addition to income restoration, capacity building and enhancing social capital of the affected communities are major objectives of the ILRP. Hence, training and skills development and measures for income and livelihood restoration of those affected have been included in addition to compensation and resettlement benefits. An approach in two phases has been selected. Phase I (2014-2019) is a short-term program implemented during the construction of the main structure and the relocation of the affected people. Phase II will start in 2019 will start after completion of the main structure. The RAP has provisions for a Social Development Fund to finance a long-term (10 year) livelihood development program. The detailed planning of livelihood activities will be carried out with participation of the local community. The long-term programs will be designed considering the sustainability of income and livelihood based on local resources, skills, and market opportunities.

Gender Action Plan: A gender assessment was conducted under the project. The assessment revealed the lacking development status of women, analyzed the challenging environment and explored potential entry points for gender interventions under the project. A Gender Action Plan was developed on the basis of this assessment. The action plan recommends a three-prong approach. The first is to educate project staff, including construction forces to raise awareness and increase sensitivity on gender. The second is to educate men, such as maliks, religious leaders and husbands on the importance for women to access project benefits. The third is to identify existing and future entry points and use them as much as possible to benefit women. It

is cautioned that, given the sensivity, all interventions related to women will need to be discussed and agreed with the communities first before putting to implementation

Communication and Information: WAPDA has developed a communication strategy for different target groups (local communities, previously affected persons, local and provincial authorities, general public and press). During the project regular briefings of progress will be organized for public information and for the media. The Communication and Information Centre will also have a section where complaints and grievances can be registered and addressed. A Communication and Information Specialist will be appointed for the project. WAPDA is engaging consultant experts to develop the Communication and Information Plan. This plan is expected to be completed by end 2014.

Public Health and Safety: A Public Health and Safety Plan has been prepared by the contractor on the basis of an evaluation of the health situation and services in the area as well as the additional requirements of health services in terms of quality and extent during project construction. The Plan will be submitted to the environmental monitoring team/WEC for their review and approval. Also the increased safety risk for workers and public are during construction has to be considered. The objective of the plan is to minimize the risks and possible harmful effects on health due to construction activities. The plan is scheduled for a period of seven years. In the beginning of the construction phase an information and prevention program will be carried out aimed at the resident population in the project area who will interact with the expected influx of workers during construction. The plan will furthermore focus on keeping the construction workforce safe from occupational hazards and health risks from living together in compounds. The workforce would have easy access to clinical care in order to minimize adverse effects and health risks. A medical facility will be set up for the construction workers. The facilities must also have the capacity to treat emergency cases.

Management Plan for construction-related impacts.: This plan outlines the approach and steps to be taken by the project during construction and operation periods to manage these impacts. The objective of the plan is to avoid and mitigate potential adverse impacts of influx of construction workers and other in-migrants on the local communities and the project-affected persons. The plan will also address the social dynamics between the different communities and groups and strengthen inter-cultural understanding. Finally it will help to build an integrated vibrant local community to facilitate better project management and implementation of the project.

9.4. Overview of Impacts and Mitigating Measures

An overview of all impacts and mitigating measures, including responsibilities and monitoring requirements is given in **Table 11** (next page).

Table 11: Overview of Impacts and Mitigation

	IMPACTS/ISSUES	MITIGATION MEASURES	TIME FRAME	COST IN US$ x 10^6	RESPONSIBILITY		MONITORING INDICATORS	MONITORING FREQUENCY
					Implement	Supervision		
DASU HYDROPOWER PROJECT (overall impacts)								
1	Installation of 1,080 MW hydropower plant in phased development expanded to 4,320 MW at final stage through a run-of-river structure with minimal environmental and relatively low social challenges	Desirable outcome of project	2020 and after	Total of 3,650	Contractor	WAPDA	Power generated	Monthly
2	Expansion of Pakistan electricity generation with minimal Carbon emission	Desirable outcome of project	2020 and after		WAPDA	GoP	% hydropower of total power production	Annually
3	Stimulation of socio-economic development of one of the least developed districts of Pakistan	Creating structures and preconditions for further development of the district	From 2015onwards	p.m.	Civil administration	GoP	Socio-economic development indicators	Annually
A1- PRE-CONSTRUCTION STAGE: ENVIRONMENTAL IMPACTS								
1	Change in land use and acquisition of land needed for reservoir, physical project infrastructure and construction will require the acquisition of 4,643 ha of land, including 425 ha of agricultural land	Compensation for land acquisition paid to the affectees (767 households); Temporary leasing of land needed for batching plant, construction workshops, labor camps and borrow areas	2014- 15	In RAP budget	PMU	WAPDA	Land acquired	Monthly until start of construction
2	Loss of natural vegetation and cutting of some 21,000 trees	- Replanting of 105,00 trees near resettlement sites and along roads - Promote alternatives for fuel wood	2014- 19	In EMP budget	WAPDA	Forest Dept	- Nr of trees planted - Nr of trees survived	Annually
3	Inundation of a 400 year old historic mosque in Seer Gayal	Dismantling of wooden structure and rebuilding at higher	2020	In EMP budget	Contractor	Local community, Archeology Dept.	Mosque rebuilt	
4	Impacts of increased traffic and transportation (congestion, noise, air)	Prepare Traffic Management Plan and plan for by-pass road	2015-2022	In budget contractor	Contractor	- PMU	Plan prepared	At start of construction

IMPACTS/ISSUES	MITIGATION MEASURES	TIME FRAME	COST IN US$ x 10^6	RESPONSIBILITY		MONITORING INDICATORS	MONITORING FREQUENCY
				Implement	Supervision		
on city of Dasu and along KKH	Dasu				- Local authority		
5 Inundation of 52 km of KKH	- Realignment of 62 km of KKH to higher level above reservoir - Construction of 13 km access road from Komilla to damsite	2014-16	KKH-1 39,600 KKH-2 110,000	Contractor	PMU	km of road rebuilt	Half yearly
6 Loss of 2 suspension bridges and 3 other bridges, 5 footbridges and several cable cars	Rebuild bridge on Indus and develop access road all along the right bank	2014-16	In budget contractor	Contractor	PMU	- Number of bridges/river crossings rebuilt	Half yearly
7 Loss of 25 km of secondary access roads at right bank and other jeepable roads	Construct access roads on right bank of river at higher level giving access to side valleys and resettlement sites	2015-2016	In budget contractor	Contractor	PMU	- km of access roads built; - Number of resettlement sites connected.	Half yearly
8 Impacts on Kaigah Community-managed Game Reserve	Development of new conservation areas Compensation of lost income due to hunting	2014- 19	In EMP budget	PMU	Wildlife Dept in cooperation with WWF	- Number of hunting permits sold - Number of markhor sighted	Yearly
A2 - PRE-CONSTRUCTION STAGE: SOCIAL IMPACTS							
1 Land Acquisition for project (4,643 ha)	Compensation and/or resettlement according to entitlement matrix/RAP	2014-15	In RAP budget	PMU	WAPDA	Land acquired	Monthly
2 Relocation of households from 34 villages	Compensation and/or resettlement according to entitlement matrix/RAP	2014-15	In RAP budget	PMU	WAPDA	Number of households compensated and/or resettled	Monthly
3 Relocation of shops/commercial establishments.	Compensation and/or resettlement according to entitlement matrix/RAP	2014-15	In RAP budget	PMU	WAPDA	Number of businesses compensated	Monthly
4 Loss of various civic amenities, 31 mosques, 7 schools, 1 motel, 2 basic	Rebuilding of civic amenities in resettlement areas	2014-15	In RAP budget	PMU/DCO	WAPDA	Number of civic amenities, sites and	Monthly

IMPACTS/ISSUES	MITIGATION MEASURES	TIME FRAME	COST IN US$ x 10^6	RESPONSIBILITY		MONITORING INDICATORS	MONITORING FREQUENCY
				Implement	Supervision		
health units.						services rebuild	
5 Loss of 423 ha of farmland, grazing area and crops	- Livelihood restoration; - Agriculture, Livestock and Fisheries Development Program	2014-15	In RAP budget	PMU/DCO	WAPDA	Social development indicators	Annually
6 Increased pressure on high/altitude grazing areas and forests	- Forestry and Wildlife Management Study - Implement Forest Rejuvenation Plan	2015 and after	In EMP budget	WWF/Forest Dept/ Wildlife Dept	WAPDA	- Study implemented - Update Forest Assessment (GIS) - Hectares of forest planted/rejuvenated	Every 5 year
7 Impacts of construction of 132 kV power supply line for Project and Colony	• Compensation of owners of land; • Avoiding residential and agricultural areas and dense forest • Reduction of health hazards for community and workers	2014-2015					
8 Generation of employment in region	- Contractor attract local workers and technicians on basis of quota; - Development of fisheries in reservoir - Livelihood restoration; - Vocational training for local workers.	2015-22		Contractor	PMU	Number of employed workers from region	Annually
9 Increased activity in the project area will stimulate local economy	Indirect positive impact					Social development indicators	Annually
B1 - CONSTRUCTION STAGE: CONSTRUCTION-RELATED ENVIRONMENTAL IMPACTS							
1 Increased traffic on KKH and local access roads due to project related vehicles, also from borrow areas.	Implement Traffic Management Plan, provide by-passes, take safety measures and repair damage	2015-2022	In budget contractor	Contractor	PMU	- Road status reports - Number of complaints	Permanent

	IMPACTS/ISSUES	MITIGATION MEASURES	TIME FRAME	COST IN US$ x 10^6	RESPONSIBILITY		MONITORING INDICATORS	MONITORING FREQUENCY
					Implement	Supervision		
2	Impact on river habitat during construction and loss of aquatic life between two coffer dams (temporarily) at the footprints of the dam (permanently)	- Study on significance of fish and monitoring - Implementation of ECPs	2015-20	In budget EMP	Fisheries consultant Contractor	Environment and Social Unit (ESMU) - DHP	- Study results published - Environmental flow maintained	Annually
3	Mortality of fish during downstream movement on spillway, intakes and inlets of hydraulic structures	Prevent fish passage by acoustic deterrent methods	2015-20	In budget fisheries contractor	Contractor	ESMU - DHP, Construction Supervision Consultants (CSC)	- Number of screens placed - Amount of restocking needed	Annually
4	Potential risk of pollution of air, noise, soil, surface water and groundwater from construction areas, yards, batching plants, quarry areas, worker camps and residential areas	- Prepare Pollution Prevention Plan; - Establish base line data - Implement measures prescribed in ECP	2015-22	In budget contractor	Contractor	ESMU-DHP, CSC	Usual chemical and bacteriological water quality parameters	Permanent
5	Pollution through solid waste and waste effluents from field camps and construction yards	- Waste Management and Effluent Management Plan; - Protocols and measures prescribed in ECP	2015-22	In budget contractor	Contractor	ESMU-DHP, CSC	- Plan ready and accepted; - Solid waste - Monitoring reports	Permanent
6	Potential loss of land by deposition of excess rock material	- Reduction of excavated rock material through re-use of material in construction works - Re-use plan for disposal areas	2015-22	In budget contractor	Contractor	ESMU-DHP, CSC	Area of arable land lost	
7	Impact from quarry activities	Implementation of ECPS Plan for Restoration of quarry Areas	2015-2019	In budget contractor	Contractor	ESMU-DHP, CSC	- Monitoring reports; - Percentage of plan implemented	Quarterly
8	Impacts of noise and dust from construction and use of explosives on residential areas and workers	- No blasting and drilling during night time; - Continued consultations with communities	2015-20	In budget contractor	Contractor	ESMU-DHP, CSC	- Noise levels - Number of complaints	Permanent
9	Increased risk of landslides and collapse of slope (use of explosives,	Pro-active measures to stabilize and protect slopes and to	2015-19	In budget	Contractor	PMU	Visual inspections	Permanent

IMPACTS/ISSUES	MITIGATION MEASURES	TIME FRAME	COST IN US$ x 10^6	RESPONSIBILITY		MONITORING INDICATORS	MONITORING FREQUENCY
				Implement	Supervision		
heavy rainfall) during construction	protect workers safety		contractor				
10 Impacts from increased human activities on flora and fauna	- Code of conduct for workers and employees - Awareness raising	2015-22	In budget contractor	Contractor	ESMU-DHP, Forest & Wildlife Departments	- Number of incidents reported - Monitoring reports	Quarterly
11 Risk of water pollution in area that will be submerged	- Removal of oil tanks and storage facilities of chemicals and other products	2015-20	In budget contractor	Contractor	ESMU-DHP, CSC	Plan prepared	At start of construction
12 Shortages and/or negative effects on local water supply and sanitation	Prepare Drinking Water Supply and Sanitation Plan based on separate water supply and sanitation for work force	2015-22	In budget contractor	Contractor	ESMU-DHP, CSC	- Plan ready and accepted; - Number of complaints	Permanent
13 Impacts of emissions of gasses and dust on air quality due to earth moving activities, vehicle and generators emissions	Protocols and measures prescribed in ECP Permanent monitoring	2015-19	In budget contractor	Contractor	ESMU-DHP, CSC	-air quality - monitoring reports	Permanent
14 Impact on the ecological connectivity and composition of the aquatic fauna and migration of fish in Indus and tributaries between Raikot bridge and Tarbela	- Implement aquatic and terrestrial ecology baseline study - Monitoring of changes and recommendations for environmental flow	2014 - 15	In EMP budget	Ecological NGO in cooperation with Consultant or University	ESMU-DHP, CSC	- Monitor ecological parameters aquatic and terrestrial fauna	Seasonally
15 Disturbance of visual landscape and natural habitats	- Landscaping plan - Establishing nurseries - Plantation of trees	2015-22	In EMP budget	Contractor in cooperation with Forestry Dept	ESMU-DHP, CSC	- Acreage nurseries - Number of trees planted	Seasonally
B2 – CONSTRUCTION STAGE: - CONSTRUCTION-RELATED SOCIAL IMPACTS							
1. Safety hazards and reduced mobility due to increased traffic especially for women, children and elderly people.	- Implement Traffic Management Plan; - Recruitment of trained drivers; - Adequate facilities for	2015-22	In budget contractor	Contractor	local health services	- Plan ready and accepted - Number of accidents - Number of incidents	Permanent

IMPACTS/ISSUES	MITIGATION MEASURES	TIME FRAME	COST IN US$ x 10^6	RESPONSIBILITY		MONITORING INDICATORS	MONITORING FREQUENCY
				Implement	Supervision		
	emergencies						
2. Social unrest due to influx of about 5,000 immigrant construction workers, technicians and other staff and their families	- Awareness campaign; - Implement Migration Management Plan - Grievance mechanisms to address complaints from local community and immigrants	2015-22	In SRMP budget	Contractor	WAPDA/DCO/local leaders	Number of complaints	Permanent
3. Lack of respect for cultural norms and values by workers coming from different parts of the country	- Awareness campaign; - Code of conduct for workers - Grievance mechanism to address complaints from local community	2015-22	In SRMP budget	Contractor/PMU	WAPDA/DCO/local leaders	Number of complaints	Permanent
4. Reduced safety and adverse effects on health situation by interaction of construction workforce with local residents, including spread of infectious diseases (hepatitis, HIV/AIDS)	- Implement Public Health and Safety Plan; - Safeguards and awareness raising against communicable diseases; - Gender Action Plan	2015-22	In SRMP budget		DoH/WAPDA	- Plans prepared and accepted - Incidence of infectious diseases - Health indicators	
5. Increased load on local services and supplies (markets, service providers, and others),	Contractor to procure the supplies in a manner not to significantly affect the availability of essential commodities in the area.	2015-22	In budget contractor	Contractor	WAPDA		Permanent
6. Increased risk of accidents, unsafe working conditions and health risks for workforce	- Emergency Preparedness Plan; - Contractor follows IFC Performance Standards on Labor and Working Conditions; - Safety training for workers	2015-22	In budget contractor	Contractor	WAPDA	Plan prepared and accepted	Permanent

IMPACTS/ISSUES	MITIGATION MEASURES	TIME FRAME	COST IN US$ x 10^6	RESPONSIBILITY		MONITORING INDICATORS	MONITORING FREQUENCY
				Implement	Supervision		
C1 – OPERATION AND MAINTENANCE STAGE: ENVIRONMENTAL IMPACTS							
1 Adverse impacts on aquatic fauna downstream of the dam site	Maintain environmental flow in low flood season	2020 and after	In EMP budget	Aquatic ecologist, Fishery Dept	ESMU-DHP, CSC	- Aquatic biota observed; - Trial catches of fish	Seasonally
2 Impacts of first filling of the reservoir on safety of people and livestock and the stability of valley slopes.	- Awareness campaign to inform local population; - Slow rate of filling to prevent collapse of slopes	2020	In EMP budget	WAPDA	ESMU-DHP, CSC	- Number of incidents - Rise in water level per day	Permanent
3 Impact of sedimentation on reservoir area	Yearly flushing after 10- 15 years operation	2020 and after		WAPDA	ESMU-DHP, CSC		Monthly
4 Impact of flushing on downstream fisheries of reservoir on fish production during base-load operations	Fisheries management plan including restocking	2035 and after		Fisheries Contractor	WAPDA	- Fish catches - Percentage of losses	Permanent
5 Impact of daily reservoir operation on downstream hydrology during peaking production	- Continuous operation of one turbine	after Basha		WAPDA	ESMU-DHP, CSC		Permanent
6 Increased human activities at higher altitudes will increase the pressure on forests and wildlife	Rejuvenation of high altitude forests and livelihood restoration concentrated on the reservoir area and the lateral valleys	2015 and after	Environ-mental Fund	Dept. of Forestry & Dept. of Wildlife	ESMU-DHP, CSC	- Number of incidents with illegal logging poaching, hunting etc. - Livelihood development	Permanent
7 Risk of bird collisions with transmission cables	Design of lines with 1.5 m spacing Provide markers, bird deterrents in transmission cables	2020 and after	In budget NTDC	NTDC		Number of fatalities recorded	Weekly during migration
C2 – OPERATION AND MAINTENANCE STAGE: SOCIAL IMPACTS							

IMPACTS/ISSUES	MITIGATION MEASURES	TIME FRAME	COST IN US$ x 10^6	RESPONSIBILITY		MONITORING INDICATORS	MONITORING FREQUENCY
				Implement	Supervision		
1 Loss of employment for construction workers	Implement Social Assistance Program, including vocational training	2022 and after		PMU	WAPDA, CSC		
2 Efficient use of reservoir fisheries will create employment opportunities	Fisheries Management plan	2020 and after		Fisheries contractor	WAPDA	- Nr of jobs+ - Fish production	

9.5. Monitoring Plan

The monitoring program has a dual purpose. It is designed (i) to monitor the contractor's work during project implementation in order to check contractual compliance with specified mitigation measures, and subsequently (ii) to assess the actual environmental and social impacts of the project over the years following completion of the various project components. The first type of monitoring will be carried out by the Engineering Consultant and supervised by an independent environmental management consultant. The second type of monitoring will be commissioned and carried out by a local organization or consultant with sufficient experience in environmental, ecological and social monitoring. The total cost of monitoring has been estimated at US$ 0.50 m. Monitoring indicators and frequency are shown in **Table 12.**

Table 12: Effects Monitoring Plan

Parameter	Means of Monitoring	Frequency	Responsible Agency	
			Implementation	Supervision
During Construction				
Landslides	Visual Inspection on stability of landslide areas	Monthly	Contractor	CSC, DHP
Top Soil	Visual inspection on stripping, storage and reuse of top soil	Monthly	Contractor	EU-CSC, EU-DHP
Erosion	Visual inspection of erosion prevention measures and occurrence of erosion	Monthly	Contractor	EU-CSC, EU-DHP
Operation of quarry sites	Visual inspection of quarry sites	Monthly	Contractor	EU-CSC, EU-DHP
Surface water quality	Sampling and analysis of river water quality and waste water discharges for the parameters given in NEQS 2000	Quarterly	Contractor	EU-CSC, EU-DHP
		Annually	External Monitor (DHP through a nationally recognized Laboratory)	EU-CSC, EU-DHP
	Spot measurements of pH, conductivity, turbidity. Visual inspection on presence of petroleum products.	Monthly	EU-CSC	EU-CSC, EU-DHP
Air Quality (dust, smoke)	Visual inspection to ensure good standard equipment is in use and dust suppression measures (spraying of waters) are in place.	Weekly	Contractor	EU-CSC, EU-DHP
	Visual inspection to ensure dust suppression work plan is being implemented	Weekly	Contractor	EU EU-CSC, EU-DHP
Air Quality in tunnels	Spot measurements for CO and O_2 levels in the tunnels	Monthly	EU-CSC	EU-DHP
Air Quality (PM_{10}, NO_2, SO2, CO_2, CO)	Air quality monitoring for 24 hours for the parameters specified in NEQS 2000	Quarterly	Contractor	EU-CSC, EU-DHP
		Annually	External Monitor (DHP through a nationally recognized laboratory)	EU-CSC, EU-DHP
Emissions from plant and equipment	Visual Inspection	Monthly	Contractor	EU-CSC, EU-DHP
Noise and vibration	24 hour noise monitoring	Quarterly	Contractor	EU-CSC, EU-DHP
	24 hour noise monitoring	Annually	External Monitor (DHP	EU-CSC, EU-

Parameter	Means of Monitoring	Frequency	Responsible Agency	
			Implementation	Supervision
			through a nationally recognized laboratory)	DHP
	Spot measurements	Monthly	CSC	EU-DHP
Waste Management	Visual inspection on spoil disposal in accordance with EMP Sub plan on Waste Management	Monthly	Contractor	EU-CSC, EU-DHP
	Visual inspection that solid waste is disposed at designated sites	Monthly	Contractor	EU-CSC, EU-DHP
Spills from hydrocarbon and chemical storage	Visual Inspection for leaks and spills	Monthly	Contractor	EU-CSC, EU-DHP
Wild life (including migratory bird)	Surveys for wildlife and migratory birds in accordance with EMP Sub-Plan on Terrestrial and Ecology Management	Half yearly	DHP through nationally recognized institute	EU-CSC, EU-DHP
	Ensure the adherence of the migratory measures proposed in the EMP	Monthly	DHP through nationally recognized institute	EU-CSC, EU-DHP
Fish	Surveys for fish in accordance with EMP Sub-Plan on Aquatic Ecology Management	Half yearly	DHP through nationally recognized institute	EU-CSC, EU-DHP, External Monitor
Traffic Safety	Visual inspection to see whether Traffic Management Plan (EMP Sub Plan 12) is implemented	Monthly	Contractor	EU-CSC, EU-DHP,
Local Roads	Visual inspection to ensure local roads are not damaged	Monthly	Contractor	EU-CSC, EU-DHP,
Cultural and archeological Sites	Visual observation on implementation of EMP Sub Plan 13 on Physical Cultural Resources Management	Monthly	Contractor	EU-CSC, EU-DHP,, External Monitor
Drinking water and sanitation	Ensure the construction workers are provided with safe water and sanitation facilities in the site	Weekly	Contractor	EU-CSC, EU-DHP,
Safety of workers	Usage of Personal Protective equipment	Monthly	Contractor	EU-CSC, EU-DHP,
Reinstatement of Work Sites	Visual Inspection	After completion of all works	Contractor	EU-CSC, EU-DHP,
Plantation	Visual inspection to ensure plantations are growing well.	Monthly	District Forest Office with support of civil society	EU-CSC, EU-DHP,, External Monitor
During Operation				
Surface Water Quality	Sampling and analysis for sediment load, DO and temperature	Half Yearly	DHP through nationally recognized laboratory	CSC, External Monitor
	In situ measurements on DO and Temperature at different depths in the reservoir	Quarterly	DHP through nationally recognized laboratory	CSC, External Monitor
Downstream river flows	Measurements of discharges to the downstream	Monthly	DHP	External Monitor
Migratory birds	Surveys for migratory birds in accordance with EMP Sub-Plan on Terrestrial and Ecology Management	Half Yearly	DHP through nationally recognized institute	EU-DHP, External Monitor
Fish	Surveys for fish in accordance with EMP Sub-Plan on Aquatic Ecology	Half yearly	DHP through nationally	EU-DHP,

Parameter	Means of Monitoring	Frequency	Responsible Agency	
			Implementation	Supervision
	Management		recognized institute	External Monitor
	Monthly data on fish catches	Monthly	Fisheries Contractor	EU-DHP,
Dam Safety	Monitoring of data from dam safety equipment	Quarterly	DHP	Dam Safety Organization of WAPDA
	Survey, inspection and testing	Yearly	Dam Safety Organization of WAPDA	DHP
	Survey, inspection and testing	Once in three years	External Monitor (DHP through an internationally recognized institute)	DHP

The role of WAPDA is to select consultants, NGOs and organizations needed for implementing the EMP and the SRMP They will supervise progress and quality of EMP and SRMP and take over regular monitoring activities during O&M phase. Result of monitoring of impacts will have to be reviewed and evaluated from time to time by the M&E consultants. Findings might be used to revise the operational rules of the project.

Third Party Monitoring: WAPDA will engage qualified consultants to conduct third party monitoring on an annual basis. The purpose of this monitoring will be to carry out an independent assessment and validation of the EMP and SRMP implementation.

9.6. Institutional Aspects

The overall responsibility for the implementation of the project rests with the Project Management Unit (PMU). Within the PMU there will be an Environment and Social Management Unit (ESMU), responsible for implementing the EMP and the SRMP. The ESMU will include representatives of all actors responsible for EMP/SRMP implementation. The responsibilities of the ESMU are: (i) supervision, facilitation and coordination of environmental and social measures; (ii) ensure that contractors follow PEPA regulations and other requirements mentioned in the EMP; (iii) identify any issues of non-compliance and report these; (iv) suggest mechanisms to link contractor performance in relation to the EMP to the timing of financial payments, incentives or penalties; (v) interaction with stakeholders for their concerns about the construction activities; and (vi) implementation of contingency plans.

The ESMU will ultimately be responsible to the WEC, stationed in Lahore. It is proposed that WEC takes a leading role in the ESMU by charging a senior WEC representative with overall responsibility for ESMU during the construction phase. The potential for institutional strengthening and capacity building of WEC has been identified. Currently WEC is understaffed. WEC operating at proposed sanctioned strength would be adequately resourced to deliver the commitments set out in this EMP and SRMP. The head of the ESMU unit reports directly to the Director PMU.

Composition of ESMU: The proposed composition of the ESMU team is as follows: (i) a Senior Engineer level WAPDA officer with environmental science background; (ii) an HSE Specialist to be appointed by WAPDA; (iii) a Social Scientist to be appointed by WAPDA; (iv) an Environmental and Social Monitor to be appointed by the Design/Supervising Consultant; and (v) an Environmental and Social Supervisor to be appointed by the Contractor.

Environmental and Social Management Unit: The task of the ESMU is to support and supervise the Engineering Consultants responsible for daily supervision of the Construction operations in environmental management and quality control. The ESMU is also responsible for supervising the preparation of the Health and Safety Plan, and other social plans, such as the Emergency preparedness Plan, the Waste Management and Effluent Management Plan, the Drinking Water and Sanitation Plan, the Information and Communication Strategy and for addressing the Social Legacy issues.

Construction Supervision Consultants: The Construction Supervision Consultants will appoint dedicated Environment and Social Supervisor(s) (ESS), to ensure the EMP and SRMP implementation during the project. ESS will supervise the contractor for the EMP implementation, particularly the mitigation measures. S/he will also be responsible for implementing the monitoring of effects of these measures.

Contractor: The contractor will be required to appoint a dedicated Environment/Social Officer(s) at the site for the implementation of EMP in the field, particularly the mitigation measures. The contractor will also be responsible for communicating with and training of its staff in the environmental/social aspects. The

contractor will develop the various plans directed towards health, safety, the environment and social issues, and get them approved by the Supervision Consultants before the commencement of the physical works on site. The construction contract will have appropriate clauses to bind the contractor for the above obligations.

9.7. Capacity Building and Training

Capacity building will be aimed at strengthening the WAPDA organization in Dasu in the field of environmental management and social development. Members of the environmental/social unit responsible for supervision of environmental and social mitigation measures would be trained in environmental management, environmental quality control, ecology, environmental awareness, participatory approach and social development. Training would not be restricted to WAPDA staff, but selected project staff involved in construction and operation of the project would also be trained. The contractor will also be required to impart environmental and social trainings to its staff, to ensure effective implementation of the EMP and SRMP. A budget of US$ 0.6 million has been earmarked for capacity building and training. In addition to the project-specific capacity building described above, WEC will be strengthened to actively partake in the environmental and social management of the WAPDA projects, particularly towards the effective ESMP implementation of the DHP, as well as the ESA studies and EMP and SRMP implementation of the forthcoming hydropower projects such as the Basha dam. Additional funds of US$ 0.3 million have been allocated to establish a GIS/MIS facility and for institutional strengthening of WEC.

9.8. Panel of Experts

WAPDA has engaged an independent panel of international environment and social experts to advise ESMU and other project entities on all environmental and social matters including effective implementation of EMP and SRMP, particularly on unanticipated situations, impacts, and their mitigation. The Panel has started work and has sofar implemented three missions to Pakistan. They had discussions with WAPDA and design consultants, carried out field visits and reviewed various reports and documents. During the preparation and construction period they will continue to convene on a regular basis. They will review reports produced by the EMU, Supervision Consultants and contractors; periodically visit the site to have first-hand information on the environmental and social impacts and EMP/SRMP implementation; and provide report to WAPDA on the overall environmental and social performance of the project. An amount of US$ 0.43 million has been included in the Project cost for this purpose.

9.9. Audits

Internal Environmental Audits will be held once during construction phase and once at the end of the construction activities. The objective of the audits is to review the effectiveness of environmental management. It is proposed that WEC would carry out these audits on six-monthly basis. External audits on the implementation of the EMP and SRMP will be made by an independent industrial environmental management specialist on an annual basis. These audits would be used to re-examine the continued appropriateness of the EMP and SRMP and to provide advice on any up-dates required.

9.10. Reporting and Grievances

Reporting: Proper arrangements are necessary for recording, disseminating and responding to information which emerges from the various environmental monitoring and management programs. They are also necessary for rendering the environmental management system "auditable". However, the primary focus must remain on the pragmatic control of impacts, not the creation of complex bureaucratic procedures.

Grievances: Grievances are actual or perceived problems that might give grounds for complaints. As a general policy, WAPDA will work proactively towards preventing grievances through the implementation of impact mitigation measures and community liaison activities that anticipate and address potential issues before they become grievances. Grievances recorded will be reviewed and investigated by Project staff and outside authorities as appropriate. The investigations will aim to identify whether the incident leading to the grievance is a singular occurrence or likely to reoccur. Possible remedial measures or actions will be identified and implemented when justified. The responsibility for addressing grievances will rest with a committee including Project Manager, the Contractor's Site Manager and a person designated to be responsible for stakeholder liaison.

9.11. Cost of EMP and SRMP

The cost of implementing EMP is shown in **Table 13**.

Table 13: EMP Implementation Cost Estimates

Description	**Estimated Cost in (million US$)**
Implementation of EMP by contractor	18.32
Environment staff in CSC	4.33
Environment staff in PMU	2.18
Internal auditing	0.20
External monitoring	0.50
Panel of experts	0.43
Capacity building, institutional strengthening	0.90
Monitoring of water and waste water quality	0.54
Spot monitoring of air, noise and water quality	0.44
Traffic management	1.54
Aquatic ecology and development of fisheries	4.31
Terrestrial ecology, forestry and nature conservation,	5.75
Environmental management and enhancement of resettlement villages	2.10
Physical cultural resources	1.65
Baseline studies terrestrial and aquatic ecology Upper Indus Basin including monitoring of biodiversity and wildlife	10.0
Weather station in Colony	0.15
Glacier, Flood warning, climate change, watershed management	10.50
Total	**63.84**

A summary of the cost of implementing the Resettlement Action Program (RAP) is given in **Table 14**.

Table 14: Cost of implementing RAP

	Expenditure Item		**Total PKR (Million)**	**Total US$ (Million)**
1.	Compensation & Allowances			
	a	Land acquisition	17,122	180.2
	b	Structures	2,310	24.3
	c	Standing crops	64	0.7
	d	Trees	536	5.6
	e	Relocation cost	89	0.9
	f	Rehabilitation assistance	15	0.1
		Sub total compensation & allowances	20,136	211.9
2		Resettlement sites development	1,585	16.7
3		Livelihood support	1,500	15.8
4		Local area development	2,850	30.0
5		Institution & Management	831	8.8
6		Planning and design	485	5.1
7		Administrative overheads	10	0.1
8		Monitoring & Evaluation	330	3.5
9		Training & Capacity Building	542	5.7

	Expenditure Item		Total PKR (Million)	Total US$ (Million)
10		Contingencies (Physical and price)	9,611	101.2
		Total Cost RAP	**37,881**	**398.7**

The cost of implementing SRMP is presented in **Table 15.**

Table 15: Cost of implementation of SRMP

No	COST ITEM	Total PKR (Million)	Total US$ (Million)
1	Public Consultation and Participation Plan	50	0.5
2	Resettlement Action Plan	37,881	389.7
3	Public Health Action Plan	1425	15.0
4	Grievance Redress Plan	190	2.0
5	Communications Plan	81	0.8
6	Management Plan for Construction-related Impacts	0	0
7	Downstream Fishing Communities: baseline & impact assessment	475	5.0
8	Safeguard Implementation & Monitoring Plan	375	3.9
	Total Estimated Cost	**40,480**	**426.1**

10. Stakeholder Consultations and Disclosure

10.1. Overview

Extensive consultations were carried out during the detailed design phase of the project, primarily through community consultations, *jirgas* and stakeholder consultation workshops. Community consultations involved multiple methods – for example, household level interviews, participatory rural appraisal (PRA), community meetings, and focus group discussions (FGD). Given the cultural context, key issues were largely addressed by community elders at *jirga* meetings. In some sense, standard participatory tools such as PRA and FGD and small group meetings are constrained by the tribal political and decision-making systems. Therefore, *jirga* meetings are the predominant modes for disclosure and decision-making in the project area.

A total of 2,392 persons were involved in various consultation meetings at the project sites and consultation workshops (**Table 16**) between April 2012 and October 2012.

Table 16: Number of persons covered in various Consultation Meetings

	Activities	No. of participants
1.	Social environmental surveys and inventory survey	1,435
2.	*Jirga* meetings, consultation meetings	718
3.	National consultative workshops	239
Total		**2,392**

10.2. Community Consultations

The main issues discussed with affected persons and communities are listed in **Table 17** and how these issues are addressed and incorporated is also shown in this table.

Table 17: Key issues raised in community consultations

Issues	Description	Action Point
Compensation for land and other assets	The compensation issues and rates are of importance both to affected persons (APs) and WAPDA. The local demands have been for the rate applied in the case of Basha Diamer Dam upstream. Land acquisition (LA) notification has not been set yet by Dasu District Revenue Officer (DRO). In view of the absence	Resettlment Action Plan has been prepared

Issues	Description	Action Point
	of cadastral surveys/maps, it is important to prepare the maps and records first with community and jirgas inputs. However, the affected communities want WAPDA to fix the rate prior to Section 4 notification. A recent jirga formed a committee to discuss this with WAPDA Project Office.	
Resettlement Site development	Affected communities want to relocate to higher elevations, to sites of their own choosing in the hills with basic amenities to be built at project costs. People expressed their concerns regarding access roads to new sites at upper elevations, water, power and irrigation systems for terrace cultivation.	Resettlement sites will be developed with all basic amenities and access roads. Provisions for land development for terrace cultivation and irrigation are included in the resettlement sites design.
Job and Employment	The affected communities/sub-tribes demand full employment in the project during construction and in post-construction periods. In one of the jirga meetings, a request was made for vocational schools for boys and girls to prepare the affected persons for employment in the project. Accordingly, In addition, some outside employment or overseas employment opportunities are also expected by local APs.	WAPDA has also taken initiatives to conduct pilot training for candidates selected in batches from project affected households.
Livelihoods	The traditional terrace cultivation by the sub-tribes will be affected due to relocation and lack of terraced land in upper elevations. Thus, alternative livelihood after relocation must be explored since the vocational training mainly focuses on the limited scope of APs, namely, youth with at least completed primary education.	A long term livelihood restoration plan is developed.
Environmental and Social Issues	Despite community-based preferred relocation, it will bring some disruptions- for example schooling, access to market and health clinic. Two suggestions were made at meetings: (i) reforestation as an alternative livelihood after relocation, and (ii) the agro-ecosystem of the affected area and need for new irrigation support.	A long term livelihood restoration plan is developed.
Health and safety issues	The health and safety issues during dam construction were discussed. Local people are concerned about migrant workers for dam construction, noise and air quality issues, and heavy traffic on KKH during the construction period. It was claimed that the dam will affect community health and well-being and will impact on their limited and fragile social infrastructure.	ESA includes issues relating to traffic management, community health as well as safety
In-migrants and Outsiders	This has been flagged in the community level meeting as a very big concern by the affected communities. The "outsiders" – for example, construction workers, construction material suppliers and service providers (such as chefs, grocers, barbers, etc.) are required, in addition to local human resources. However, local villagers have "mixed" feeling about the outsiders moving in to work, including potential cultural and social conflict.	A plan on In-migrant Management is prepared.

10.3. Consultation Workshops

A summary of comments and suggestions received in the consultation workshops is given in **Table 18.**.

Table 18: Summary of Discussions in Consultation Workshops

Comments and suggestions	Action Point/Response
Development of an agricultural terrace in the hilly areas will take several years of effort and hard work. Development of agricultural terraces to be considered for the affected households in their new resettlement areas.	Agricultural terraces will be developed in the resettlement sites.
Physical cultural resources in the area are to be properly documented.	ESA addresses issues relating to PCR and proposes mitigation as well as enhancement measures.
The people in Kohistan have a unique social culture, which may be affected by resettlement.	The social structure of the affected people will not be disturbed and will remain same. Relocation of the affected people will be still within their annual migration range.
It is apprehended that existing health facilities will not be enough to meet local and inward migrant workers' need. How	A public health action plan has been developed. Public health issues such as safe drinking water, safe disposal of sewage, safe collection and disposal of solid waste,

Comments and suggestions	Action Point/Response
the Project will address these health needs?	protection against dust and community health are considered as part of EMP.
Protection of aquatic flora and fauna should be considered in project design. Requirement of environmental flows for the sustainability of downstream habitat is to be assessed.	Environmental flows will be designed for the Project
KKH is life line of northern areas as it is only highway connecting northern areas with rest of Pakistan. Impact of construction traffic on KKH has to be assessed.	A traffic management plan is prepared to address the traffic related issues along KKH and along the access roads to the Project sites.
Impacts during demobilization of contractors are to be considered in the EIA	Contractors' demobilization is considered in the EMP and ECPs.
WAPDA shall have an Environmental Monitoring Unit at Project Site for supervision of EMP implementation.	An Environmental Unit is recommended for both DHP (WAPDA) and supervising consultants.
Initial filling of reservoir may affect the downstream release of water to Rabi crops	The first water filling of reservoir will be carried out slowly at the rate of 1 m/day. The rest of the river water will be allowed to flow downstream of the dam through LLO. No impact on Rabi crop will be expected. The first reservoir filling will take over 8 months to complete.
Low flow season operation of the dam and its impact on aquatic life to be considered.	The reservoir will be operated as a run-of-river project (base load plant). There is limited storage of water in the reservoir and whatever water will be used for generating electricity will be returned to the river. In this way a guaranteed environmental flow will be maintained towards downstream habitat.
Project design shall consider geo-hazards (landslides and earthquakes) in the area.	The Project is designed complying with guidelines of International Commission on Large Dams (ICOLD) to deal with geological and geomorphological hazards. State of art engineering modeling was carried out for the design of the dam.
Floods from glacial lake outburst floods (GLOFs) will be a serious risk to the Project. Early warning system for flood forecasting is necessary for the safe operation of the Project.	Design flood (Probable Maximum Flood) of the Project considered extreme flood events from GLOFs and extreme rainfall events. A flood telemetry network will be established in the upstream of Dasu for early warning system and better management of floods.
Security issues are to be considered during implementation of the Project.	Security situation in the Project area is assessed and a plan is prepared to address these issues in one of the SRMP volume on 'Hydropower Development, Conflict and Security Issues: A Perspective'
Historical and archeological sites are to be protected. DHP should support the Archeology Department of Peshawar for protection of Shatial rock carvings, a designated archeological site.	The PCR plan considered the protection of Shatial rock carvings.
Impact on the community and their livelihood due to relocation to higher elevation.	A livelihood restoration program is proposed in RAP with both short term and long term goals to mitigate any impacts on livelihood.
Community based conservations should be promoted. The conservancy at Kaigah where Markhor is protected by private arrangement and selling one trophy annually for $100,000 is good example.	The Project identified a suitable site in the Project area (Kandia valley) for development of similar community based conservation.
Traffic on KKH requires careful planning if construction of Basha and Bunji projects start along with Dasu.	Traffic is considered as a part of the cumulative impact assessment
There are no proper health facilities in Kohistan. Health and safety of construction workers and host community need to be planned.	A public health action plan is prepared to address these issues.
Indus valley is a flyway for migratory birds from Siberia to the Subcontinent. Impact of transmission line on birds' migration has to be assessed.	Bird collision and electrocution are potential threats on migratory birds. These issues will be addressed in the Transmission line EIA
Electromagnetic waves from transmission lines and their impact on human health to be assessed.	These issues will be addressed in the Transmission line EIA

Comments and suggestions	Action Point/Response
Cumulative impacts of hydropower development on Upper Indus Basin on Lower Indus Basin should be monitored.	The present assessment limits its scope of Upper Indus Basin (Tarbela Catchment). A detailed study is in pipeline from WCAP on 'Strategic/Sectoral Environmental and Social Assessment of the Indus Basin'
Impact on migratory birds and important bird areas to be assessed.	The DHP reservoir may have a positive impact as staging area on the migration of birds.
Indus river ecology should be protected. Feasibility of fish ladders should be studied.	Detailed studies on terrestrial and aquatic ecology were under taken as part of environmental assessment of the Project.
The Project design should consider geological hazards (seismic activity and faults) in the Project area.	The Project is designed complying with guidelines of International Commission on Large Dams (ICOLD) to deal with seismicity and faults. State of art engineering modeling was carried out for design of dam.
Climate change impacts may trigger GLOFs, high erosion and sedimentation; and finally may affect the Project.	A climate change assessment study was under taken as part of EA.
Habitat management plan for endangered species is to be proposed.	A community conservation area is proposed for protection of important fauna in the project area such as Markhor, Musk deer, Monal and Tragopan pheasant.
Lost community facilities in the affected villages are to be restored in the new resettled villages.	All basic amenities like roads, water supply, irrigation, sanitation, schools and any other facilities that were lost will be built in the new resettlement areas.
Involvement of local community in planning and development process is very important.	Consultation meeting were carried out in all the project villages through PRA techniques.
Ensure timely & frequently stakeholders meetings for suggestion and feedback.	WAPDA has established a full time office at Dasu which is constantly providing a forum to consult on any and all issues. An Executive Engineer of WAPDA heads the office. DCO is also involved.
Proper compensation of affected community is needed, to make it more transparent & clear; affected persons be given proper guidance.	Recommended in RAP.
Capacity of WAPDA in term of human resources needs to be increased to address social and environmental issues.	Field level social and environmental units will be established in DHP.
Potential livelihood and income generation activities to start	Short term and long term livelihood restoration plans are recommended in RAP
Education sector is very important in this area. Focus on Education & Health sector.	Education and heath will be considered in the social development plan and benefit sharing of the Project
Involvement of women is very important. Design livelihood livestock related activities for women.	A Gender Action Plan is prepared.
Mobilization of women for capacity building related to income generation activities need to be more focused	A Gender Action Plan is prepared.
Invertebrate fauna / aquatic flora should be addressed	These are part of aquatic ecology assessment
Establishment of a fish hatchery	A fish hatchery will be established, initially for research and development (R&D) and later for full scale development when farming of snow trout is feasible in the reservoir.
Motivate local people for terrace farming.	Recommended in RAP
Livestock farming through providing quality animals breeds	Recommended in RAP

10.4. Disclosure

The updated EIA will be submitted to KP- EPA on 16 December 2013. A Public Hearing is expected to be held in Dasu in February, 2014, which will be about 30 days after the submission of the EIA, which is in accordance with the ESA review and approval process in the Country. Organized by the KP-EPA, the Hearing will be attended by WAPDA officials, media, local representatives, and most importantly, local community members. The ESA summary has been translated in Urdu. Both the Urdu and the English version will be distributed to local authorities and relevant stakeholders. The Summary and the ESA document have been published on the website of WAPDA.