PAKISTAN

WATER AND POWER DEVELOPMENT AUTHORITY

ATTABAD LAKE HYDROPOWER PROJECT

FEASIBILITY STUDY

VOLUME 6

ENVIRONMENTAL AND SOCIOECONOMIC IMPACT ASSESSMENT

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HYDRO PLANNING ORGANIZATION

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ATTABAD LAKE HYDROPOWER PROJECT
LIST OF VOLUMES

LIST OF ABBREVIATION

A	
ADB	Asian Development Bank
AKCSP	Aga Khan Cultural Service Pakistan
AKDN	Aga Khan Development Net Work
AKF	Aga Khan Foundation
AKHS	Aga Khan Health Service
AKRSP	Aga Khan Rural Support Programme
C	`
CBM	Confidence-building measure
CBOs-	Community-based organizations
CPEC	China Pakistan Economic Corridor
DLP	Defect Liability Period
E	
EIA	Environmental Impact Assessment
EL	Elevation Level
EMMP	Environment Monitoring Management Plan
EOT	Electric Overhead Bridge Type Traveling
EPA	Environment Protection Agency
ESIA	Environmental Impact Assessment
G	
GB	Gilgit-Baltistan
GEF	Global Environment Facility
GHG	Green House Gases
GLOF	Glacial Lake Outburst Floods
GSP	Geological Survey of Pakistan
H	
ha	Hectare
HPO-	Hydro Planning Organization
HPP	Hydropower Project
I	
ICT-	Information and Communication Technologies
IEE	Initial Environmental Examination
IRS	Indus River System
IUCN	International Union for Conservation of Nature
K	
KKH	Karakoram Highway

LIST OF ABBREVIATION

KNP-	Khunjerab National Park
KPK-	Khyber Pakhtunkhwa
L	
LAA	Land Acquisition Act
LGO	Local Government Ordinance
M	
MASL	Meters Above Sea Level
MBT	Main Boundary Thrust
MKT	Main Karakoram Thrust
MMM	Mitigation Management Matrix
MMT	Main Mantle Thrust
MW	Mega Watt
N	
NA	Northern Areas
NCS	National Conservation Strategy
NEQS	National Environment Quality Standards
NGO	Non- Governmental Organizations
NOC	No Objection Certificate
P	
PAP	Project Implementation and Resettlement of the Affected Persons
PEPA	Pakistan Environmental Protection Act
PEPC	Pakistan Environmental Protection Council
PMAC	Program for Mountain Areas Conservation
PPC	Pakistan Penal Code
R	
RAP	Resettlement Action Plan
RNR	Renewable Natural Resources
S	
SC	Supervisory Consultants
SWHP	Surface Water Hydrology Project
T	
TOR	Terms of Reference
U	
UNDP	United Nations Development Program
V	
VO	Village Organizations

LIST OF ABBREVIATION

W

WAPDA	Water and Power Development Authority
WCSDO	Wildlife Conservation and Social Development Organizations
WCS	Wildlife Conservation Society
WHO	World Health Organization
WUO	Water Users' Organizations
WWF	World Wide Fund

UNITS: CONVERSION FACTORS: SI TO FPS

Length	To convert from	to	Multiply by
	m	ft	3.281
	cm	ft	0.0328
	km	ft	3,280.84
	m	mi	0.0006214
	km	mi	0.6214
Area	m^2	ft^2	10.764
	km^2	mi^2	0.3861
	m^2	acre	0.0002471
	km^2	acre	247.105
	hectare	acre	2.471
Volume	m^3	ft^3	35.315
	m^3	US gal	264.172
	m^3	UK gal	219.969
	L	ft^3	0.035315
	m^3	Acre Feet	0.000810714
Velocity	m/s	ft/s	3.281
	cm/s	ft/s	0.03281
	m/s	mi/h	2.237
	km/h	mi/h	0.622
Acceleration	m/s^2	ft/s^2	3.281
Mass	kg	lb_m	2.205
	kg	ton	0.00110
Pressure and Stress	Pa or N/m^2	psi	0.000145
Discharge	m^3/s	ft^3/s	35.315
	L/s	ft^3/s	0.035315
	m^3/s	US gal/min	15850.3
	m^3/s	UK gal/min	13198.2
	L/s	US gal/min	15.850
	L/s	UK gal/min	13.198

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1 INTRODUCTION

1.1 GENERAL

Gilgit-Baltistan, formerly part of the Northern Areas, is the northern most administrative territory of Pakistan. Gilgit-Baltistan lies at the extreme north of the country with borders joining Xinjiang Province of China in the north, Chitral in the west and Kalam, Kohistan and Kaghan valleys in the south. Towards the east are the Indian occupied territories of Ladakh and Kashmir. Gilgit-Baltistan is linked via the Silk Route: i.e. the Karakoram Highway which starts from Mansehra district of Khyber Pakhtunkhwa and ends at the Khunjerab Pass of Hunza District where the road continues into China.

Administratively, the Gilgit-Baltistan is divided into 10 districts: Gilgit, Ghizer, Hunza, Nagar, Skardu, Ghanche, Shigar, Kharmang, Diamer and Astore. Previously there were seven districts in the region. In 2016, the number rose from seven to ten after the addition of 2 districts in Baltistan region and the bifurcation of the Hunza-Nagar district. As of 2021, there are 10 districts in the entire region, four in the Baltistan Division, four in the Gilgit Division and two in the Diamer Division. In 2019, Darel, Tangir, Gupis–Yasin and Roundu were announced as new districts by the GB Cabinet, but so far these districts are not notified officially.

Figure 1-1: District and Tehsil Boundaries of GB

Tourism in Pakistan is a growing rapidly. One renowned travel guide book termed Pakistan "tourism's next big thing". Pakistan was also ranked “the best holiday destination for 2020” and

was also declared the third-highest potential adventure destination in the world for 2020 by a travel magazine.

Gilgit-Baltistan is home to five of the "eight-thousanders" out of fourteen and to more than fifty peaks above 7,000 meters (23,000 ft). The region is home to some of the world's highest mountain ranges. The main ranges are the Karakoram and the western Himalayas. The Pamir Mountains lies at the north, and the Hindu Kush lies to the west. Amongst the highest mountains are World's 2nd highest peak 'K2' (Mount Godwin-Austen) and World's 9th highest peak 'Nanga Parbat'. Three of the world's longest glaciers outside the polar regions are located in Gilgit-Baltistan: the Biafo Glacier, the Baltoro Glacier, and the Batura Glacier. There are, in addition, several high-altitude lakes in Gilgit-Baltistan

Hunza Valley was composed of two independent kingdoms: Hunza and Nager in the early 1600s. Hunza is located on the branch of the ancient Silk Route from Kashgar to Kashmir and is linked to Turkistan/western China since ancient times.

Hunza is one of the primary destinations in Pakistan and is the center piece of tourism in the northern region. The major valleys in Hunza are Nilt, Nagar, Shimshal, Morkhun, Chapursan and Hanging Glacier in high Karakoram Range. The climate varies widely from monsoon-influenced moist temperate to arid and semi-arid cold deserts in the north. Below 3000 m.a.s.l, precipitation is less than 200 mm per annum while there is a sharp precipitation gradient along the altitude, and over 2,000 mm annual snow fall above 6000 m.a.s.l. Climate of the area is cold arid with moderate dry summers and severe winters.

Figure 1-2: Affected Area of Attabad Village

Attabad Lake was created due to a massive land slide in January, 2010. Water and Power Department of Gilgit Baltistan intends to utilize this storage as an opportunity to develop Hydropower Project of appropriate capacity utilizing this potential in order to meet the ever increasing demand of Hunza district and its suburbs.

1.2 LOCATION

The Attabad Lake HPP is located in the Gilgit-Baltistan. The site of the project is located on Hunza River at Attabad Lake about 15 km upstream from Ganish Bridge of Hunza. Its distance is about 20 km from Hunza, 115 km from Gilgit. The powerhouse location is on the left bank of river and easily accessible from Karakoram Highway. The intake weir/dam site is selected at current exit point of Attabad Lake which was formed in the year 2010 due to a huge slide from right bank mountain.

The Hunza River is joined by several tributaries like Chapursan, Khunjerab, Ghujerab, Shimshal and Hisper Rivers. Nagar is the nearest district to Hunza and its capital is 25 km from the project site.

1.3 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

The ESIA is the planning tool developed in recent years to foresee the environmental and social impacts of human intervention in nature arising from development projects. Major hydropower and storage dam projects invariably result in many far-reaching environmental, ecological and socio-cultural changes. Some of these changes benefit human population, while others threaten the natural resource base on a short or long term basis.

The undesirable changes are not solely restricted to increasing pollution or loss of natural resources and habitats for native flora and fauna, but they cover the entire range of environmental and social components, such as soil, water, air, and socio-economic and cultural system. It is now accepted fact that for sustainable economic development, strategies must be compatible with environmental goals. This requires the incorporation of environmental consideration into the process of development. It is important to make choices and decisions that will eventually promote sound development by understanding the environmental functions under the exercise of power conferred by Section 33 of PEPA, 1997, EPA, Pakistan with the approval of the Federal Cabinet has promulgated EPA Regulations, 2000. These regulations provide the basis for the screening of a Project as per Project size and magnitude. The subject Project falls under the Schedule II of category E, which is related to Water Management, Dams, Irrigation and Flood Protection with criteria that dams and reservoir with storage volume of 50 Mm^3 and above or surface area greater than 8 km^2 and hydro projects above 50 MW of installed capacity requires an EIA. Attabad Lake Hydropower Project has installed capacity of 54 MW having reservoir surface area of 4.5 km^2, therefore, it requires an EIA for the issuance of NOC from the concerned EPA.

The negative environmental and social impacts of a development project are avoided or minimized through the ESIA and where adverse impacts cannot be avoided, the mitigation measures and resettlement activities are conceived and executed as part of the project.

The overall objectives of an Environmental and Social Impact Assessment in accordance with the Pakistan Environment Protection Act (PEPA 1997), and the World Bank guidelines (OP 4.0) include the following:

- Help ensure the environmental and social soundness and sustainability of projects.
- Support integration of environmental and social aspects of projects into the decision making process.
- Promote environmentally sustainable development by supporting the protection, conservation, maintenance, and rehabilitation of natural habitats and their functions
- Avoid or minimize involuntary resettlement and if not feasible, to assist displaced persons in improving or at least restoring their livelihoods and standards of living in real terms relative to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.
- Design and implement projects in a way that fosters full respect for indigenous peoples' dignity, human rights, and cultural uniqueness and so that they: (a) receive culturally compatible social and economic benefits; and (b) do not suffer adverse effects during the development process.
- Assist in preserving physical cultural resources and avoiding their destruction or damage.
- Assure quality, health and safety in the design and construction of new dams and the rehabilitation of existing dams, and in carrying out activities that may be affected by an existing dam.
- Enable vulnerable and disadvantaged stakeholder groups to participate in an informed manner.

1.4 PROJECT CATEGORIZATION

According to Pakistan Environment Protection Agency regulations for review of IEE and EIA, hydroelectric projects with a generation capacity of over 50 MW and power transmission lines with a capacity more than 11 kV fall into Schedule-II, i.e. projects requiring EIA. Similarly, in accordance with the guidelines of the World Bank, the Asian Development Bank and the Japan Bank for International Cooperation Environmental guidelines, the Attabad Lake HPP (with a planned generating capacity of 54 MW and 132 kV power transmission lines) would fall within the category 'A' projects could be having significant impacts on the environment and requiring a full scale EIA.

1.5 SCOPE AND LIMITATIONS OF ESIA

1.5.1 Scope

The scope of the study proposed by WAPDA in the Terms of Reference (TOR) for this feasibility study includes this ESIA which only covers the dam site, reservoir, powerhouse areas and transmission systems. Resettlement Action Plan (RAP) is not under consideration as there is no displacement of people involved. Team of Engineers from Hydro planning have envisaged the following Statement of Work related to environmental studies:

a. Review of national and local guidelines, laws and policies;

b. Review of all relevant existing data, studies, reports and drawings;

c. Avoid, minimize, mitigate and the potential significant environmental and social impacts due to the proposed intervention;

d. Collection of baseline data related to Physical, Ecological and Social environmental aspects;

e. Identification, evaluation and categorization of the potentially significant adverse physical, ecological and socio-economic impacts on the local environment during the construction and operational stages of the proposed Hydropower Project;

f. Recommend appropriate environmental and social mitigation measures for the identified adverse impacts and monitoring plans to address them;

g. Preparation of Environment Monitoring Management Plan (EMMP);

h. Cost estimate for environmental setup;

i. Public consultation and disclosure;

1.5.2 Limitations

The baseline information documented in the present report reflects the prevailing physical, biological and socio-economic conditions of the project area. The project is at feasibility stage and the detailed design and tender documents preparation stages will follow during the execution. If the project is implemented after two years of completion of the feasibility stage then certain variables such as development of infrastructure, population growth, increase or decrease in the forest, land use, cropping patterns and economic conditions could be changed significantly.

1.6 APPROACH AND METHODOLOGY

1.6.1 Review of Previous Studies

Attabad Lake Hydropower Project was conceived by Water and Power Department, Govt. of GB for 32.5 MW. Consequently, a Feasibility Study was conducted by the Water & Power Department Gilgit Baltistan through Consultants. No detailed EIA was required for less than 50 MW installed capacity. Only Initial Environmental Examination was carried out to fulfill the requirement of the Pakistan Environmental Protection Agency (PEPA) by the consultants engaged by Govt. of GB. Later on the request of Govt. of GB, WAPDA updated the feasibility study of the project with

enhanced capacity of 54 MW and for such project, detailed environmental and social impact assessment study was required.

The following earlier project reports have been reviewed to assess their applicability in the prevailing environmental conditions specially in Gilgit Baltistan region:

- Bunji Hydropower Project: Feasibility Study Report (Vol-III), Environmental Impact Assessment by Bunji Hydropower Consultants (March 2005).
- Detailed Engineering Design Report of Phander Hydropower Project.
- Feasibility Study Report of Shyok Dam Project, Environmental Impact Assessment Study.
- And Various Other Reports Related to Gilgit Baltistan.

1.6.2 Acquisition of Secondary Data

The secondary data was collected from various offices and published reports of different organizations in the Gilgit Baltistan. These organizations included Water & Power, Education, Forest, Agriculture, Fisheries, Sanitation, Wildlife, Environmental Protection Agency, District Administration, Tehsil Offices, Local Councils and others. The studies are carried out on the information received during field visits of Project area, data received from some NGOs, water samples collected from project area at various places and tested in Gilgit-Baltistan Environmental Protection Agency Laboratory, Gilgit, climate data received from Metrological department, and other data taken from earlier conducted feasibility study and other reports of projects.

1.6.3 Collection of Primary Data

The primary data were collected and assessed with reference to different project components, i.e. dam site, reservoir area, powerhouse, construction camps etc. The data regarding climate, hydrology, geology, seismology, neo-tectonics and other physical features of the project area were also obtained as part of the preparation of this feasibility study. Data collected from the villages as shown in the Figure1-3

i. Vegetation Studies

The assessment area for terrestrial flora and fauna encompasses the terrestrial environments upstream and downstream of the dam and adjacent areas that may be affected by the project activities, specifically from the dam to the upper end of the reservoir impoundment and from the dam to the powerhouse.

Since the lake was formed in January 2010 and no new area would be submerged with the project except the powerhouse site, therefore, there would be no new threat to plants with the construction of hydropower project. However, concentration was given to study the rare species and special emphasis was given to the economic species such as medicinal plants.

ii. Wildlife Fauna Studies

Information on wildlife fauna species (mammals, amphibians, reptiles, birds etc.) in the assessment area was compiled based on opportunistic observation, gathering the existing information and consultation with local experts, community members and government and non-government organizations.

iii. Aquatic Ecology

Generally Northern Area are blessed with great water resources comprised of rivers, streams, and alpine lakes fed by the snowmelt and glacier waters. These freshwater resources harbor several fish species, which are the important component of the biological diversity. The fish fauna in Hunza Valley is relatively poor due to high turbidity, low water temperature and high water speed.

iv. Environmental Flow Study

An environmental flow study was carried out to determine the optimum environmental flow downstream of the proposed dam for sustainability of the aquatic ecosystem. The study is based on the hydrological data 50 years obtain from Surface Water Hydrology Department WAPDA that involves analysis of river flow data coupled with aquatic ecosystem analysis.

v. Social Surveys

The purpose of social survey was to record the present conditions of the people living in the project area and to assess the expected project impacts on their life, subsistence systems, and social and cultural conditions. Prior to conducting the field surveys, the following steps were taken:

- Geographic boundaries of the project area were identified and existing villages and settlements were listed.
- Decided the sampling procedure in order to draw a representative sample size of the target population and households
- Developed the tools for data collection i.e. questionnaires for household sample survey, village profile, women sample survey, community participation and water use.

In order to obtain comprehensive and detailed information, the following techniques and tools of data collection were used.

vi. Sampling Design

A stratified proportionate random sampling technique was applied to select adequate and representative samples to generalize survey findings at the project level. The stratification variables were taken into consideration for enhancing the representation level for adopting appropriate sampling design.

vii. Stratification Variables

The major objective of the study was to establish baseline socio-economic conditions for the inhabitants near the existing reservoir upto original extent of lake formed in 2010, powerhouse and adjacent areas of the project. The following factors were taken into consideration for enhancing the probability of every household being selected in the sample size:

Each village was included in the sampling frame because of the heterogeneity of socio-economic characteristics between villages and relatively homogeneity within a village.

viii. Sampling Unit

The primary sampling unit for the socio-economic survey was the head (male or female) of the household falling within the nine sample villages of proposed Attabad Lake Project area.

ix. Basic Unit of Study

The basic unit of study and analysis for the purpose of socio-economic investigation is nine villages of project area for Attabad Lake Hydropower Project.

x. Questionnaires

In order to test the validity and reliability of the proposed questionnaires, interviewing guides were pre-tested in the area and then the questionnaires were reviewed to assess whether questions needed to be clarified, changed or re-sequenced and then a final editing of questionnaires was conducted prior to their subsequent application in the real sample areas.

List of Respondents of socio-economic survey is attached at **Appendix-A** The different questionnaires used for the social survey are included in **Appendix-B** of this volume.

xi. Field Investigators

A team of experts of Hydro Planning Organization moved to project area for field investigations. The team hired services of one local graduate lady and one local graduate man for questioning and answering with local people in their language. The team spent more than three weeks to visit seven villages of upstream and two villages of downstream side of the project area. In this exercise both genders were covered in field visits of project area. The role playing exercises provided the field investigators with the ability and confidence to establish a rapport with the respondents as well as other interviewing skills in order to minimize the no sampling error, wrongly asked or interpreted or recorded answers. The services of a local well educated female were hired for the data collection on the subjects of gender and women empowerment.

xii. Interviewing Guide for Community Participation

Well informed persons in the village were interviewed by using a questionnaire to obtain information about village and their perceptions about the project.

xiii. Household Sample Survey

Household heads of total sample size from each sample village of the project area were interviewed by using structured questionnaires. Detailed information about the socio-economic status of the family and household was obtained from the respondents.

xiv. Village Profile

A comprehensive village profile was prepared to document the socio-economic and demographic data of each sample village in project area.

xv. Gender Survey

The experts developed a separate questionnaire covering various aspects and issues of women in the area. The services of a qualified local female were hired for this survey. Women from all the villages were interviewed. Respondent women were selected by applying the same technique as used for socioeconomic survey.

xvi. Data Editing

The filled-in questionnaires and interviewing guides were edited by the same field investigators, who were involved in the data collection. This was done immediately after completing the field investigations.

xvii. Data Analysis

Data sets were processed after the completion of the field survey and editing of socio-economic information. Analysis of this diversified data and preparation of conclusions in the minimum possible time was achieved using statistical techniques of data analysis.

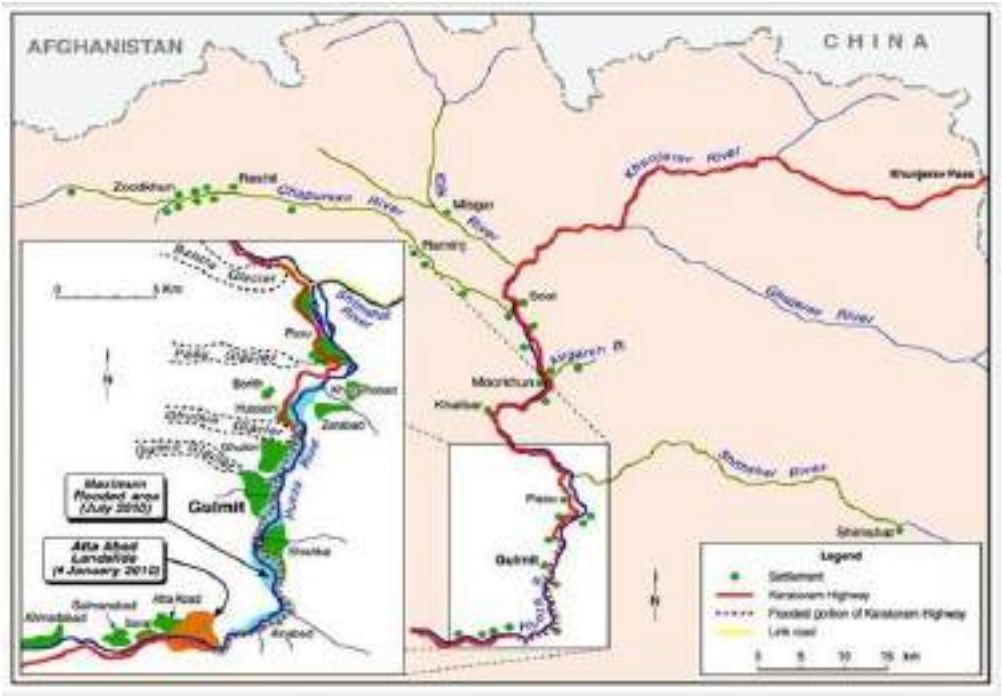

Figure 1-3: Extent of Attabad Lake showing Villages

2 Project Description

2.1 BACKGROUND

The Hunza region is facing acute shortage of power resulting in long hours Load Shedding in the area, especially the conditions become worse in winter season, due to low flows in streams. Presently, there is high supply and demand gap; therefore, load shedding is common in summer, while it becomes very acute in winter. The commercial and industrial demand is partly fulfilled from privately owned diesel generators. The diesel generators are mainly used by the hotels, small businesses, banks and other consumers which can afford the high running cost. Apart from the cost the use of these diesel generators is creating environmental pollution (i.e., noise and air), which is also affecting the tourism in the area. The expected fast growth in tourism industry will immensely increase the electricity demand in future, if not planned properly and addressed timely, it will most likely create a crisis like situation in the near future.

2.2 PROJECT INTRODUCTION

Attabad Lake Hydropower Project is proposed on Attabad Lake which is located on the Hunza River in the Hunza District of the Gilgit-Baltistan. Attabad Lake was created due to land slide dam formed in January, 2010 due to a huge landslide from right bank of Hunza River at Attabad about 15 kilometers upstream of Ganish Bridge and about 111 kilometers upstream of Gilgit.

The project has been sized as per flows availability, size of conveyance system and surface powerhouse executable under prevailing topographic and geological features. The plant size of 54 MW will provide the installed power during peak hours throughout the years. The off-peak power would remain from 20 to 54 MW in six winter months, while in six summer months, 54 MW would be available for 24 hours.

A weir/dam will be constructed to divert the flow of Hunza River into Head Race channel, 2300 m long nearby Karakoram Highway. Before construction of weir, a deep flushing channel/ under sluices structure would be constructed in order to lower down the level of lake and to evacuate the water from lake on the left side of existing outlet. The under sluices structure will also act as flushing of sediment from the lake once project comes into operation. The diverted water enters into the head race tunnel 2300 m long. The tunnel is followed by surge shaft. Water will enter into 450 m long penstock pipe branching into three units at the end through manifold. These high-pressure penstock pipes and feed three turbines, for the generation of 54 MW hydropower. Layout of the Project is attached at **Drawing-I**.

The project is proposed to be developed on Hunza River at Attabad Lake with design discharge 60m^3/s to generate the rated power round the year. This project will enhance the generation capacity and augment the power supply network of entire Hunza-Nagar Valleys and Gilgit Town. Once completed and operational this project will help improve the power supply situation in the region.

The salient features of the envisaged power supply project are given as follows;

- Type of Development: High Head Run of River with Peaking
- Gross Head: 111.7 m
- Net Head: 105.5 m
- Installed Capacity: 54MW
- Type of Turbine: Francis (Vertical)
- No. of Units: 03
- Design Discharge (Q_d): 60.00 m^3/s (20 m^3/s to each unit)
- Overflow Weir Length: 60 m
- No. of Undersluices: Three (03)
- Undersluice Gate Size: 5m x 5m
- Power Tunnel Length: 2300 m
- Penstock Length: 450 m
- Type of Powerhouse: External
- Annual Energy: 373.69 GWh
- Plant Factor: 79 %

2.3 PROJECT COMPONENTS

2.3.1 Civil Works

2.3.1.1 Main Weir

The weir is located on the natural spillway of Attabad Lake. It will be an overflow type weir having 60 m width. Crest of weir is located at 2414 m.a.s.l. and has been designed to pass the flood of 3,250 m^3/s along with undersluice. The existing spillway will be treated and given a proper shape of a weir. Grouting and cutoff wall will be provided to keep the structure safe from any kind of seepage.

2.3.1.2 Undersluice

The undersluice channel is provided for the diversion of flow during the execution stage and for sediment flushing during operation stage of the project. Life of Attabad Lake will be maintained by flushing the sediments during most months of the year. A rectangular shaped Undersluice channel has been proposed at an elevation of 2402 m.a.s.l having width of 20 m.

2.3.1.3 Power Intake

The Intake will be the structure built to divert the design flow from the lake towards the headrace for onward transmission to the proposed power house. The intake would ensure proper & efficient working besides adherence to the hydrology of the River during low flows, normal flows and maximum possible flows.

Intake structure has been proposed at the point where the earthen embankment meets the face of left bank mountain in the rocks exposed on left bank just closed to lake boundary. The sill level of intake structure has been proposed as 2404 m.a.s.l. The maximum and minimum operation levels of water have been kept as 2414 m.a.s.l. and 2412 m.a.s.l. respectively. A trash rack will also be provided at the front of intake structure to avoid the entering of unwanted materials.

2.3.1.4 Low Pressure Headrace Tunnel

A horse shoe type low pressure power tunnel of 5.2 m width has been proposed on the left bank of the river with diversion intake to cater the 60 m^3/sec design discharge for the power generation. Power Tunnel having 2300 m length passes through the stable rock portion on the left side.

2.3.1.5 Surge Shaft

Surge tank has been proposed to accommodate surges to facilitate maintaining water level in headrace tunnel.

The surge shaft is proposed have an internal diameter of 8.0 m and maximum surge level reaches upto 2440 m.a.s.l.

2.3.1.6 Penstock

One penstock will be laid down at the end of power tunnel to convey flow to powerhouse. The length of the penstock is about 450 m with diameter of 3.6 m. The thickness of steel is kept as 20 mm to withstand the water pressure. The initial 80 m penstock from surge tank would be pressure tunnel.

2.3.1.7 Power House

The external type powerhouse is proposed near the old Chinese camp at 2 km downstream of existing spillway of Attabad Lake. It will be constructed in front of Sarat village near the bridge on Hunza river. It is designed for three vertical Francis units. The approximate dimensions of the power house will be L x W x H are 45 m x 18 m x 22 m. The turbine level in powerhouse has been kept as 2300 m.a.s.l., and the level for draft tube has been proposed as 2293 m.a.s.l.

2.3.1.8 Tailrace channel

Tailrace Channel consists of an open channel forming part of power house structure and connecting to river Hunza. Tailwater levels varies for different situations. For normal operation when all three units are running the tailwater level reaches upto 2302.3 m.a.s.l. and during off

peaking it reaches to as minimum as 2301.5 m.a.s.l. The maximum tailwater level reaches at around 2307 m.a.s.l.

2.3.2 Mechanical Works

2.3.2.1 Turbines

The installed capacity of the Attabad Lake HPP shall be 54 MW with three units each having rated turbine output of 19 MW. Based on the technical and economical consideration and range of the head, Vertical Francis turbine have been selected for the Attabad Lake HPP due to the reasons that their part load operation is stable and the efficiency is high. The Vertical Shaft Francis turbines are selected for Attabad Lake HPP.

Each turbine shall be equipped with modern digital governor consisting of solid-state programmable microprocessor system of the electric-hydraulic PID type.

2.3.2.2 Inlet Valves

Butterfly valve is suggested for Attabad Lake HPP. The valve diameter as worked out shall be 1.83 m, operated by servomotors.

2.3.2.3 Cranes

One electric overhead bridge type traveling (EOT) crane of 100-ton capacity has been proposed for unloading and handling the powerhouse equipment at the loading/erection bay. Besides, the same crane shall be used for assemblies at the loading bay and for erection of plant.

2.3.2.4 Cooling Water System

Independent closed loop system for each unit has been provided for turbine and generator coolers.

2.3.2.5 Drainage System

The drainage system shall be designed to collect the Seepage water from different floors of the powerhouse. & leakage of oil from various components.

2.3.2.6 Mechanical & Electrical Workshops

For the day-to-day maintenance jobs of the power plant, mechanical and electrical workshops along with storage areas for essential tools will be provided under the erection bay of the powerhouse.

2.3.3 Electrical Works

2.3.3.1 Generators

Three Generators with rated output of 21.2 MVA each, rated power factor of 0.85 & rated Voltage of 11kV will be coupled with the Turbines.

2.3.3.2 Transformers

Three Unit step up Transformers be installed with Rated power of 22 MVA & Rated Voltage of 11 kV/132 kV each.

2.3.3.3 Control Panels

Digital Control panels be installed for overall control of the power house and auxiliary systems.

2.3.3.4 132 kV Transmission Lines

132 kV Transmission line of 27km (double circuit) will be constructed from Attabad Lake HPP to Aliabad. And 132 kV Transmission line of 70 km (single circuit) will be constructed from Attabad Lake HPP to Sost.

2.3.3.5 Grid Stations

132 kV switchyard will be constructed at Attabad Lake HPP.

2.3.3.6 Protections

Digital type Relays of latest version will be used for protection of turbines, generators and transformers.

2.4 SALIENT FEATURES OF THE PROJECT

Table 2-1: Salient Features of Attabad Hydropower Project

Location	Attabad village, Hunza District, Gilgit-Baltistan of Pakistan, 130 km west of Gilgit & 740 km north- of Islamabad	Design Discharge Gross head Installed Capacity Mean Annual Energy Plant Factor	60 m^3/s 111.7 m 54 MW 373.69 GWh 79 %
River Catchment Area Mean Annual Discharge Total annual volume	Hunza 8920 km^2 209 m^3/s 6591 mill m^3	Penstock Length Diameter Thickness	1 no. Embedded 450 m 3.6 m 20 mm
Weir Crest elevation Crest length Weir height Stone Pitching length	Lateral weir 2414 m.a.s.l 60 m 2.0 m 30 m u/s and 20 m d/s	Powerhouse Size Height Type of units No. of units	External slope type 45 m x 18 m 22 m Francis 3
Attabad Lake length Lake width Lake depth	14000 m 100 m 50 to 60 m	Tailrace Turbine level Max. Flood level	20 m, concrete lined 2300 m.a.s.l 2307 m.a.s.l
Tunnel length Size Type	2300 m 5.2 m diameter Horse Shoe	Firm Power Off peak winter Peak Summer	26 MW 18 MW 54 MW
Peaking Storage Full supply level Minimum supply level Gross Storage	5 Million m^3 2414 m.a.s.l 2412 m.a.s.l 123 Million m^3	Distance up to Gilgit Transmission Line upto Voltage level Areas to be served	130 km 70 km single circuit and 27 km double circuit 132 k V Hunza-Nagar, Gilgit, and Ghizar valleys

3 REGULATORY LAWS AND THE INSTITUTIONAL FRAMEWORK

3.1 GENERAL

This chapter deals with the National Policy, Regulatory Framework related to environmental protection, preservation and environmental assessment and approval procedures.

3.2 NATIONAL POLICY FRAMEWORK

The Federal Ministry of Environment (now called the Ministry of Climate Change) was established in Pakistan in 1975 as a follow up to the Stockholm Declaration of 1972. The Ministry was instrumental in the promulgation of the Environmental Protection Ordinance of Pakistan in 1983. The National Conservation Strategy (NCS) was formulated in 1992 which provides a broad framework for addressing various environmental issues and environmental conservation in the country. The Pakistan Environmental Protection Act (PEPA) was enacted in 1997 repealing the Ordinance of 1983. The Environmental Quality Standards (NEQS) were promulgated in December 28, 1999 after the approval of the Pakistan Environmental Protection Council (PEPC). The IEE/EIA Regulations were promulgated by the Pakistan Environmental Protection Agency (under Section 12, PEPA Act of 1997) in 2000. A revised version of NEQS was enforced in 2000. The Ministry of Climate Change was created in 2010 to deal with the threats posed by global warming and for environmental protection in the country. However, after the approval of 18th amendment in 2010, the matters related to environment became a provincial subject. The role of the Federal EPA is now limited to the federal capital and matters related to environment in each province has to be dealt by their own EPAs which are made more independent having their own laws related to the protection of the environment and procedures for the issuance of NOC for the development Projects.

The National Policy Framework encompasses the environmental issues which Pakistan is currently facing, especially pollution of fresh water bodies and coastal waters, air pollution, lack of proper waste management, deforestation and degradation of forest cover, loss of biodiversity, desertification, natural calamities and climate change.

3.2.1 National Conservation Strategy, 1992

The Pakistan National Conservation Strategy (NCS) was approved by the federal cabinet in March 1992 and as such formulates the principal policy document dealing with environmental conservation issues in the country. The NCS outlines the country's primary approach towards encouraging sustainable development, conserving natural resources, and improving efficiency in the use and management of natural resources.

The NCS has 68 specific programs in 14 core areas in which policy intervention is considered crucial for the preservation of Pakistan's natural and physical environment. The core areas that are relevant in the context of the proposed Project are pollution prevention and abatement,

restoration of rangelands, increasing energy production, conserving biodiversity, supporting forestry and plantation, and preservation of cultural heritage.

3.2.2 National Environmental Policy, 2005

The National Environment Policy while recognizing the goals and objectives of the National Conservation Strategy, National Environmental Action Plan and other existing environment related national policies, strategies and action plans, provides broad guidelines to the Federal Government Provincial Governments, Federally Administrated Territories and Local Governments for addressing environmental concerns and ensuring effective management of their environmental resources.

The main objectives of the Policy are:

a. Conservation, restoration and efficient management of the environmental resources;
b. Integration of the environmental considerations in policy making and planning process;
c. Capacity building of public sector agencies and other stakeholders at all levels for better environmental management;
d. Meeting international obligations effectively in line with the national aspirations; and
e. Creation of an atmosphere for environmental protection through mass awareness and community involvement.

3.2.3 National Forest Policy Pakistan, 2001

The goal of this policy is to foster the sustainable development of Renewable Natural Resources (RNR) of Pakistan, through maintenance and rehabilitation of these essential resources and enhancement of sustainable livelihoods of rural masses particularly women, children and other deserving groups.

The various components of the policy include the following:

a. Reducing poverty, powerlessness and unemployment;
b. Population planning in critical eco-systems;
c. Reducing the impact of socio-economic factors;
d. Providing substitutes to firewood in the mountain-woods;
e. Reducing political interferences in Forestry and Wildlife Departments;
f. Renovating and invigorating the institutions of RNR;
g. Supporting Local Governments in the sustainable development of their RNR;
h. Policies for fragile eco-systems;
i. Riverside forests;
j. Irrigated plantations;
k. Preservation of sensitive and unique forests;

l. Wildlife conservation;

m. Rangelands and desert eco-systems; and

n. Planting trees and fodder on farmlands.

3.2.4 National Power Policy, 2013

Then Ministry of Water and Power of the Government of Pakistan developed an ambitious power policy to support the current and future energy needs of the country. This bold strategy will set Pakistan on a trajectory of rapid economic growth and social development. Simultaneously, it will address the key challenges of the power sector in order to provide much needed relief to the citizens of Pakistan. This document will frame the broad contours of the energy policy articulating the vision for the power sector, highlighting its key challenges, setting major goals, summarizing policy principles, and highlighting the strategy devised to achieve Pakistan's aspirations.

3.2.5 National Electricity Policy, 2005

The National Electricity Policy is one of the key instruments for providing policy guidance to the Electricity Regulatory Commissions in discharge of their functions and to the Central Electricity Authority for preparation of the National Electricity Plan. The Policy aims at accelerated development of the power sector, providing supply of electricity to all areas and protecting interests of consumers and other stakeholders keeping in view availability of energy resources, technology available to exploit them, economics of generation using different resources and energy security issues. This also involves development of National Grid, development of Rural Electrification Distribution, reliability and quality of power supply to be monitored by State Electricity Commissions, measures to promote competition, exploitation of small hydro, solar, biomass and wind resources / opportunities for additional power generation, emphasis on achieving higher efficiency levels through renovation and modernization, speedy implementation of stringent measures against theft of electricity, full emphasis on augmentation of R&D base and appointing Ombudsman for redressed of consumers grievances among various others.

3.2.6 Federal Government Institutions

The Federal Ministry of Climate Change deals with the issues of environmental preservation and climate change at the federal level. Within the Ministry, the NCS Resource Center (RC) is responsible for using the Information and Communication Technologies (ICTs) by setting up a decision support system in the field of environment. In addition to serving as an information and knowledge repository for all stakeholders of environmental protection and sustainable development in the country, it also aims to co-relate / restore environmental information / data, Project EIA reports, research publications, grey literature and documentaries to create accessibility among all the stakeholders, especially the public-sector agencies. This data base also contributes and facilitates decision making in the sectors of industry, health, energy, physical communication and tourism etc.

The Pakistan Environmental Protection Council (PEPC) and the PAK-EPA were primarily responsible for administering the provisions of PEPA 1997. The PEPC oversees the functioning

of PAK-EPA. Its members include representatives of the Federal Govt. industry and Non-Governmental Organizations (NGOs).

The Pakistan Environmental Protection Agency (PAK-EPA) was required to ensure compliance with the NEQS, establish monitoring and evaluation system, and identify the need as well as initiate necessary legislation whenever required.

PAK-EPA has delegated powers to its provincial counterparts for environmental monitoring and enforcement. One of the functions delegated by the PAK-EPA to the provincial EPAs is the review and approval of environmental assessment reports (EIA's) and the issuance of No Objection Certificates (NOCs).

3.2.7 Pakistan Environmental Protection Agency (Review of IEE/EIA) Regulations 2000

These regulations / schedules present the policy and procedures for the filing / review and approval of environmental assessment reports. The Projects falling under Schedule-I of these regulations require an IEE Report while Projects falling under Schedule-II require an EIA for the issuance of NOC by the concerned agency prior to the construction of the Project.

According to the PAK-EPA Regulations 2000 for Review of IEE and EIA, the proposed Attabad HPP falls under Schedule-II Projects, (water management, dams, irrigation and flood protection). Therefore, this EIA study was carried out for the Attabad HPP. The IEE / EIA regulations 2000 stipulate that within ten (10) working days of the IEE or EIA having been submitted, the federal/provincial agency will confirm that the document submitted is complete for the purpose of review. During this time, should the agency require the proponent to submit additional information, it will return the IEE or EIA to the proponent for revision, clearly listing those aspects that need further discussion. Subsequently, the Federal EPA / concerned Provincial EPA would make every effort to complete an IEE review within forty-five (45) days and an EIA review within ninety (90) days of filing.

3.2.8 Functions of Federal Environmental Protection Agency (PAK EPA)

The functions and responsibilities of the Pak EPA is now restricted to the only for Federal Capital and it adjoin areas. The functions and responsibilities of the Pak EPA are as follows:

a. Implement and administer the Pakistan Environmental Protection Act (PEPA)-1997;
b. Adopt effective measures for implementation of national environmental policies;
c. Enforcement of the NEQS;
d. Publish annual report on status of national environment;
e. Promote research in science and technology which may contribute to the prevention of pollution and protection of environment;
f. Promote public awareness and education in the environment sector;
g. Pak EPA can inquire or investigate any environmental issue at its own or upon complaint from any person or community.

3.2.9 Functions of Provincial EPAs

a) The EPAs can advise the potential proponent(s) for taking up environment assessment studies according to Schedule I and II of the PEPA 1997;

b) Issuance of NOC for an Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA).

c) The EPA can impose penalties on the violators of the applicable laws / environmental polluters;

d) The Provincial EPA can inquire or investigate any environmental issue at its own or upon complaint from any person or community within its jurisdiction.

3.3 PAKISTAN ENVIRONMENTAL IMPACT ASSESSMENT (EIA) APPROVAL PROCEDURES

Various steps encountered in the submission, review and approval of an IEE or EIA Report under Schedule-I and Schedule-II are shown in Figure 2.1.

3.3.1 Guidelines for Environmental Assessment

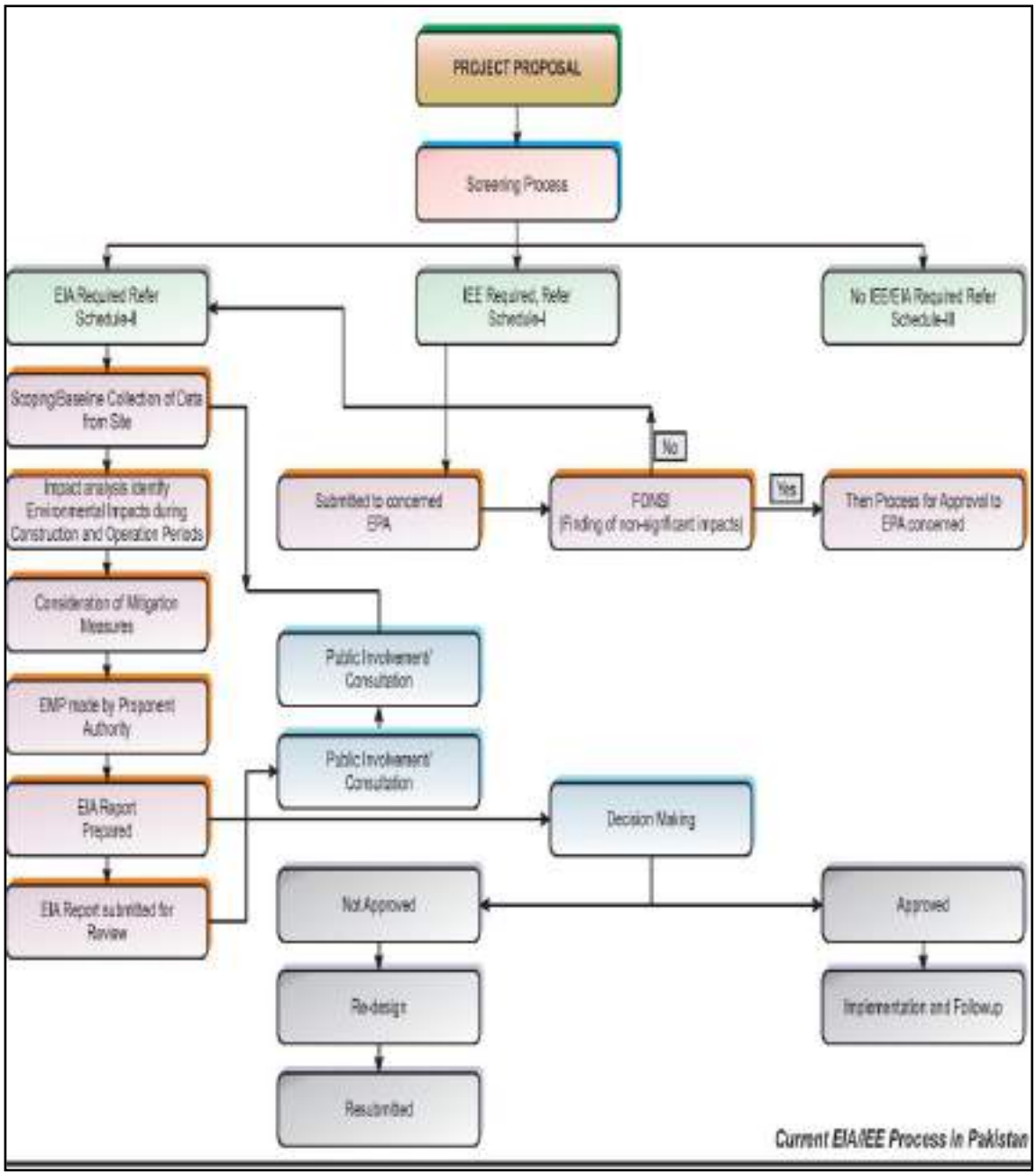

Figure 3-1: Environmental Approval Procedure

Pak-EPA has published a set of environmental guidelines for conducting the environmental assessments and the environmental management of different types for the development Projects.

The guidelines are relevant to the proposed Projects are listed below.

a) Guidelines for the Preparation and Review of Environmental Reports, Pakistan Environmental Protection Agency, 1997

b) Guidelines for Public Consultation, Pakistan Environmental Protection Agency, May 1997.

c) Sectorial Guidelines: Pakistan Environmental Assessment Procedures, Pakistan Environmental Protection Agency, October 1997.

Required Permits This section describes the procedure for obtaining NOCs for EIA from concerned authorities and for working in sensitive and critical areas, as shown in Figure 3.1

3.4 FEDERAL STATUTORY FRAMEWORKS FOR ENVIRONMENT MANAGEMENT AND ASSESSMENT

This section outlines the important statutes apart from Pakistan Environmental Protection Act, 1997, which are relevant to the Project.

3.4.1 Land Acquisition Act (LAA), 1894

This Act is the primary law for acquisition of land and built-up properties for public interest in Pakistan and also sets out the procedure and rules for acquisition and compensating the owners, as well as for compensating owners for damage caused to their properties, crops and trees by a project but it lacks the mechanism to address the complex issues of resettlement. It comprises 55 sections dealing with area notifications, surveys, acquisition, compensation, appointment awards, disputes resolution, penalties and exemptions. The latest revisions and amendments including Land Acquisition Rules were made in 1983. Presently, the Land Acquisition Act 1894 is applicable throughout Pakistan including Gilgit Baltistan. The valuation of land for compensation is governed by sections 23 and 24 of the Act, which include the following provisions:

- Market value of the land at the time of notification of Section 6
- Damage sustained by a person interested in taking of compensation of standing crops or trees
- Damage sustained by the person at the time of Collector's taking possession of land
- Damage sustained by the person at the time of acquisition of land injuriously affecting his other property, movable or immovable.

For the Attabad Hydropower Project compensation for acquisition of land for project operations and hearing of complaints will be carried out primarily in the light of this Act, supported by other measures (to be decided in the particular circumstances to suit the requirements). However, in case a need arises, this Act will be used for this purpose, supported by other measures as warranted, to fulfill requirements of the World Bank Guidelines. In the project area mostly land ownership belongs to the community, people living in valleys have ownership rights on the local rangelands. The community has unwritten traditional laws for possession, distribution and transfer of assets or the income of the assets to the original inhabitants of these valleys.

3.4.2 Project Implementation and Resettlement of the Affected Persons Ordinance 2000

The Government of Pakistan has proclaimed an ordinance entitled "Project Implementation and Resettlement of the Affected Persons Ordinance 2001", later referred to as the “Resettlement Ordinance". This ordinance will be used to safeguard the interests of persons and groups involuntarily displaced from the existing places to new resettlement areas. This ordinance establishes that the resettlement of the involuntarily displaced persons is done as a matter of right and not by way of charity or any such sentiment, also the PAPs will be accepted as special groups, who in the interest of the project have accepted and undergone involuntary displacement. However, as far as Attabad Lake HPP is concerned, there is no displacement involved for the project there will no resettlement.

3.4.3 Antiquities Act 1975

The Antiquities Act of 1975 ensures the protection of the cultural resources of Pakistan. All the archaeological sites, artefacts, historical carvings, historical monuments, temples, shrines, old graveyards etc. come under the cultural property. The Act is designed to protect "antiquities" from destruction, theft, negligence, unlawful excavation, trade and export. The law prohibits new construction in the proximity of a protected antiquity and empowers the Government of Pakistan to prohibit excavation in any area which is of archaeological significance. Under this Act, it is understood that all project proponents are obliged to:

- Ensure that no activity is undertaken in the proximity of a protected areas without permission of the competent authority
- In case any antiquities have been found or reported in any project area it will be the responsibility of the proponent to report to the Department of Archaeology, Government of Pakistan

3.4.4 Pakistan Water and Power Development Authority Act 1958

The Act provides for the unified and coordinated development of the water and power resources of Pakistan. This Act authorizes WAPDA to develop water and power resources in the country through construction and operation of water storages and power houses and erecting electrical transmission lines with powers and obligations of a licensee under the Telegraphy Act of 1910. This act also establishes policy for land acquisition and compensation, as well as the degree of liability of WAPDA for damages sustained by landowners or others.

3.4.5 The Telegraphy Act 1910

This act was promulgated for the installation of telegraph poles and lines. This Act makes provision of installing poles and towers without acquiring any land. However, provision is also made for temporary acquisition of land during the construction period. As such, compensation is made for the loss of crops for a specific period.

3.4.6 Labor Laws

Labor laws in Pakistan are governed by several legislative tools. However, the principal labor rights are provided by the constitution of Pakistan. The following articles enforce key labor rights.

- **Article 11** of the constitution prohibits all forms of slavery, forced labor and child labor
- **Article 17** provides for a fundamental right to exercise the freedom of association and the right to form union
- **Article 18** prescribes the right of its citizen to enter upon any lawful profession or occupation and to conduct any lawful trade or business
- **Article 25** lays down the right to equality
- **Article 37 (e)** makes provisions for securing human conditions of work, ensuring that children and women are not employed in vacations unsuited to their age or sex, and for maternity benefits for women employment.

In addition to constitutional rights, Acts and Ordinances have been enforced for limiting working hours, minimum working age, and conditions of employment.

3.4.7 Penal Code 1860

The Pakistan Penal Code deals with offences where public or private property and/or human lives are affected due to the intentional or accidental misconduct of an individual or body of people. In the context of the environment, the Penal Code empowers local authorities to control noise, toxic emissions and disposal of effluents.

3.4.8 Local Government Ordinance 2001

This Act empowers the Government of Pakistan and provincial governments to enforce laws for land use; conservation of natural vegetation; air, water, and land pollution; disposal of solid waste and wastewater effluents; and public health and safety, including some provisions for environmental protection. Section 93 of this Ordinance pertains to environmental pollution, under which the local councils are authorized to restrict causing pollution to air, water or land. They may also initiate schemes for improving the environment. The Local Councils of the project area have been consulted for their views on the project interventions, and mitigation being proposed for the likely impacts.

3.4.9 Regulations of Mines and Oil Fields and Mineral Development Act, 1948

This Act provides regulatory procedures for the quarrying and mining of construction material on public as well as private lands.

3.4.10 Motor Vehicle Ordinance 1965

The Motor Vehicles Ordinance of 1965 of Punjab was extended to the whole of Pakistan in 1978. The ordinance deals with the powers of the Motor Vehicle Licensing Authorities and empowers other related agencies to regulate traffic rules, vehicle speed and weight limits, and vehicle use, to erect traffic signs, and to prescribe special duties of drivers in case of accidents. It also prescribes powers of police officers to check and penalize traffic offenders. At the same time, the ordinance also empowers the regional transport authority to operate as a quasi-judicial body at district level to monitor road transport, licensing requirements, and compensations for deaths or injuries to passengers on public carriers.

3.4.11 Factories Act, 1934

The clauses relevant to the project are those which concern health, safety and welfare of workers, disposal of solid wastes and effluents, and damage to private and public property. The Factories Act also provides regulations for handling and disposal of toxic and hazardous materials. As construction activity is classified as 'industry', these regulations will be applicable to the project construction contractor.

3.4.12 Highways Safety Ordinance 2000

This ordinance includes provisions for licensing and registration of vehicles and construction equipment; maintenance of road vehicles; traffic control offences, penalties and procedures; and the establishment of a police force for motorways and national highways to regulate and control the traffic as well as keep the highways clear of encroachments.

3.4.13 Explosive Act, 1884

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

3.4.14 Wild Life Act 1975

The Wild Life Act is an Act to amend and consolidate the law relating to protection, preservation, conservation and management of wildlife in the country.

3.4.15 Private Forest Regulation 1970

Forests in state ownership in the Gilgit-Baltistan have been designated as "protected forests" under the Pakistan Forest Act (1927). The other legal category of forests here is "private forest" which are owned by the local communities. These forests are legally covered under the Gilgit Private Forests Regulations (1970) and the rules framed thereafter.

3.4.16 The Forest Act, 1927 and later amendments

This Act establishes the right of the Government to designate areas for reserved forest, village forest and protected forest, and may acquire such areas for prohibiting or restricting the public use of the resources or other activities.

3.4.17 Protection of Trees and Brushwood Act, 1949

This Act prohibits cutting or lopping of trees along roads and canals planted by the Forest Department, without permission of the Forest Department.

3.4.18 Gilgit-Baltistan Customary Laws

In NA customary laws are also practiced besides national laws. This system provides for at least one authority, chosen by the community either by nomination or election, with responsibility for managing natural resources and enforcing customary laws. This customary normative framework includes provisions for: community and individual ownership; resource use fees; and fines as penalties for violations of these laws. Most of the occupants, who claim to be the owner, do not have any written tenancy agreement. For such cases in the non-settled area, confirmation by the village jirgas on land possession is accepted at community, court and local administration levels. Adoption of current 'Gilgit-Baltistan Neuter Rule' (1980) envisages that the occupant of land will be treated as its owner. All other land beyond the settlements, mostly barren, will belong to the Gilgit-Baltistan Administration. This position was also reaffirmed by the Courts of NA.

3.4.19 Gilgit-Baltistan Forest Rules 1983

The Gilgit-Baltistan Forest Rules protected forests which are either the property of the government or have property rights to the whole or part of the forest produce. However local people may have some concessions and user rights. They may be able to use these forests for grazing and collection of fuel wood and other non-timber products.

3.4.20 Gilgit-Baltistan Strategy for Sustainable Development 2003

The Gilgit-Baltistan Strategy for Sustainable Development presents a vision and a strategic framework for economic, social, cultural, and ecological well-being of the people of the Gilgit-Baltistan. It provides a road map to improve governance, integrated gender, environment and sustainability, prioritized development needs, and creation of an enabling environment by improving policies and legislation.

3.4.21 Draft National Forest Policy 2001

A draft of the National Forest Policy was prepared in 2001 which is also applicable to the Gilgit-Baltistan. It emphasizes the sustainable use of natural resources with community participation and recommends that timber harvesting be used for poverty alleviation. It also aims to rehabilitate the environment.

4 BASELINE CONDITIONS

This section provides baseline data (physical, biological and socio-economic parameters) related to the project area. Information provided is both quantitative and qualitative and is based on secondary and primary data collected, site field visits and desk studies. A baseline consists of the existing environmental and socio-economic and cultural status of the project area. The baseline information and indigenous knowledge is required for scoping potential environmental issues associated with the implementation of the project. On the basis of baseline information, the project interventions are assessed and mitigation measures are proposed. The baseline information also helps to indicate the specific issues to be monitored during project execution as well as during operational phase.

4.1 PHYSICAL ENVIRONMENT

4.1.1 Physiography

The project area is located in Gilgit-Baltistan (N.A) of Pakistan in district Hunza. Hunza is a mountainous region forming the western part of the Karakoram and Eastern Pamir mountain range. The area generally consists of rugged and precipitous terrain classified as alpine scrub zone and is characterized by heavy snowfall at higher altitudes in winter.

The site of the project is located on Hunza River at Attabad Lake about 15km upstream from Ganish Bridge of Hunza. Its distance is about 20 km from Hunza, 115 km from Gilgit. The powerhouse location is on the left bank of river and easily accessible from Karakoram Highway. The intake weir/dam site is selected at current exit point of Attabad Lake which is was formed in the year 2010 due to a huge slide from right bank mountain, however, some portion of left bank mountain was also damaged.

People of all the nine villages within the project area are mostly dependent on agriculture and livestock. The dam and reservoir fall into the jurisdiction of Hunza district.

The Hunza River in the study area is the principal river of Hunza and Nagar Districts in Gilgit-Baltistan. It is formed by the confluence of the Chapursan and Khunjerab Nullahs (gorges) which are fed by glaciers. It is joined by the Gilgit River and the Naltar River, before it flows into the Indus River near Juglot.

4.1.2 Demography

Hunza valley is mainly divided in three parts with different tribal structure. The people living in Gojal had migrated to this part of Hunza from Wakhan, Pamir, and Badakhshan before the end of 18th century. They are mostly Wakhis (from Wakhan, a strip of land between Central Asia and Pakistan), an ethic group staying in the mountainous areas of the Karakoram and the Pamirs in the border land of Pakistan, China and Afghanistan. The language and culture distinguish them from Brush and Shina speaking people, who live in central and lower Hunza.

4.1.3 Climate

The climatic parameters that influence the climate of an area include temperature, precipitation, humidity and evaporation. Situated in the western most arm of Karakoram range, Hunza is found within semi-arid and rugged mountain landscape (mountain desert). The climate varies widely from monsoon-influenced moist temperate to arid and semi-arid cold deserts in the north. In general, two seasons prevail in the project area: winter (October to March) and summer (April to September). The Northern Areas have the high mountain ranges of the Himalayas, Karakoram and Hindukush ranges with elevations rising to over 8,000 m, which result in altitude being the dominant influence on the climate of the region. These ranges act as climate barriers between the Indus basin and Central Asia to the North, and the main part of the sub-continent to the South.

4.1.4 Precipitation

Rarefied air, intense solar radiation, strong winds, and vast ranges of temperature are the characteristic climate of the area. Below 3000 m, precipitation is less than 200 mm per annum while there is a sharp precipitation gradient along the altitude, and over 2,000 mm annual snow fall above 6000 masl. Precipitation in the form of rainfall is not sufficient to contribute significantly in meeting either crop water requirements or stream flows. The snow- and ice-melt are the major sources of precipitation contributing to the available water resources in the GB. Irrigation is based on water resources from glaciers, rivers and streams. Average Monthly and annual rainfall recorded at WAPDA High Altitude Weather Station has been given in Table-4.1.

The Hunza River catchment upstream of the dam site is highly mountainous generally with low precipitation. The low precipitation particularly during the hot (monsoon) season coupled with less catchment area likely to experience rainfall are the factors responsible for low runoff or poor contribution to flood producing mechanism source.

4.1.5 Temperature

The Northern Areas of Pakistan are dominated by one of the most mountainous landscapes on earth, with an arm of the Hindu Kush to the west, the lesser Himalaya to the south, the Karakoram to the east and the Pamir to the north. More than half of the Northern Areas is located above 4,500 meters. Temperatures in the valley bottoms can vary from extremes of 35°C in summer to less than –15°C in winter.

The summer season in Hunza Valley is cool while winter is chilly. Wide spread snow fall occurs in winter. During winter the northern winds blow constantly bringing the temperature down considerably. At Hunza, the mean temperature is 30.20 °C in July, the hottest month and the coldest month is January with an average temperature of -3.5 °C. The mean minimum temperatures are 21.9 °C in July and -7.3 °C in January respectively. Hunza like other areas in extreme north-west of Pakistan receives only 136 mm precipitation of which 40% occurs in Winter and Spring.

The Gilgit Meteorological Station is the nearest station to Hunza valley that has a sound historical record covering more than five decades.

Table 4-1: Average Max & Min Monthly Temperature and Mean Precipitation at Gilgit

Month	Mean Min Temp (^oC)	Mean Max Temp (^oC)	Mean Prec. (mm)
Jan	2.4	9.4	4
Feb	0.7	12.6	6.8
Mar	5.7	18.2	0.14
Apr	9.5	24.1	23.8
May	12.1	28.6	24.5
Jun	15.1	34	8.8
Jul	18.4	36.1	14.6
Aug	17.8	35.3	14.6
Sep	12.7	31.7	7.6
Oct	6.8	25.5	6.9
Nov	0.9	18.2	2.4
Dec	-1.9	11.5	5.1
Annual	**7.9**	**23.8**	**133.1**

4.1.6 Wind Speed and Direction

Wind speed is a highly variable parameter especially at high altitudes complex terrains and depends on the local conditions of the specific catchment. Computation of realistic wind speed is therefore very difficult due to its temporal and spatially varying nature in the mountainous regions.

The speed and direction data of Hunza Valley is not being recorded, however, data of some adjacent stations to project area are given in Table 4.2.

Table 4-2: Wind Speed and Direction

Station	Calm	N	NE	E	SE	S	SW	W	NW	Mean Wind Speed	Maximum Observed Speed
Percent of Total Time (%)										Knots	
Astore	50	17	1	0	0	29	1	0	1	3.0	29.0
Gilgit	74	0	1	4	7	1	1	9	2	2.0	28.0
Skardu	80	0	2	2	0	9	5	3	0	2.9	69.0

Wind speeds tend to be higher between April and September and lowest from November to January. However, these averages conceal the fact that often the wind is accumulated over short bursts of gusty convectional wind especially during the late spring and summer when heating effects cause strong but short lived convectional winds.

4.1.7 Geology

Tectonically, project area lies in the Karakoram Block towards the north of the Karakoram Thrust (MKT) and Main Mantle Thrust (MMT) which are considered to be the manifestation of the tectonic collision between Indian Plate (Continent) with the Kohistan Island Arc and then with the Eurasian plate (Continent). This continent to continent collision has given rise to three most famous orogenies in the world. The Himalaya, Karakorum and Hindokush are considered to be the highest mountainous ranges in the world.

The Glacio fluvial deposits forming the site of Attabad village consist of boulders, cobbles and gravels with some silt and sand as cementing material. The rocks exposed at the crown and toe; are highly fractured, sheared, jointed and weathered. A fault on the eastern side of the village is passing through Hunza River trending almost North-South. The re- sediment till deposits flank both sides of Hunza River in the power house area. These tills comprise extremely fine grained (powder) soapy-touch clays.

4.1.8 Seismology

The project area lies in the region of Northern Pakistan which has high frequency of earthquakes especially in the Himalayan orogenic belt. This belt represents the contact between Indo-Pak and Eurasian plates, which has always been the source of moderate to large earthquakes including Kangra (1905), Bihar-Nepal (1934), Assam (1897) and 2005 Kashmir earthquakes with significance consequences. The presence of some of the active faults like Main Karakorum Thrust (MKT), Main Mantle Thrust (MMT), Raikot Fault, Riwat Fault, Panjal Khairabad Fault, Jhelum Fault and Main Boundary Thrust (MBT) etc make the northern Pakistan region tectonically very active.

In October 2005, an earthquake of very high intensity (7.8) hit the area near Muzaffarabad and disturbed the ground to a significant extent in that area. The geological, tectonic and geodynamic conditions of the project area have been assessed and detailed mapping of the ground surface has been done to define the geology and tectonic features of the area.

4.1.9 Landslides, Erosion and Sedimentation

The glaciers of the Gilgit Baltistan and KPK have very high “activity indices”, an index for the total amount of water passing through the glacier system per annum. As a result, they have high flow rates in terms of the glacier melt, ranging between 100 and 1,000 meters/year. As a result of these high rates of flow, these glaciers aggressively erode their beds and transport the eroded materials to the headwaters of rivers, which causes the transport of sediments into the major rivers of the region. The exact proportion of sediment due to glacial erosion is still not measured;

however, it could be stated that these account for the huge load of the sediments passing through the upper Indus system especially Hunza River, Shyok River and Shiger River.

Landslides are very common features in the project area because of the high steep terrain. Erosion and sediment input to the river is a function of landslides and riparian erosion processes. There are frequent talus accumulations along the side slopes of the river. These are typically in a state of stable equilibrium at their current slope angle and environment but become unstable when the equilibrium is disturbed. Excess water and earthquakes often trigger landslides.

4.1.10 Land Use

There are nine villages located on alluvial fans and terraces on both sides of the Hunza River and its tributaries where water is available for human consumption and agriculture. The mountains on both sides of the reservoir have steep slopes and many streams and nallahs join the river in this length. The nallahs span out near the confluence of the river, forming some cultivable land masses as can be witnessed near Passu village. The alluvial fans contain clay silt layer with an undulated topography over hard bedrock. The available flat land is used for residential purposes as well as for agriculture, orchards and grazing for cattle, goats and sheep etc. The total geographic area of the Hunza valley is about 8,920 Km^2. Summary of land use in the Gilgit Baltistan is shown in Table 4.3.

Table 4-3: Summary of Land Use in Gilgit-Baltistan

S.No.	Type of land	Area Million (Hectares)	Percentage (%)
1	Mountain/Lakes/Rivers/Glaciers	4.810	66.3
2	Protective Forests	0.065	0.89
3	Private Forests	0.219	1.78
4	Social/agri Forests	0.368	5.07
5	Range lands	1.626	22.4
6	Cultivable Area	0.078	1.1
7	Cultivable Waste	0.090	1.2
Total		7.250	100%

Source: Statistical Unit GBP & DD 2013

A land use survey was carried out in the villages falling in the reservoir, dam site and power house areas.

The area is rugged and mountainous. The cultivated lands are concentrated in alluvial fans near habitation. Rest of the area is either under Forests/Pastures and the remaining is barren land belonging to the Government/Communities.

4.1.11 Mining

Mining is one of the common professions in small parts of the project area. Local people have developed mining at their own level with their own resources. Small horizontal mines have been excavated by local explorers. The area near the lake is rich in mineral resources however their exploitation as commercial use is still not being done. There are archeological sites were observed and reported during field investigations. People use to explorers the Mines by their own resources without any support of Government.

4.1.12 Soil Pollution and Contamination

There is no industry, commercial area, poultry farm, vehicular washing lines or any other source of contaminants in the project area which could cause soil pollution or contamination through liquid and solid waste generation. The agriculture is practiced on a limited area and limited farm yard manure is used for crop production. Use of chemical fertilizers, pesticides and insecticides is also limited.

4.1.13 Agriculture

The area under agriculture is approximately 112,688 ha or 1.6% of the total area Gilgit Baltistan. Because the climate is arid, agriculture depends on irrigation through water channels locally known as (kuhls)-that bring water through gravity flow from streams fed by glacier or snow melt. It is estimated that another 90,000 ha can be brought under farming by irrigation. Almost 80 per cent of the GB's population is engaged in subsistence agriculture. While GB exports fruits and potato to other parts of the country, it has to import of cereals, poultry and other food products to meet the needs of growing population Agricultural in GB has can be divided into two broad cropping zones depending on the elevation. At elevations between 1200 and 2000 m.s.a.l both summer and winter crops are grown, however, in areas situated in between 2000 m.s.a.l and 3000 m.s.a.l a single summer crop can be grown.

In Hunza District, a mixture of different activities is followed in the farming system. There may be some variation in the farm size or in the status of minor crops in the overall cropping practices but the general combination of crops, livestock and other farm related activities are more or less the same. Wheat, barley and vegetables are the main Rabi crops. Whereas Maize, potato, millet and pulses are Kharif crops. Shaftall and Lucerne or Alfalfa is grown as a perennial crop which is the most popular fodder for livestock throughout the year. Majority of the trees are grown on the field boundaries.

Table 4-4: District Wise Agriculture Land of GB

District	Agriculture Land (ha)	Percentage Cover
Astore	8133.43	1.51%
Diamer	9058.52	1.26%
Ghanche	11966.75	1.35%
Ghizer	16431.94	1.34%
Gilgit	10167.94	2.44%
Hunza-Nagar	12013.87	0.8%
Skardu	30589.88	1.56%
Total	**98362.33**	**10.26%**

Most of the agricultural activities in Hunza are carried out on the terraces prepared in the vicinity of settlements.

Table 4-5: Cropping Pattern in Hunza valley

Date of Land Preparation	Crops/Vegetables	Fruits	Fodder
May	Wheat, Potato, Peas	Apples, Apricot	Alfalfa
March-April	Wheat, Barley, Potato, Peas, Turnip, Buckwheat	Apples, Apricot Walnut, Mulbery	Alfalfa
March-April	Wheat, Maize Barley, Potato, Peas, Turnip, Buckwheat.	Apples, Apricot, Walnut, Mulbery	Alfalfa
March-April	Wheat, Barley, Potato, Peas, Turnip, Buckwheat	Apples, Apricot, Walnut, Mulbery	Alfalfa
March-April	Wheat, Barley, Maize, Potato, Peas, Turnip, Buckwheat	Apples, Apricot, Walnut, Mulbery Almonds, Grapes	Alfalfa
March-April	Wheat, Barley, Potato, Peas, Turnip, Buckwheat	Apples, Apricot, Walnut, Mulbery	Alfalfa

Average land per household for wheat is 10 kanals. Average wheat production in the area is 1.8 monds per kanal. Average barley production is 1.5 monds per kanal, which is grown for cereals and barley has short duration. As a yield of wheat straw is 3.3 monds per kanal and barley 2.2 monds per kanal. After harvesting the first crop, both maize is gown for fodder, or turnip and cereals are enough for 4 months and straw sufficient for 5 months.

Grass and fodder are stored during autumn for long winter. On average every household has 9 kanals of land allocated for grass. About 75% households rely on traditional grass, where as 17%

for maize or grass. Average production of fodder per kanal has been 4.5 monds. Each household collects and stores at least 30 monds of grass per year, to feed animals in winter.

Table 4-6: Cropped Area and Production

Crop	Wheat	Maize	Barley	Potato	Vegetable	Fruits	Fodder	Total
Area (hectare)	886	970	223	3267	128	3578	1572	10633
Production (Ton)	1570	2713	361	48285	1455	30483	7449	92316

Very little chemical fertilizer is applied to wheat. However, chemical fertilizer is normally applied to potato crop. Application of fertilizer is conditional with the availability of money at the time of planting the crops. The total crop area of Hunza Nagar is 9344 Hectare, 0.73 Hectare per family and about 0.081 per capita.

Irrigation intervals reported for maize were 10 to 15 days depending on the rise in temperature and grain filling periods. Harvesting is done by a serrated sickle and threshing is done either by hand or trampling of grain by oxen.

The agriculture undertaken in the project area is mainly subsistence farming, as land does not produce enough to feed the family. The estimated average yield of crops per household is estimated as 10 mounds (1 mound = 40 kg) of wheat, 15 mounds of maize and 5 monds of Barley per year. The extended family system ensures sharing of the field produce and none is marketed. It was also reported that cereals are only sufficient for four months in most cases and for eight months in few other cases. Agricultural Department and AKRSP are introducing new varieties of cereals but it has not yet been adopted fully.

The cultivated lands and orchards are irrigated from the nallas. These nallas are the only source of water to irrigate all the surrounding villages. Therefore, the village faces scarcity of irrigation water during cropping season.

4.1.14 Fruits

Gilgit Baltistan is producing many fruits like apple, cheery, walnut, and apricot. But apricot is more famous for its test and quality. Pakistan produces approximately 300,000 tons of fresh apricot, making it the world's fourth largest producer. Gilgit Baltistan (GB) and Baluchistan are the two main apricot growing regions in Pakistan, with GB alone producing 114,286 tons in 2007. Planting density is only 230 trees/ha, which is much less than the recommended 750 trees/ha, due to apricots being planted around field edges, rather than orchards. Average yields of fresh fruit are 38kg/tree which are good considering the limited use of inputs, although yields of 50kg/tree can be achieved through improved management.

Special importance is given to the cultivation of fruits. Fruits are grown for household consumption as well as for sale in the dry form. Various fruits are grown in Hunza valley. At higher altitudes

there are no fruit trees, but in lower portion of Hunza valley several types of fruit are grown. Major fruits are apricot, apple, mulberry, grapes, almond and walnut. It has been calculated on average that every household has 22 trees out of which 15 are fruit bearing trees. The average production of fruit by each tree is 50 kg. Average fruit available to each household is 20 monds. Fresh fruit is consumed at home and there is no marketing of fruit.

Table 4.7 shows Area and Production of Fruit in Sub division Hunza.

Table 4-7: Area and Production of Fruit in Sub division Hunza

Fruits	Fruit Bearing Trees	Non Fruit Bearing Trees	Total Trees	Area (ha)	Production (Ton)
Apricot	140078	59755	199833	869	9629
Apple	68660	23515	92175	401	2321
Grapes	4789	915	5704	25	171
Pears	3659	2960	6619	29	147
Peaches	11838	1453	13291	58	395
Pomegranate	2064	323	2386	10	39
Cherry	21685	10493	32178	140	399
Mulberry	5058	1614	6672	29	322
Walnut	6830	4472	11302	49	102
Almond	8224	4987	13211	57	55
Total	**2722885**	**110486**	**383371**	**1667**	**13582**

Data Source: GIS Lab, WWF-Pakistan (2013)

Table 4.8 shows utilization of fruits on district sub division Hunza.

Table 4-8: Utilization of Fruits on District Sub division Hunza

Fruits	Production (Ton)	Wastage (Ton)	%age Losses	Consumption		Marketed	
				Fresh (Ton)	Dry (Ton)	Fresh (Ton)	Dry (Ton)
Apricot	9629	3298	34	240	378	75	694
Apple	2321	451	19	797	0	1074	0
Grapes	171	49	29	118	0	4	0
Pears	147	28	19	86	0	33	0
Peaches	395	165	42	228	0	2	0
Pomegranate	39	3	7	33	0	3	0
Cherry	399	55	14	128	0	216	0
Mulberry	322	231	72	74	11	0	11
Walnut	102	0	0	0	95	0	5
Almond	55	0	0	0	36	0	19
Total	**13582**	**4280**	**32**	**1703**	**521**	**1407**	**729**

Data Source: GIS Lab, WWF-Pakistan (2013)

Detail of nurseries and seed farms is given in Table 4.9 below.

Table 4-9: Detail of Nurseries and Seed Farms

Sr. No	Nursery/Seed Farm	Location	Area (kanal)	Stock Position For the Year 2020		
				Issue able Plants	Non-Issue able Plants	Total Stock
1	Fruit Nursery	Murtazabad	10	3200	3700	6900
2	Fruit Nursery	Khanabad	20	Development in progress however 1600 issue able and 2500 non-issue bale plants are available in some developed plots		
3	Fruit Nursery	Shishkat	23.4	5300	3500	8800
4	Seed Farm	Khudabad	10	Sown 30000 Invetro Tuber under an area of 6 kanal		

4.1.15 Livestock

The people of entire Hunza River the livestock reared by almost all households. Usually with the snow melt, goat, sheep and cows giving no milk are taken to the alpine pastures for grazing. They stay there during the summer season and are brought back with the onset of snow on the top of the hills. When the animals are brought to the village they are grazed in the agricultural fields of maize crop residues. All the milking animals are kept in the houses and stall fed. In general women take care of all animals in the houses and graze cows around the village on pastoral lands. These are situated between agricultural and forest land and are covered with grasses intermixed with oak stands. Only men take small animals i.e., goats and sheep to the alpine pastures. Normally a herders belonging to the same village collects other farmers animals and take them to alpine pastures for grazing during summer. These herders keep all the milk produced at pastures in lieu of herding charges. They convert this milk into ghee and other dairy products for their own use and marketing. The number of domestic animals the villagers owned has decreased over the past few decades due to decrease in grasses near the villages.

Livestock contributes a great deal to the local economy. However, physical condition and general health of the animals is not satisfactory, especially in winter due to the shortage of fodder. Bullocks are the main source of farm power, but they are hardly capable of drawing plough due to poor health. Cows, sheep and goats are also lean and thin. Animal diseases cause considerable losses to the livestock. Productivity of cattle is generally low because of severe winter and lack of proper feed. Meat, milk, butter and eggs are the main animal /poultry products but most of these are consumed at the household level. At some places milk, meat, animal hides, wool and poultry are sold.

The livestock is also a social and financial capital of the family. Every family keeps some extra heads to be sold or slaughtered on occasions of marriage or death in the family. A few heads are kept to be given as dowry to daughters on their wedding. The livestock numbers far exceed the carrying capacity of natural pastures and available forage resources.

List of veterinary units are shown in Table 4.10 below.

Table 4-10: List of Veterinary Units

Veterinary Hospitals/Dispensaries	Ownership
Veterinary Hospital Aliabad (Not Functional currently at disposal of District Administration)	Government
Veterinary First Aid Post Khanabad Hunza	Rented
Veterinary Dispensary Nasirabad Hunza	Government
Veterinary Dispensary Murtazaabad Hunza	Government
Veterinary Dispensary Mominabad Hunza	Government
Veterinary Dispensary Gulmit Hunza	Community
Veterinary Dispensary Sost Hunza	Government
Veterinary Dispensary Misgar Hunza	Rented
Veterinary Dispensary Chupurson Hunza	Government
Veterinary Dispensary Shimshal Hunza	Community

Source: Office of the Deputy Director Livestock & Dairy Development Hunza

Table 4-11: Livestock Census 2017

Name of Village	No. of Farmers	Cow Local	Cow Jersy	Bull Local	Bull Jersy	Yak Male	Yak Female	Zho	Zomo	Horse	Donkey	Goat Local	Goat Imprd	Sheep Local	Sheep Imprd	Rural Poultry	Fancy Bird	Total No Large Animals	Total No Small Animals	Total No. Poultry
Khizarabad	14	24	2	11	1	0	0	0	0	0	0	27	2	79	6	72	0	38	114	72
Hussainabad	142	207	11	69	5	0	0	0	0	0	0	248	21	509	17	879	110	292	795	989
Mayoon	31	160	0	46	1	0	0	0	0	0	0	170	0	60	2	220	52	207	232	272
Khanabad	158	286	0	16	3	0	0	0	0	0	0	306	0	302	2	236	30	305	610	266
Nasirabad	465	829	3	304	0	0	0	0	0	0	0	1598	0	3123	0	1942	0	1136	4721	1942
Murtazabad	289	424	43	96	10	0	0	0	0	0	0	434	82	112	24	522	41	573	652	563
Hassanabad	107	219	3	66	0	0	0	0	0	0	0	216	6	42	3	157	15	288	267	172
Hyderabad	376	477	48	123	29	27	45	6	2	0	0	551	44	479	25	590	26	757	1099	616
Altit Hunza	103	77	0	6	0	0	0	0	0	0	0	86	0	43	0	18	0	83	129	18
Ganish	224	243	1	49	0	8	11	1	0	0	0	291	0	156	2	281	100	313	449	281
Gulmit	728	1713	240	160	16	67	120	5	1	1	1	1685	40	2731	35	2006	15	2324	4491	2021
Sost	523	1158	136	6	5	150	235	0	0	0	2	2045	0	3002	0	3480	14	1692	5047	3494
Chupurson	396	1131	5	102	5	252	311	2	6	22	20	534	0	3370	0	1693	0	1856	3904	1693
Misgar	122	164	0	17	0	42	125	2	4	0	9	1163	0	1408	0	639	0	363	2571	639
Shimshal	174	412	0	0	0	440	447	0	0	0	40	1250	0	2100	0	408	1	1339	3350	409
Ahmadabad	90	179	36	40	6	11	1	0	0	0	0	104	40	39	24	191	0	273	207	191
Karimabad	103	126	3	19	0	86	75	0	0	0	0	202	2	172	7	302	0	309	383	302
Aliabad	208	337	8	9	6	0	0	0	0	0	0	298	7	232	20	295	0	360	557	295
Grand Total	**4253**	**8166**	**539**	**1139**	**87**	**1083**	**1370**	**16**	**13**	**23**	**72**	**11208**	**244**	**17959**	**167**	**13931**	**404**	**12508**	**29578**	**14335**

Source: Office of the Deputy Director Livestock & Dairy Development Hunza

4.1.16 Hydrology

The Karakoram and Himalayan mountains form the main source of snow and ice melt runoff to the Indus River System. The precipitation enhancing and shadowing effects of the main mountain ranges provide dramatic contrasts that greatly complicate the hydrological picture. The main tributaries of Hunza River are; Chapursan, Kilik, Bola Das joining the Hunza river from the west and Khunjerab along with Ghujerab, Simshal and Hispar Rivers joining river from the east of the valley. The river flows of Hunza are usually maximum in the month of July when snow and glacier melt is at its peak while these are minimum in the month of March when snow and ice melting is insignificant.

There is only one hydrological gauging station on Hunza River at Danyore Bridge being operated by SWHP-WAPDA. This station is located at about 107 kilometers downstream of Attabad Landslide Dam Location. The catchment area of Hunza River upto Danyore gauging station is 13,157 km^2, whereas it is 14,083 km^2 upto its confluence with Gilgit River. Hunza River catchment area is 8,901 km^2 upto Attabad Landslide Dam Location. Therefore, river flows are transposed and estimated from documented discharge data from hydrological station at Danyore. Daily discharge data from 1966 to 2015 is available and processed for the calculations. Data for year 2016 was incomplete, missing the values of high flow months, and there was no record of hydrological data for the period 2017 to 2018 at SWHP therefore, it was not used in the calculations. Mean annual flows are calculated and drawn in the figure below for the period 1966-2015. Average value for mean annual flow has been calculated as 208.36 m^3/s.

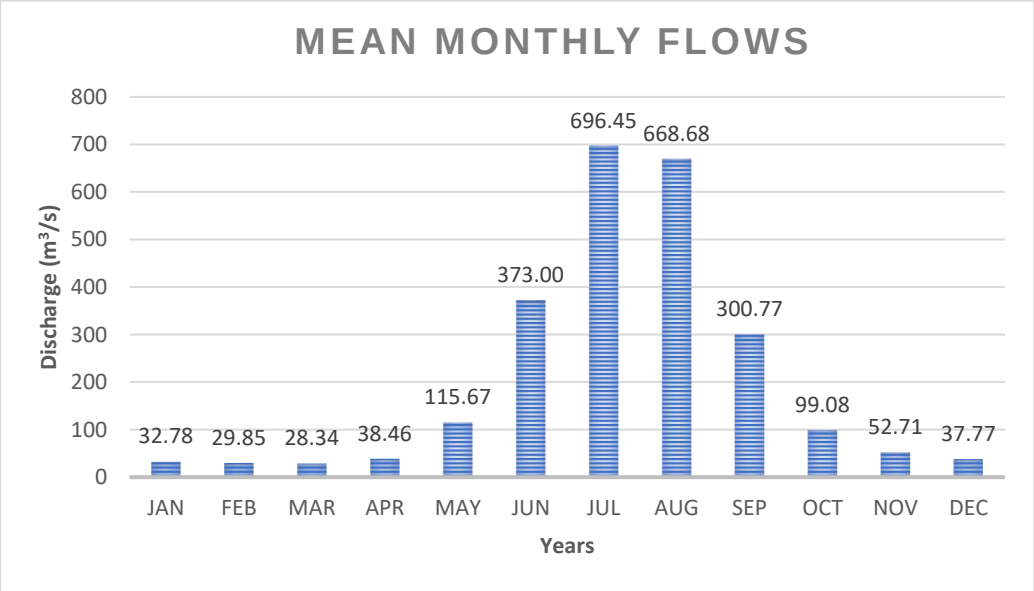

Figure 4-1: Mean Monthly Flows

Flows are generally maximum in July and August almost reaching 700 m^3/s. Whereas, flows are low from December to April each year when snow falls in the catchment. The record shows that design discharge of 60 m^3/s is available for about half year (almost 6 months). Graph shows that flows are exceeding the design discharge from June to mid-December which shows the potential of hydropower generation.

4.1.17 Flooding

The maximum peak discharges of mean daily for every year recorded. The instantaneous peaks will definitely be higher than the measured daily flows and can be enhanced while execution accordingly. Instantaneous peak flows for the period 1966 to 2015 has been calculated and plotted as well.

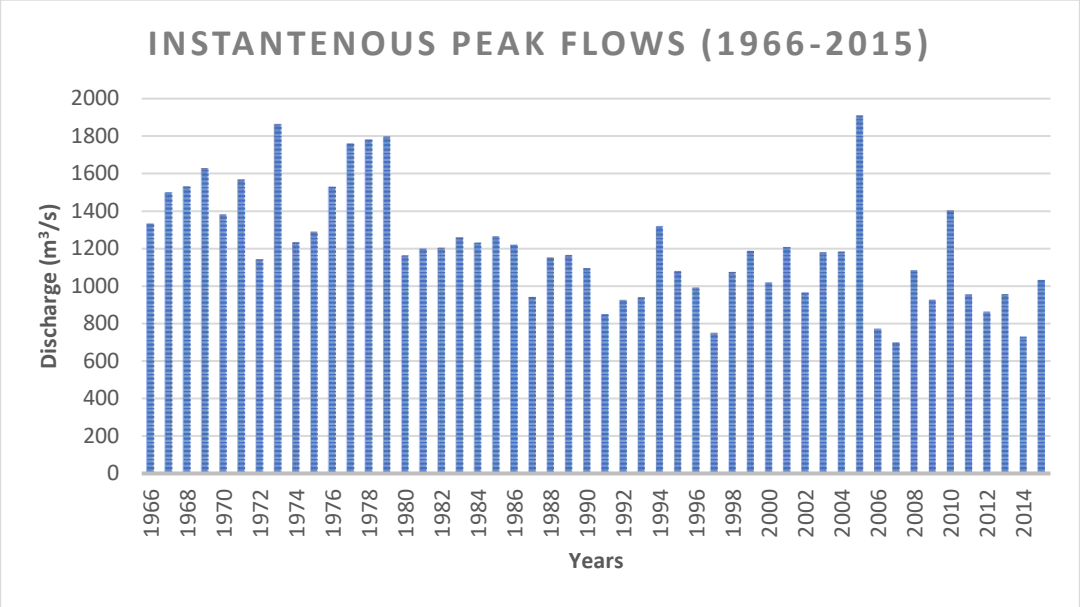

Figure 4-2: Instantaneous Peak Flows at Attabad Lake HPP Site

4.1.18 Surface Water

In the project area, the Hunza river carries water of various streams (nallahs)of snowmelt, and rainwater fall. The people use the water of these nallahs for drinking, household and agriculture purposes. Generally, there is no shortage of clean potable water in the project area as it is very difficult to fetch the water of river and nallahs due to the very steep slopes. People mostly use water from nallahs for drinking, washing and other domestic purposes. During the socio-cultural survey of the project area, many of the respondents from the villages falling in the project area reported stomach, skin, bones, diseases. Initially, rainwater as well as snowmelt water do not contain significant impurities. As these waters flow over land they pick up sediments, salts, toxic elements, pulverized organic matter and bacteria from the surface. Water samples were taken in November 2020 covering the complete affected area within the project area. The laboratory results of these samples summarized in Table 4.12 & 4.13 and detail at **Appendix-C** reveal that all the parameters are within the permissible limits when compared with drinking water quality standards of WHO, except the presence of Escherichia coli pathogenic bacteria which causes gastroenteritis in human beings.

Table 4-12: Chemical Parameters Results of the Samples (Surface Water)

National Standards for Drinking Water Quality of Pakistan (mg/l)									
Nitrate	**Nitrite**	**Cu**	**Al**	**Fe**	**Mn**	**Cr6**	**Zn**	**Ni**	**B**
≤50	≤3	2.0	≤0.2	-----	≤0.5	≤0.05	5.0	≤0.02	0.3

Sr. No	**Location from Sample Collected**	**Test Results (mg/l)**									
		Nitrate	**Nitrite**	**Cu**	**Al**	**Fe**	**Mn**	**Cr6**	**Zn**	**Ni**	**B**
1	Hunza River Side before Confluence of Shamshal Nullah	ND	ND	0.4	ND	ND	ND	0.03	ND	0.01	ND
2	Shamshal Nullah before entering Hunza River	ND	ND	0.07	ND	0.04	ND	0.02	ND	0.02	ND
3	Hunza River Side Near Power House	ND	ND	0.2	ND	0.3	ND	ND	ND	0.01	ND
4	Attabad Lake Boating Area	1.3	ND	ND	ND	ND	ND	0.03	ND	0.02	ND
5	Gulmit Tap Water	ND	ND	0.02	ND	ND	ND	ND	ND	0.01	ND
6	Gulmit Glacier Near Hunza River	ND	ND	ND	ND	ND	ND	0.14	ND	0.2	ND
Conclusion:	The concentrations of nitrate, copper, iron. Chromium 6 and nickel are within National Standards for Drinking Water Quality of Pakistan for first four areas.										

Table 4-13: Bacteriological and Physical Parameters Results of the Samples (Surface Water)

Bacteriological Parameter	National Standards for Drinking Water Quality of Pakistan (Physical Parameters)						
E.coli	**pH**	**Turbidity**	**Total Dissolved Solids**	**Electrical Conductivity**	**Color**	**Odor**	**Taste**
0/100 ml	6.5-8.5	<5 NTU	<1000 ppm	2000 µs	Un Objectionable	Un Objectionable	Un Objectionable

Sr. No	Location from Sample Collected	Test Results								
		Bacteriological	Physical Parameters							
		E.coli	pH	Turbidity	Total Dissolved	Electrical Conductivity	Temp.	Color	Odor	Taste
1	Hunza River Side before Confluence of Shamshal	0 col/100ml	8.4	<5 NTU	67.8 ppm	130.4 µs	7ºC	Clear	Odorless	Tasteless
2	Shamshal Nullah by entering Hunza	0 col/100ml	8.4	15 NTU	98.1 ppm	186.8µs	7ºC	Clear	Odorless	Tasteless
3	Hunza River Side Near Power House	0 col/100ml	8.0	<5 NTU	62.7 ppm	125.4µs	7ºC	Clear	Odorless	Tasteless
4	Attabad Lake Boating Area	0 col/100ml	8.5	<5 NTU	65.4 ppm	129.7µs	7ºC	Clear	Odorless	Tasteless
5	Gulmit Tap Water	0 col/100ml	7.4	<5 NTU	23.5 ppm	47.2µs	7ºC	Clear	Odorless	Tasteless
6	Gulmit Glacier Near Hunza River	0 col/100ml	8.0	<5 NTU	29.7 ppm	59.4µs	7ºC	Clear	Odorless	Tasteless
Conclusion:		Results show that the turbidity in Shamshal Nullah by entering Hunza water sample exceed the National Standards for Drinking Water Quality of Pakistan.								

4.1.19 Tributaries

Nine villages are located in the project area. All the villages are situated near to streams (nallah) fall in main tributaries of Hunza River. Main tributaries of Hunza River are:

- **Khunjerab River** begins in the snow clad mountains and glaciers in the north and south of Khunjerab pass. The river flows to the west then turns southward. It ends when it flows into the Hunza River.
- **Chapursan River** begins in the area of the Chilanji pass and Kampiri Diwar peak. It flows to the east and joins Khunjerab River near Khuda Abad.
- **Misgar River** begins from the mountains of Mintaka and the Kilik pass on the northern boundary of Hunza. It flows to the south east and ends when it falls into the Khunjerab River.
- **Gujerab River** starts from small glaciers and snow-topped mountains of the Gujerab range, and flows to the west and later joins Khunjerab River.
- **Shimshal River** begins in the Shimshal pass from Virjirab and other glaciers. This is in the north eastern region of the Gilgit Region. It flows to the west and after reaching Passu it joins the Khunjerab River.
- **Hispar River** forms from the melt water of the Hispar Glacier - a forty-nine-kilometer-long glacier in the Karakoram Mountains. The Hispar Glacier and river both flow northwest, passing through Hispar, Hopar and Nagar villages until the confluence with the Hunza River.

4.1.20 Groundwater

The project area consists of rocky mountainous terrain. The water originated from rainfall and snowmelt flows through streams and enters into river. Only a small quantity of water has the chance to percolate and form a groundwater reservoir.

4.1.21 Water Availability & Quality

Glacier and snowmelt are the main source of water for domestic use in the valley, while springs are the principal source of drinking water in Gojal tehsil. The melted water gradually enters the streams, which subsequently feed man-made channels - Kuhls - that bring water into the populated areas for agriculture, livestock and domestic purposes.

Piped water supply that covers only 40% of the total population of the Gilgit-Baltistan does not provide safe/ clean drinking water to urban and rural settlements in the region.

In upper Hunza region, drinking water is obtained from glacier melt and piped water only in summer season, because the glacier water freezes in winter for three months. The villagers meet their need of water from the Hunza River.

4.1.22 Air Quality and Noise

The air quality of the project area and its vicinity is very fresh and clear under normal condition. There is no major source of air pollution as there are no major vehicular movement or industrial setup in its vicinity.

The vegetation cover in the area is thick and the level of ambient (suspended) dust increases during windy conditions. Being far from the roadside they are not faced with impact of air and noise pollution resulting from transport vehicles. Air and noise pollution has not yet emerged as an environmental issue owing to operation of a small number of vehicles increasing by a fair degree during the tourist season. Based on a number of observations on ambient air quality in rural areas the following range of concentration of gaseous pollutants is estimated on the roadside at Gulmit:

Table 4-14: Range of Gaseous Pollutant Concentration & Noise Emission Level

Range of Variation	CO ppm	SO_2 ppb	NO_x ppb	SPM $\mu g/m^3$	Noise dB(A)
Minimum	0.65	05	05	45	40
Maximum	0.9	10	12	90	70
Average	0.7	07	07	70	55

The noise level near the river is fairly high and range between 50 to 65 dB without traffic, mainly due to the flowing water colliding against rocks and boulders. There is normal traffic on the Karakoram Highway which runs through the Hunza valley. So traffic noise has negligible contribution to the noise level in the project area.

4.1.23 Greenhouse gases

Greenhouse gases are those gases (CO_2, CH_4, O_2, CFCs and NO) which contribute to global warming. The main sources of these gases are industries and vehicles using fossil fuel as fuel. At present there is no industry in the project area that emits greenhouse gas (GHG) and vehicles intensity is also very low. The main sources of carbon and nitrogen oxide emissions are the automobiles being operated in the project area.

4.1.24 Waste

The villages within the project area do not have any drainage, sewerage or treatment system for sewerage collection and disposal. More than50 per cent of the houses have improvised pour flush pit latrines. The remaining 50 per cent of the house hold use locally made toilets, dry pits or defecate in the fields. Wastewater (sludge) from kitchen, bathing and washing is discharged

into small drains/water courses leading to the nalaor directly to small fields outside the houses. Modern health facilities are available at Hunza and patients are brought to Hunza for treatment.

There are no special disposal practices or collection in the area. People use their solid waste in the vegetable field as fertilizer. Animal waste especially cow dung is used for farm manure or used for burning after drying (though rarely).

4.2 BIOLOGICAL ENVIRONMENT

Habitat loss is considered as the leading cause of loss of world's biodiversity. Most species need undisturbed habitat to find food, water, shelter, and mates. But people are altering habitats all over the world. In such areas, the activities causing habitat loss include commercial logging (not based on technical and sustainable basis), land development, over-grazing, fuel wood collection, construction of roads, and building new settlements. All these actions change landscapes, natural water flows, and the species composition in the area. Moreover, changes in climate and land use patterns also reducing the amount of snowfall and rain upon which the habitat depends.

The high altitudes, rugged mountains and sweeping glaciers make much of the region uninhabitable. Only two per cent of the Northern Areas estimated to be suitable for agriculture through irrigation by diverting stream water. However, so far only one percent of the total area is being cropped. Approximately nine per cent of the Areas is covered by natural forests and open scrub, 22 per cent area constitutes alpine pasture, and remaining 68% is mostly bare rock, under permanent snow and glaciers.

4.2.1 Flora

A study was carried out on the Biodiversity of Khunjerab National Park (KNP) during May and June, 2006 to establish baseline information about existing plant wealth and wildlife including flora, reptiles, birds and mammals in order to make some vantage points for future monitoring of key wildlife species. Using different direct and indirect investigation techniques, 14 different valleys and Nullahs of KNP were surveyed and observations on various habitats were recorded.

Four types of vegetation zones were identified including Dry Alpine Scrub, Moist Alpine Pastures, Dry Alpine Plateau Pastures and Sub Alpine Scrub and Birch Forests. So far, 62 plant species belonging to 45 genera and 25 families were identified. Of them, 4 grasses and one species of Liliaceae were determined.

The wide variety of climatic conditions in the region, coupled with the extreme variations in altitude and aspect, has created a wide array of vegetation and ecological zones. Five distinct zones can be identified.

4.2.1.1 Dry Alpine Zones and Permanent Snowfields

This ecological zone is characterized by vast glaciers, boulder fields and sheer cliffs. This zone predominates at high altitudes, around the major peaks of the Karakoram Mountains. It covers most of upper Hunza and the northern parts of Baltistan.

4.2.1.2 Alpine Meadows and Alpine Scrub

This zone covers the areas between the high valleys and the permanent snowfields, between 3,500 and 3,800 meters. It is characterized by lush, green and well-watered alpine meadows, located on valley bottoms or high plateau surrounding the main watercourses. Alpine meadows occur in almost all the higher regions of Gilgit, Baltistan, Ghizar and Diamir, particularly where mountains extend above the tree line. The meadows support a wide variety of wildflowers, grasses, sedges and other plants.

4.2.1.3 Sub-Alpine Scrub

The sub-alpine scrub zone occurs throughout the higher mountains of the Himalaya, Hindu Kush and Karakoram, and is found in Gilgit, Skardu, Ghizar and Astore. However, it is often confined to small ravines on the upper slopes. The vegetation consists of small deciduous species such as Betula utilis, and evergreens such as Juniperus communis and Rhododendron hypenanthemum.

4.2.1.4 Dry Temperate Coniferous Forest

These forests are usually found on the inner or northerly slopes of the Himalaya, between 1,500 and 3,400 meters. They occur in parts of Gilgit, Diamir and Baltistan Districts, and are characterized by single species stands of conifers. Typical tree species include Picea smithiana, Cedrus deodara and Pinus wallichiana, with an understory of Quercus ilex and Junglus regia and scattered shrubs of Artemisia maritima and other species.

4.2.1.5 Dry Temperate Evergreen Oak Scrub

This is an intermediate zone, lying between 1,500 and 2,500 meters. The vegetation is dominated by dry oak forest (Quercus ilex). Occasionally individual stands of evergreen species are also found, including Pinus gerardiana, Pinus wallichiana, Cedrus deodara and Juniperus spp.

4.2.2 Medicinal Plants

A large number of medicinal plants grow in the natural forests of Gilgit-Baltistan, especially Astore Valley. The following is a list of important medicinal plants found in the region.

Table 4-15: Important medicinal plants report in GB Forests

	Botanical Name	**Local Name**		**Botanical Name**	**Local Name**
1	Aconitum chasmanthum	Mohri	12	Onasin echioides	Laljari
2	Aconitum hetrophyllum	Partis	13	Orchus-latifolia	Salib misri
3	Aconitum lavae		14	Picrohiza-kurrva	karroo
4	Angelioa glauca	Chora	15	Podophyllum-emodi	Ban kakri
5	Arterrisia bravifolia	Rund	16	Rheun emodi	Rhewand chini

6	Carum spp.	Kala zeera	17	Sausuria-lappa	Kuth
7	Ephedra spp.	Oman (asmani booti)	18	Saxifraga ciliata	Zakhmay hayat
8	Ferula feotida	Heeng	19	Shymus serpyllum	Bannanajwainu
9	Ferula narthex	Heeng	20	Swertia chiretha	Chiretta
10	Lavatria kashmirianian	Resha Khatimi	21	Valeriana wallichii	Mushak bala
11	Macrotomia-benthami	Gao zaban	22	Viola serpans	Banafsha

4.2.3 Forestry

Forestry is important for fuel, timber, in addition to control of the soil erosion and reduction silt load in lakes and rivers. In the Gilgit-Baltistan only Diamer district is rich in forest while the other five districts including Hunza have nominal forest of Juniper. The forests consist of blue pine, spruce, willows and shrub consist of rosa species.

A new program of planting trees over private land by AKRSP and 10 billion trees tsunami in the valley has been started. The forest areas including uncultivated wasteland are State Forests owned by the government. Wood is used for timber, fire and fuel wood is used throughout the year. Firewood is used during winter season. Based on data used by AKRSP each house on average use 100monds of fire and fuel wood during a year. On the other hand, fire and fuel wood collected from common property is 63 mounds per annum. Forest trees are rich source of fodder. It was noted that 12 mounds of fodder are also collected by each household from the forest. The Region is rich in natural forest although it has been extensively exploited. In the valley more forest plots are planted to reduce the pressure on existing forest. For this purpose, an average 130 trees of Poplar by each household and 90 plants of willow per household are planted

In program of ten billion tree tsunami 4.4 Million trees were planted in 2019-20 year through Gilgit forest circle, Diamer Astore Forest Circle, Baltistan Forest Circle, Wildlife Divisions, AKRSP and through Agriculture Department in Gilgit Baltistan.

- **Proposed Plantation in Hunza District for the year 2021**

S.No	Activities	Sites	Area /KM	Total nos. of plants to be planted
1	Avenue Plantation	Nasirabad to Aliabad	45 km	30,000
2	Slope plantation	Attabad lake	700 Kanal	25,000 (first Phase)
3	Block Plantation	Hussaini	1680 Kanal	50,000 (first Phase)
4	Block Plantation	Gulkin Shahabad	948 Kanal	25,000 (first Phase)
5	Block Plantation	Khuramabad	1500 k	50,000 (first Phase)
6	Free Distribution of plants	Across Hunza District	-	150,000
7	Urban Planation	District Head Quarter	-	15,000
Total			-	**345,000**

With action plan of 10BBT, it will improve the production and procurement of forest and fruit plants, rehabilitation program of natural forest and awareness campaign for forestry will help in plantation of trees in the region. Proposed site for plantation is shown in figure.

Figure 4-3: Plantation site Khuramand & Zarabad, Hunza

4.2.4 Fauna

This diverse range of vegetation and ecological zones also supports a rich faunal diversity, including an estimated 54 species of mammals and 230 species of birds. About 23 species of reptiles and 6 of amphibians have been reported from GB. Among reptiles 9 species are of lizards and 14 of snakes, while among amphibians 2 species of frogs and 4 of toads. Very little information is available on insect diversity in GB, however, about100 species of butterflies have been reported from GB.

Several globally threatened species – including the snow leopard and Markhor – continue to survive in Gilgit-Baltistan in significant numbers. The flora and fauna belong to Palearctic region. Fifty-four species of mammals have been reported in GB, which comprise 1 shrew, 10 bats, 18 carnivores, 6 artiodactyls, 3 lagomorphs, and 16 rodents. The region is also home to a few globally threatened species like Snow Leopard, Himalayan lynx, Marco polo sheep, Blue sheep, Ladakh urial, Markhor, Musk deer, and Woolly Flying Squirrel. The resident avifauna includes Monal pheasant, Snow Partridge, Himalayan Snow Cock, and several birds of prey species.

Woolly Flying Squirrel has been reported as endemic in GB, whereas Astore Markhor (flare-horned Markhor) can be considered near endemic, as its distribution is restricted to a few valleys mainly because of rugged terrain and geographic barrier like rivers. The distribution of many small mammal species is very patchy and restricted to the certain watersheds due to the physical barriers like high mountains and rivers.

Occurrence of some rare species has been reported in GB. These include species like Lammergeyer and Golden eagle. Few sightings of Lesser Kestrel have also been reported in lower Hunza near Hunza river. The main diverse group of birds in NA is the Passeriformes species. These are mostly Warblers, Tits, Flycatchers, and Buntings. Some of the restricted range species like Snow Partridge and Himalayan Monal pheasant are extremely rare and may be at the verge of extinction from many of their earlier strongholds. According to Birdlife International (2001) report there are 27 species of Pakistan, which are threatened internationally out of which 7 species are found in GB.

Hunza is very scattered settlement with meager population. Considering its wildlife resources to be protected and preserved. Shooting, trapping of wild animals is not allowed except with a special permit. The number of animals or birds killed or captured is also restricted and specified in the permit. Snow leopard and Ibex are already declared as endangered and other species of mammal are also scarce. But trophy hunting is allowed which is beneficial to the local community as the 70% of the funds go to local community which is used for the development of the local area.

Table 4-16: Fauna available in Gilgit Baltistan

English Name	Urdu Name	Scientific Name
Ibex	Kill or Kil	Capra ibex sibirica
Snow Leopard	Cheeta	Pantherauncia
Red fox	Lombrei	Vulpesvulpes
Lynx	Seaa gosh	Felis lynx
Wolf	Bharia or Bahdia	Canis lupus
Maramot	Barfani choh Tershoon	MaramotaCandata
Alpine weasel	Gilhari	Mustelaaltacia
Musk rat	Chachondar	Mustelaaltacia
Himalayan snowcock	Ramchakur	Mustelaaltacia Tetraogallushimalayencis
Chukor	Chukor	AlectorisChukor
Eagle	Shaheen	Aquila Chrysaetos
Hawk	Gid	-
Falcon	Ooqaabor Ooqabaa	-
Pie	Jample	UrocissaEryphrohyncha
Hopoe	Hodhodh	Upepaepaps
Pigeon	Kabutar	-

4.2.5 Insects

The Project Areas is rich in biodiversity of insects including butterflies found in the project area, particularly during the humid months of July and August. In addition, caterpillars, bugs, beetles, black bees, weevils, mosquitoes, ants, green aphids, codling moths, leaf miners, mitts, fruit flies, woody aphids, stray grass hoppers, leaf hoppers, mealy and woolly bugs, peach leaf curling aphids, scale insects, walnut weevils, blister mites, and dusky veined aphides are all found in the Northern Areas including the project sites.

4.2.6 Endangered, Threatened or Vulnerable Species of Fauna

The IUCN Red List of endangered, threatened and vulnerable species in the project area are Markhor (*Capra flconeri*) Snow leopard (*Unica unical*) Ladakh urial (*Ovis vignei*) Woolly flying squirrel (*Eupegaurus cinereus*.)

4.2.7 Community Controlled Hunting Areas

The concept of biodiversity conservation through community development was piloted in a few selected valleys by International Union for Conservation of Nature -IUCN under a Global Environment Facility (GEF)/ United Nations Development Programme (UNDP) project in Gilgit, Baltistan and Chitral during the period 1995-1998. The success of the project resulted in expanding the concept to a larger canvass and today there are 27 communities-controlled hunting areas. The participating communities are required to write a management plan for conservation and sustainable use and monitor the population of species targeted for trophy hunt. The major species being managed for trophy hunt are Markhor, Ibex, and Urial. The communities are issued permits by government for the number of animals that can be safely hunted. The community's sale the permits nationally and internationally through outfitters. Eighty percent of the income from successful hunt goes to local community while 20% goes to government to cover administrative costs.

In Diamer district, the local people manage wildlife through their own traditional system known as Zaitu Committee. These traditional committees exist in almost all villages/valleys of district Diamer for the sustainable management of respective natural resources. The Zaitus (conservation committee) are formed by village elders (mostly numbardars), with representation of the whole population from each Haiti (Muhallah). However, these traditional committees were reformed by Wildlife Conservation Society (WCS) as Wildlife Conservation and Social Development Organizations (WCSDOs) and have been registered under social act at respective districts offices.

4.2.8 Protected Area

In order to safeguard the biodiversity of key ecological systems, Government of Gilgit-Baltistan has declared four National Parks to protect and conserve bio-diversity of Gilgit Baltistan. These include Handarb National Park, Khunjerab National Park, Deosai National Park and Central Karakorum National Park. In the protected forest, the forest owned by Government as per Forest Act-1927, all activities are prohibited until and unless permitted by the government. Usually, removal of fallen, dying, and dead trees is not banned, however, grazing, sometimes, is regulated to ensure regeneration. In Gilgit Baltistan, designated protected forests cover an area of 445,712 ha and are mostly found in Ghizer, Astore, Skurdu and Gilgit Districts. Out of that 64,512 ha is conifer forests while 3, 81,200 ha are scrub forests (IUCN, 2003).

Aga Khan Rural Support Programme (AKRSP), International Union for Conservation of Nature (IUCN), Wildlife Conservation Society (WCS) and World Wide Fund (WWF) are the main international organizations who over the last two decades have played a crucial role in creating awareness among communities for sustainable management of biodiversity resources. The then Ministry of Environment also implemented a Program for Mountain Areas Conservation (PMAC) to promote biodiversity conservation in Gilgit Baltistan through community participation. This program was completed in 2011. As a result of these efforts the Gilgit Baltistan offers a model for community based management of forestry resources.

Despite of all these conservation initiatives and efforts by government and international organization, fast depletion of forest ecosystems has been observed in the last two decades. The following strategies and actions will be taken to achieve the objectives of conservation, sustainable use and equitable sharing of benefits.

4.2.9 CONSERVATION AND SUSTAINABLE USE OF BIODIVERSITY

The major threats to biodiversity are deforestation, degradation and fragmentation of habitats, indiscriminate hunting, wildlife-livestock competition and killing predators to control livestock losses. Out of total area of 72,496 Km^2, less than one percent (5,016 ha) area – the protected forests, is under management of the government. In addition, 216, 584 or three percent of total area is designated community forests, where except for regulating logging the government has no other role. The remaining 98% landscape is under customary control of the local communities and is used for grazing of livestock and fuel wood collection.

In order to conserve representative samples of ecosystems, and protect the threatened species, a number of protected areas have been established across the region. There are four National Parks, two game sanctuaries, and six game reserves. In addition, to recover the populations of the rapidly declining game animals, the government has introduced a sport hunting programme where local communities are encouraged to protect populations of big game and keep 80% of the permit fee. The location of protected areas is shown in figure 4.6 and an over view of the conservation and sustainable use measures follows.

- Khunjerab National Park
- Central Karakorum National Park (CKNP)
- Deosai National Park
- Qurumbar (Karambar) National Park
- Shandur-Hundrub National Park

4.2.10 GAME RESERVES

The game reserves areas set aside for conservation of key game species, however, hunting and shooting is allowed except under a special permit. There are eight game reserves in GB and an overview of the major species in the area.

Table 4-17: Game Reserves Areas

Game Reserve	Area (km^2)	Key Species
Danyore (Gilgit)	443	Markhor, ibex, Urial, snow leopard, lynx, wolf, fox, etc and bird species
Kilikmintika (Hunza Gojal)	650	Ibex, Marco polo sheep, snow leopard, brown bear, fox, marmot, etc and bird species
Nazbar Nallah (Ghizer Yasin)	334	Ibex, snow leopard, brown bear, wolf, fox, etc and bird species

Chassi Bowster (Ghizer Phander)	370	Ibex, snow leopard, wolf, brown bear, fox, etc and bird species
Pakora (Ghizer Ishkoman)	75	Ibex, snow leopard, wolf, fox, etc and bird species
Askore Nullah Skardu	129	Ibex, snow leopard, wolf, fox, etc and bird species

4.2.11 Aquatic Ecology

Gilgit-Baltistan is blessed with highest potential of cold and clean water resources in shape of lakes, canal, reservoirs, rivers, and water logged areas that offer ideal habitat for trout and other cold water fish species. There is dire need to get maximum benefit from these resources through technological advancement in production, processing and marketing. Both the public and private sector are fully involved in order to judicially exploit this potential both in natural waters as well as its development in culture conditions.

Hunza Valley is blessed with great water resources comprised of streams and alpine lakes fed by the snowmelt and glacier waters. The fish fauna in Hunza Valley is relatively poor due to high turbidity, low water temperature and high water speed.

4.2.12 Fisheries

Fisheries department Hunza was established in the year 2012 with the core aim to develop and promote Fisheries and aquaculture activities in newly created district. District Hunza has very rich aquatic resources of aquaculture and fisheries in forms of bluish lakes, gashing rivers, torrential streams, seasonal and perennial springs etc.

District Hunza being gate way to the CPEC and hub for tourist has great potential in terms of natural recourses and well aware educated man power can contribute and play vital role in the development of the area. The scenic beauty and natural water resources of Hunza attracts a great influx of national and international tourist every year, which may directly or indirectly contribute to the economy of local people and the region.

Fisheries department Hunza has come up with novel approach and ideas to get maximum benefit from wise use and sustainable exploitation of natural resources in multiple ways with special focus on introduction and installation of cage culture system in Attabad lake under controlled environment to enhance production with stocking and multiplication of fine verities of fish in nature. At the same time, it has also been planned to promote sport fishery providing enabling environment and other related facilities for tourists and fish anglers.

For this the Attabad lake having crystal clear water offers as natural gene pool reserve, ideal for excessive multiplication and better growth of many indigenous and exotic fish species.

Table 4-18: Potential Fisheries Resources in District Hunza

S.No	Name of River	Name of Lakes	Name of Nallas
1	Hunza River	Attabad Lake	Misgar Nallah
2		Borith Lake Gojal	Khunjarab Nallah
3		Shimshal Lake I	Dee Nallah
4		Shimshal Lake II	Choporsun Nallah
5		Bathora lake Gojal	Gojarab Nallah
6		Pasho Lake	Khyber Nallah
7			Shimshal Nallah
			Hassan Abad Nallah
Total	01	06	08

4.2.12.1 EXOTIC FISH SPECIES OF HUNZA

i. Salmo Trutta Fario (Brown Trout)

ii. Onchorynchus Mykiss (Rainbow Trout)

4.2.12.2 INDEGENOUS FISH SPECIES

Among the 15 identified indigenous fish species in GB the following six fish species found in District Hunza:

i. Shizothorax plagiostomus

ii. Shizothorax Nasus

iii. Ptychobarbus Conirostris

iv. Triplophysa Terwasae

v. Triplophysa Yasinensis

vi. Diptychus Maculatus

4.3 SOCIAL AND ECONOMIC ENVIRONMENT

4.3.1 Population

The population in Gojal consists of 51% male and 49 % female; it has a population density of 17 persons/acre. The child-women ratio of the study area is 345 children per 1000 women. The dependency ratio is 142 % in Hunza Valley, which shows that there are about 3 dependents on every two earning members. The average size of household is 7.26 persons. The average size of family is 7 persons per household, while the density of room is 4 rooms per household.

In the study area of Gulmit, Shishkat and and Passu total number of households according to the census 2017 is 8697 people, these are the areas surrounding the Attabad village. The detail of population is shown in table

Table 4-19: Population of the Area (2017)

Name of Jamatkhana	No. of household registered	Actual Population
Gulmit central	142	963
Kamaris	42	319
Odver	42	320
Dalgiram	44	307
Chamangul	131	858
Ghulkin	158	1178
Hussaini	89	670
Passu	89	771
Janabad	24	169
Muradabad	4	49
Nazimabad central	117	989
Nazimabad-I- Bala	76	638
Nazimabad II Darmiyan	142	1417
Borith payeen	6	49
Borith bala	2	1
Total	**1108**	**8697**

Source: Gulmit Local Council

Table 4-20: Jamatkhana Wise Population Information Summary 2016

S.#	Name of Village	Name of Jamat Khana	No of Jamati H/holds	No. of Sister Community House Holds.	Sister Community Population			Total Population of Jamati Members			Total No. of House	Total Population		
					Male	Female	Total	Male	Female	Total	Holds	Male	Female	Total
1	Gulmit	Gulmit Central	128	0	0	0	0	486	505	991	128	486	505	991
2		Kamaris	51	0	0	0	0	148	160	308	51	148	160	308
3		Odver	48	0	0	0	0	163	153	316	48	163	153	316
4		Dalgiram	39	0	0	0	0	165	151	316	39	165	151	316
5		Chamangul	201	0	0	0	0	432	426	858	201	432	426	858
OVERALL GULMIT			467	0	0	0	0	1394	1395	2789	467	1394	1395	2789
6	Shishkat	Nazimabad-II Centre	154	0	0	0	0	761	698	1459	154	761	698	1459
7		Nazimabad-1 Bala	80	0	0	0	0	345	312	657	80	345	312	657
OVERALL SHISHKAT			234	0	0	0	0	1106	1010	2116	234	1106	1010	2116
8	Ghulkin	Ghulkin	161	0	0	0	0	639	604	1243	161	639	604	1243
9	Hussaini	Hussaini	127	0	0	0	0	352	341	693	127	352	341	693
10	Passu	Passu + Janabad	119	0	0	0	0	523	444	967	119	523	444	967
11		Muradabad	5	0	0	0	0	37	22	59	5	37	22	59
OVERALL PASSU			124	0	0	0	0	560	466	1026	124	560	466	1026
12	Borith	Birith payeen	7	0	0	0	0	16	8	24	7	16	8	24
13		Borith Bala	Include in Ghulkin											
TOTAL			1120	0	0	0	0	4067	3824	7891	1120	4067		7891

4.3.2 Languages

Burushasky and Wakhi are the main languages of Hunza Valley. There are some other languages in the region as well which are described below:

- **Shina**. Shina is the main language in Gilgit. It is spoken in the Gilgit, Diamer, Ghizer and Astore. Shina speaking people are further found north in the Ishkoman valley and in Hunza, Nagar and further east in Baltistan.
- **Burushasky.** Burushaski is the main language of Hunza valley. It is spoken by the people settled on either sides of the middle cause of the Hunza River, on its northern bank (Hunza) as well as on its southern bank (Nagar). There are also Hunza speaking settlements in Yasin and in Gilgit. Burushasky is still an unwritten language.
- **Khowar.** It is the main language of Chitral, however Khowar speakers may be found in Yasin. Marriage ties make Khowar understood in Gilgit in some families.
- **Balti.** Balti is the sector largest language in the Baltistan Division. It is mainly spoken in the two districts of Baltistan division. Balti peaking people are settled in Skardu, Rondu, Shigar, Khapolu, Kharmang, Gultari and Ganche.
- **Domaaki.** Domaaki is the language of the Domas of Berichos who are also found in Gilgit and in some Shina speaking villages of the lower Hunza valley. They are mainly musicians and smiths.
- **Wakhi.** Wakhi is spoken in Ishkoman valley and in upper Hunza valley by more than 3,000 people. It belongs to the Pamirian branch of Iranian languages.
- **Gojri.** Gojri is the language of Gojar family settled in Naltar valley, Karga and also in the surrounding areas of Gilgit.

4.3.3 Ethnic Groups and Religions

Almost, 95% of the people living in Hunza valley and 100% in Upper Hunza belong to Ismaili faction with The His Highness Prince Karim Aga Khan as their spiritual leader. 5% in Hunza Valley are members of Shia Imami faction which is concentrated in the village Ganish and surrounding settlements.

4.3.4 Administrative Setup

Hunza remained an independent state after 1947 while still staying under the control of the Islamic Republic of Pakistan. The last Mir (Jamal Khan) and his family were retired and the Mirdom was abolished, and Hunza became a subdivision of the Northern Area in 1974. The government tried to establish administrative structure in the valley. The abolition of the traditional institutions left a gap that was partly filled by institutions established under projects of the Aga Khan Development Net Work (AKDN), which started operation in 1979.

4.3.5 Aga Khan Development Network (AKDN)

After the annexation of Hunza and the abolition of the principal state a space concerning rule, law, administration and organization was created. It took a long time for the government institutions to fill this gap. AKDN is an international network and as part of Aga Khan Foundation (AKF) deals with issues such as education, rural development, culture, health services, housing programs and quite a few others. With its headquarters in Geneva and having been founded in 1967, The AKF is an international agency for development co-operation. Within the sub-branches of the AKDN, the Aga Khan Rural Support Program (AKRSP) is for rural development. The activities of the AKDN have shaped the development of the valley extraordinarily. Its various offices provide jobs for higher qualified Hunza cuts when they return from their studies in down country. Employment is also provided in the public sector in the rural areas. The AKDN extends its activities to establishing healthcare facilities and educational institutions.

The AKRSP was established in Gilgit and covers 84% of the household in Gilgit-Baltistan. The AKRSP started supporting institutional development on the local level in 1982 by establishing community-based organizations (CBOs) like Village Organizations (VO) and Women Organizations (WO). These associations were established all over Hunza within a few years. It initiated developmental projects in this area aiming at improvement of the condition of the rural population and providing basic facilities to the masses, with special emphasis on infrastructure.

4.3.6 Housing Characteristics

People in Gojal valley are very traditional about the situation of their households. Settlements are located in the center of the village and agriculture area surrounded it. The center still remains the center but the settlement is now of dispersed type, with the houses being sited on the individual fields. The area also remained safe and secure, and therefore the people did not find it necessary to cluster their houses together in selected sites. Thus the houses are scattered throughout the village from one end to the other end.

The Wakhi house type is a combination of all human activities in one open connected space. The whole structure is erected on five central pillars to support the roof. The fireplace is in the middle of the floor. The different functions of houses are located around the central fireplace (buxari). The house has a lantern place at the ceiling. Almost all the houses in the valley have the facilities of electricity.

4.3.7 Health Facilities and Common Diseases

The villages in the Hunza Valley have somewhat better healthcare facilities than rest of the GB except Gilgit and Skardu. Aga Khan Health Service (AKHS) and Government health workers are providing health facilities in the area. They provide first aid facilities and also give family planning guidance to the people. Gulmit Government hospital was established in 1980.

4.3.8 Education and Literacy

Almost all the settlements in Hunza Valley have a high literacy rate. There was no school before 1946 in the villages of Gojal. Diamond Jubilee School for Boys was established in the Gulmit on the occasion of the Diamond Jubilee Ceremony of Sir Sultan Mohmmad Shah, Aga Khan III in 1946. At present there is one Government High School for Boys and one D. J. High School for Girls, besides one public high school: Al-Amin Model School for boys and girls. There are two primary schools in Hussaini village. Literacy rate in Hunza is almost 95% which is higher than other districts of GB. Girls in Hunza are enthusiastic about their future so they prefer to have higher education. For higher education students go to KIU Hunza Campus in central Hunza; a number of boys and girls are studying in Gilgit, Islamabad, Peshawar, Lahore, and Karachi for higher studies.

4.3.9 Infrastructure and Recreation

Infrastructure facilities including health, education and transportation are available in Hunza Valley to those near the KKH. Construction of Karakoram Highway (KKH), the Silk route or Pak China Friendship Highway, was started in 1965 and was completed in 1986. The KKH starts from Thakot in KPK and continues up to Khunjerab Pass; it has over one hundred bridges. The length of KKH is 1300 km and width is two lanes. KKH has played an important role in the development of Hunza Valley. Buses and vans are used for traveling in Gojal from and to Gilgit and down areas of the country. Public transport is provided by both Private vans and Government buses (NATCO).

The impact of the Karakoram Highway is very conspicuous on the socio-economic condition of the villages. Karakoram Highway provides an important link between Pakistan and China. This road serves the tourist traffic and acts as supply route for the mountaineers to the down country and other neighboring countries.

Recreation and tourism has grown in the area rapidly, which in future can become an important source of income. Impact on literacy rate is also becoming obvious with the fact that on the one hand more educational institutions are being opened.

4.3.10 Professions and Source of Income

The people of the area are linked with different professions like tourism sector, business, livestock, dry fruits, trade and government jobs.

4.3.11 Social Organizations and NGO Involvement

NGOs have also been very active in the water sector. Aga Khan Rural Support Programme (AKRSP) has accorded high priority to the Northern Areas' irrigation systems and water supplies from its inception; AKRSP also pioneered the creation of Water Users' Organizations (WUOs), which now play a pivotal role in all village-level, water-related activities. With the technical assistance of Aga Khan Cultural Service Pakistan (AKCSP), the Karimabad Town Management Society has been involved in the development of a new sewerage system for the town of Karimabad.

4.3.12 Tourism and Cultural Heritage

Hunza is the tourism and business hub of Gilgit-Baltistan thus a large number of residents from this area directly or indirectly involves either in business or work in tourism sector.

4.3.13 Status of Women

Women are empowered in Hunza Valley and receive primary as well as secondary level education, while those having education limited to intermediate go in for teaching thus making primary female teachers available locally. Moreover, male as well female students from each village in the Gojal tehsil are studying outside Gojal and also abroad and more preparing to leave in the near future, women and girls have to take up what the men and boys were supposed to do.

5 ESIA AND MITIGATION MEASURES

5.1 GENERAL

Determining the significance of impacts identified is one of the main purposes of an ESIA and it enables the identification of necessary mitigation and a determination of environmental and social costs associated with the Project. Environmental and social impacts of any project are identified taking into account all phases of the project cycle, including planning, construction, operation and decommissioning. The environmental issues and impacts of a project depend upon the nature of the project activities, and the types and extent of interventions involved. It is not easy to predict the future and assign a relative value or overall significance to an impact, since every impact has a different and multi-dimensional nature, and also because it involves personal and subjective judgment for many attributes. An environmental or social impact can be either beneficial or adverse and is assessed by comparing the quality of the existing environment with the predicted quality of the environment once the project is in place. This ESIA identifies the impacts likely to arise as a result of construction and operational activities and assesses the likely magnitude of the impact in order to provide some indication as to which impacts are likely to be most significant. The impact assessment has been based on that environmental checklist developed by the Asian Development Bank (ADB).

5.2 IMPACT ASSESSMENT PROCEDURE

In order to describe the significance of an impact it is important to distinguish between two concepts: sensitivity and magnitude. As far as possible the sensitivity and magnitude of the impact are described with reference to legal requirements, accepted scientific standards or accepted impact assessment practice, and/or social acceptability. Where no known published 'standard' criteria exist for determining the magnitude of effects, established professional criteria and best practice techniques are used and clearly described.

5.2.1 Sensitivity

Sensitivity is generally site specific and criteria are developed from baseline conditions. The sensitivity of a receptor is determined based on review of the population (proximity/ numbers/vulnerability), presence of biological features of the site or the surrounding area, soil, agricultural suitability, geology and geomorphology, existing air quality, presence of any architectural and historic heritage, landscape etc. Sensitivity, relates to the value, importance and tolerance of an environmental resource or receptor and should take into account where possible stakeholders views and public acceptability. Sensitivity can be categorized as high, medium, low, and negligible to the assessment of receptor sensitivity.

5.2.2 Magnitude

The assessment of magnitude is undertaken in two steps. Firstly, the key issues associated with the project are categorized as being either adverse or beneficial. Secondly, beneficial and

adverse impacts are then further subdivided into major, moderate, minor or negligible based on consideration of the parameters listed below:

- duration of the impact
- spatial extent of the impact
- reversibility
- likelihood; and
- legal standards and established professional criteria.

In order to make the report as meaningful and useful as possible, an attempt has been made to describe each impact in the following terms: positive impacts refer to beneficial effects and negative impacts refer to harmful effects on e.g. natural resources, human beings and economy.

5.3 IMPACTS DURING CONSTRUCTION

During the construction phase of the project most of the impacts identified are of a negative nature but some of them will be temporary and will vanish with the completion of project.

5.3.1 Impacts on Topography

Topographically, the study area (consisting of a major part of the Hunza Valley), is characterized by steep slopes and narrow valleys. Attabad situated on the outside bend of the Hunza River bed is one of the smaller villages of the Hunza Valley and was located in a rough pastoral environment surrounded by natural slopes with sparse vegetation.

The interventions of the Attabad Lake HPP are not likely to impact the topography of the area on a large scale except for those areas where the physical activities of excavation, digging and movement of heavy machinery will take place. Similarly, areas where excavated material from tunnels will be disposed, dumped or stored will be negatively affected. This impact can be considered as a negative impact with moderate magnitude.

Mitigation

To reduce the negative impacts of excavated material: firstly, the emphasis should be to reduce the volume of material requiring disposal and, secondly, to dispose it in environmentally friendly way. The following measures are proposed in this respect:

- As far as disposal on the dam site area is concerned, some of the spoil can be used for construction project related structures.

- To make the dam site easily accessible for movement of heavy machinery and for large number of vehicles (per hour/per day), it will be necessary to improve, upgrade and widen the roads. Some of the spoil can be used for widening of the roads.

- Part of the excavated material on the powerhouse site can be used for making aggregate required for project construction and for the development of infrastructure such as roads and filling of natural depressions.

5.3.2 Impact on Seismicity

The area is well known to consist of active landslide zones as more than 33 damaging events have occurred in the region during the period from the year 1830 till January 2010 (Kreutzmann 1994). In addition to this, according to the Geological Survey of Pakistan (GSP) a fault line also passes through the area. During the devastating 2002 earthquake in Astore that also hit Attabad, the process of crack evolution in the mountains of Attabad region was observed, which worsened during the subsequent strong earthquake (7.5 on Richter scale) in 2005. With the passage of time, cracks began to widen slowly and gradually on January 4, 2010, slope failure occurred in the Attabad region resulting in the establishment of a natural dam that completely blocked the Hunza River. According to the initial estimates, a slide mass of approximately 30 million m_3 fell from the northern valley wall.

Mitigation

All structures to be built must be designed giving maximum allowance to seismic factors. A very careful analysis of the situation will be required during the design stage of the project by specialist consultants.

5.3.3 Impact on Geology

Almost all project interventions involve excavation of natural rocks, cutting of formations, moving and dumping of spoil. During tunnel excavation and some other operations, blasting of the formation will be required. All these activities will disturb the existing geological formations and consequently physical features of the local geological formations of the project area will be damaged at some places, which is a negative impact of moderate magnitude.

Mitigation

All these activities are an integral part of the project interventions and cannot be avoided. Blasting should be minimized where possible (near the surface) and, if unavoidable, low power explosive should be used and a greater number of blasts with low power material may be preferred instead of high intensity single blasting.

5.3.4 Impacts on Landslides

As the natural dam had been a result of a major landslide, therefore, special emphasis should be given to this aspect. Landslides are common in the project area due to the high steepness, unstable geological formations on both sides of the river and common seismic activities. Due to the project activities, especially blasting of rocks in some areas, the formation will become loose and the risk of landslides will increase in the immediate vicinity of the construction sites

specially at the right bank of Hunza River, which may be considered as a moderate negative impact of the project.

Mitigation

To avoid the major risks, all structures are proposed on the left bank of Hunza River. Further, to minimize blasting of formations and, if unavoidable, then use low intensity explosive if possible.

5.3.5 Impacts on Land Use

There will be no major impacts on the land use of the area as the lake has already been formed and changes has already been taken place long before this project. However, new infrastructure will be built in the area which would have positive impacts on the land use.

5.3.6 Impacts of Excavated Material

It is planned to excavate a 5.3 m diameter headrace tunnel 2.1 km long from the weir site to the powerhouse, one diversion channel and one tailrace tunnel. Excavated spoil material will require dumping at both ends of the tunnels near the dam and near the powerhouse. Unplanned disposal may create environmental degradation of the area and environmental issues of significant adverse impacts can emerge during construction of the project. The nuisance created by excavated material will be a moderate negative impact of the project.

Mitigation

Same mitigation measures as of Section 5.3.1.

5.3.7 Impacts on Infrastructure

As there would be no resettlement involved in the project, therefore, impacts on infrastructure would be rather positive.

5.3.8 Impact on Climate

Project construction involves large scale activities including the movement of different types of light and heavy traffic, working of heavy machinery, blasting of rocks, operation of batching and mixing plants and the presence of large numbers of people in the area. Due to all these activities, it is expected that the microclimate of the project area (surrounding the dam site and powerhouse site) will suffer significantly. However, no impact on climate of the whole project area is expected, either positive or negative, during the construction phase.

Mitigation

The deterioration in the local climate during the construction phase will be of a temporary nature and will disappear with the completion of the project. However, some measures to minimize the impacts on air quality mentioned are as under:

- Use of new and good condition old vehicles which emit less quantity of smoke.
- Regular tuning and maintenance of vehicles and other machinery.
- Avoid blasting to the maximum level but where necessary make the moderate intensity blasting instead of heavy intensity and blasting must be during daytime.

5.3.9 Impacts on Hydrology

During the construction stage, there will be no changes in the hydrology of the river. The flow from the reservoir will be diverted to downstream of the weir through diversion channel. The adverse impact may be considered as of negligible magnitude.

Mitigation

No mitigation is required as impact is very minor in nature.

5.3.10 Impacts on Surface Water

During the construction stage, no impact on quantity and quality of the surface water is envisaged as entire water in the river will be diverted from the reservoir to the river from the diversion channel.

Mitigation

No mitigation is required.

5.3.11 Impacts on Sedimentation

During the construction stage, the overall sedimentation rate will remain almost the same up to the dam site, but it may change because of movement of heavy traffic, dumping of the excavated material and other project related activities. The impact is considered as negative but of short duration and of minor magnitude.

Mitigation

This impact is unavoidable due to the nature associated with project activities, which will disappear with the completion of the project.

5.3.12 Impacts on Flooding

Flooding of the river at the dam site is not a common feature although some floods of high intensity are recorded in the past e.g. the glacial lake outburst floods of 1929. As river water from the upper cofferdam will be passed through diversion channels, there is chance that these tunnels could not accommodate the flows in any abnormal year. In such cases, floodwater can overtop or breach the cofferdam and damage the partially constructed civil works and lower cofferdam. The impact can be considered as significant positive impact.

Mitigation

The diversion tunnels must be designed to pass maximum flow of the river and height of the upper cofferdam should be fixed keeping in view the historic flood height at dam site.

5.3.13 Impacts on Groundwater

During construction stage, no impact on groundwater is envisaged as the flow of water will continue as such without any storage.

5.3.14 Impacts on Air Quality

The project activities during construction at both weir and powerhouse sites will involve large movements of heavy diesel operated machinery and vehicles which produce more noise and generally emit more smoke. Similarly, various levels of noise and air pollution are expected to be generated from construction machinery and equipment, working of heavy earth moving machinery, drilling, blasting operations, concrete mixing, pouring equipment and stone crushers etc. The impact on air quality is considered as short duration negative impact of moderate magnitude.

Mitigation

All sources of air quality deterioration will be for short duration, temporary in nature and associated with project construction activities, which will end with the completion of the project. The contractors and sub-contractors must be held responsible through special clauses in the tender documents to strictly follow precautionary measures.

5.3.15 Impacts on Agriculture and Vegetation

Agriculture in the project area is practiced on a limited scale on scattered flat patches and on contour strips developed by the farmers with their own efforts and resources. The main source of irrigation in the area is the snow melt water diverted from streams towards crops, orchards and fields. No irrigation is practiced from river water in any part of the project and no impact on agriculture is expected during the construction phase of the project.

5.3.16 Impacts on Terrestrial Flora

The project area has very thin vegetation cover due to the special features of the terrain i.e. poor rainfall and steep mountains with very little soil cover. During construction stage, the damages to flora can be done by vehicles and machinery, establishment of camps and permanent structures etc.

Mitigation

Dumping of construction materials should be avoided where large number of terrestrial trees, shrubs, herbs, grasses and fruit trees are found.

5.3.17 Impact on Terrestrial Fauna

Construction activities will generate moderate to major impacts to Fauna within the project area in particular at the powerhouse, dam site, tunnel route and quarrying areas. Blasting and tunneling in particular will cause loud shocks and vibrations that are likely to affect habitats and wildlife in surrounding of the project area. The ability of wildlife species to move out of construction areas will depend on the availability of suitable alternative habitats, access to those habitats, and rapid mobility required to avoid construction clearance activities. Sometimes some mammals come down from the uplands in search of food. Construction activities will disturb the migratory route of mammal species, however, this will be a minor impact.

Overall, the construction activities will generate impacts of negative nature on all types of fauna but of moderate magnitude.

Mitigation

Almost all impacts will be of a temporary nature, which will end with completion of the project. Dumping of construction materials should be avoided in areas where mammals, amphibians, reptiles and birds settle.

5.3.18 Impacts on Aquatic Life

During the construction phase, very nominal impact on aquatic life is expected as there will be no change in flow patterns in the river. The impact can be taken as of negligible magnitude.

5.3.19 Involuntary Resettlement

There is no displacement involved for the project, thus, no resettlement will be taken place.

5.3.20 Impacts on Employment Opportunities

At present employment opportunities in the project area are limited to few fields which would increase with the construction activities. Majority of local employees will be engaged in the unskilled and semi-skilled sectors. Employment generation impacts during the construction period are to be considered as major positive impact of the project.

Enhancement

The contractors of the project components shall be bound legally through contract agreements to engage 100% unskilled labor from project area / Gilgit-Baltistan. Preference should also be given to local skilled and semi-skilled manpower if available.

5.3.21 Impacts on Regional Safety and Health

People of Hunza are used to interact with people from different areas, cultures and communities. However, when there is sudden influx and congestion of people at any place from other areas for a longer period of time, it may contribute to adverse effects on the community health, safety

and security of locals. There is always potential for such social impacts as incidences of accidents, social conflicts, theft and spread of communicable diseases.

Mitigation

The contractors must be bound to establish workers camps sufficiently away from the settlements of local people. During construction, the project working sites need to be bordered by a fence to safeguard life and property. As appropriate, any warning signs related to safety and security should be displayed in local languages. An appropriate security system must be in place to control all access routes to the site.

5.3.22 Impacts on Occupational Health and Safety

There is a tendency for the construction sector to be unregulated with respect to occupational health and safety. Additionally, unskilled and even some skilled construction workers may be illiterate and not necessarily informed or familiar with the protective measures to be adopted during work.

Mitigation

The contractors will need to carry out risk assessments and then develop site and project specific Health and Safety Management Plans to prevent accidents, injuries and work-related diseases.

5.3.23 Impacts on Resources

Construction workers will need their daily supplies in the project area. This could potentially negatively affect the existing resource base and cost for firewood, food, goods, water and fish as well as create considerable amounts of waste. Both community members and construction workers will be affected by resource constraints and changing prices and are considered sensitive socio-economic receptors, because of their limited purchasing power and state of poverty which could be affected by these impacts. These impacts are considered to be negative and of minor magnitude.

Mitigation

Mitigation measures will be needed to ensure that the project site is managed in a manner that is socially responsible and reflect sound environmental management practices. With respect to resource use, the Contractors will be expected to develop a plan and budget for providing workers with fuel for cooking and heating, water for cooking and cleaning, food supplies, and hygienic sanitation facilities for collecting and disposing rubbish, including construction waste.

5.3.24 Impact on Roads Traffic

The project area is approachable only through KKH which is also used for trade purposes with China, however, some weir and tier will be occurred with the movement of heavy traffic. This impact is one of the minor negative impacts of the project.

Mitigation

Care must be exercised for the safe transport of raw materials and the transport and disposal of waste. Project vehicles and equipment will be maintained properly and project related traffic will be required, as a minimum, to travel at not more than the speed limit.

5.3.25 Impacts on Communication

The existing local roads network of the area is very poor. During construction, a number of additional local access roads and bridges will be required to facilitate construction works. The proposed location for the headrace tunnel is currently not properly accessible at the weir site on left side of the river and will require repair. Impacts of the enhanced road network and improved communication facilities in the project area are considered to be a major positive impact of the project as local inhabitants will also use the same infrastructure.

Mitigation

No mitigation is required as impacts are positive in nature.

5.3.26 Impacts on Cultural Heritage and Archaeology

No site of archaeological and historical importance has been identified in the project site. Some carving on stones were found near the powerhouse site regarding the incident of 2010 landslide but these carvings are outside the project construction area.

Mitigation

Appropriate community relations have to be maintained for social respect between the local people and labor coming from other parts of the country.

5.3.27 Impacts on Tourism

The Gilgit Baltistan areas of Pakistan cover 72,496 km² and possess one of the most rugged landscapes on earth and about 101 peaks above El 7,000 m. Hunza has even a special place in GB itself and every year hundreds of local and foreign tourists move into the area particularly during the summer. During the construction phase of the project no impact of any positive or negative nature is expected.

5.3.28 Impacts on Women and Indigenous People

Construction of the project may affect access of local people to their traditional migratory routes, and may reduce safe passage not only for the people but also for their animal herds.

Mitigation

The impacts described above will occur during the construction period and are reversible once the project is complete. Efforts shall be made by the contractor to inform and consult the leaders

and elders of the community about the project, especially regarding mobility and access through the construction areas.

5.4 IMPACTS DURING OPERATIONAL STAGE

During the operation phase, most of the impacts of the project on the environment of the area will be of a positive nature and negative impacts will be much less as compared to the construction phase.

5.4.1 Impact on Seismicity

The project area is considered as part of a seismically active zone. The construction of large structures may enhance seismic activity in the area which can adversely affect the weir structure, headrace tunnel, diversion channel and other structures as well as public and private property besides the loss of human life.

Mitigation

As the project is situated in an active seismic zone, continuous monitoring of the behavior of faults will be required during the operation stage and contingency plans to deal with such a situation must be part of the project management. Instruments to monitor seismic activity must be installed at the time of construction.

5.4.2 Impacts on Geology

During operation of the project the seepage from the reservoir will significantly impact the geology of the area. The seepage water will saturate the formation below and along the reservoir and soluble minerals from the rocks will dissolve in the water. Some solution channels may develop in the formation making the formation more pervious.

Mitigation

It is difficult to check or reduce the seepage from the reservoir. A continuous monitoring system will be required during operation of the project to monitor the changes in groundwater level and chemistry of ground water.

5.4.3 Impacts on Landslides

It is expected that landslides could increase due to construction activities. Further the seepage of water will make the formation loose and unstable and the chances of sliding due to rainfall, abnormally high and low temperatures and due to seismic activities will increase. The sloughing and slippage of saturated formation during regular flushing of the reservoir may also enhance the sliding potential of the area. This impact may be considered as a major negative impact.

Mitigation

As no mitigation is possible to check either the seepage or any resulting landslide, however, as after a few years of project operation most of the rocks along the weir site will become stable.

5.4.4 Impacts on Land Use

After construction and during the operation phase, some positive changes in land use are expected as areas under construction camps and other auxiliary services will revert to their pre-project use.

5.4.5 Impacts of Dismantling Material

After completion of the project construction but before operation of the project, temporary structures, batching and mixing plants and labor camps etc. will require dismantling and a large quantity of spoil material will become available for proper disposal, which will be a moderate level negative impact of the project. The debris produced will require proper dumping or disposal to avoid any environmental degradation. This spoil will pose a moderate negative threat to the environment.

Mitigation

There are places in this length near powerhouse site where spoil can be dumped without producing any adverse impact.

5.4.6 Impacts on Infrastructure

The construction at powerhouse site will disturb the supply line of goods and services for people living on the right side of the river at Sarat Village, however, enough space is available at the powerhouse site for the movement of locals. The impact is considered as a moderate negative impact of the project.

Mitigation

Proper boundary shall be marked by the contractor at the construction sites to facilitate the locals.

5.4.7 Impacts on Climate

The lake has already been there since 2010, therefore, no major changes would occur to the climate after the project has been completed.

5.4.8 Impacts on Hydrology

During the operation stage, there will be no changes in the hydrology of the river. Flushing will be carried out regularly and no special annual flushing will be needed, therefore, no changes would take place on hydrology of Hunza River, moreover, 3 m^3/s environmental flows will be released, at least, to downstream of the weir for the aquatic life during operation.

Mitigation

To conserve the aquatic life (flora and fauna) of the river downstream of the weir (2 km patch), minimum flow of 3 m³/s has been calculated as the environmental flow. It will be obligatory for project operating agency to release 3 m³/s in the river throughout the year as environmental flow.

5.4.9 Impacts on Surface Water

The capacity of the reservoir at El 2,409 m.a.s.l is calculated as 125 Mm³, which is very small compared to inflows. As the Attabad Lake HPP is a run-of-river power project, with the implementation of the project there is no chance of reduction of discharge in the river except in the section between weir and end of tailrace (2 km). Presently, in this section of the river, water is not being used for any purposes either for human consumption or for agriculture. Therefore, it is anticipated that there will be no impact on human population due to the diversion of discharge into the tunnel.

Mitigation

Environmental flows must be ensured to maintain the surface water hydrology of the Hunza River.

5.4.10 Impacts on Sedimentation

The Hunza river water always contains huge sediments of around 20-21 Million Tons annually on average. Diversion Channel will be used for flushing of sediments during high flow months. It is expected that release of sediments in moderate quantity could change the morphology of the river below the dam. However, as sediments will be released during high flow months with relatively high velocity of water and the river in this section has a high gradient, it is expected that sediment will move far away from the downstream of the weir site.

Mitigation

The silt clearance (flushing) mechanism has been provided in the project design through channel/sluices. It is proposed to flush the reservoir regularly during high flow months.

5.4.11 Impacts on Flooding

Flooding of the Hunza River at the weir site is not a common feature although some floods of high intensity have been recorded in the past at upstream site e.g. the glacial lake outburst floods (GLOF) at Shimshal River. As river water will pass through the headrace tunnel and overflow spillways, there is a chance that these tunnel and spillways could not accommodate the flows in abnormal years, which may pose a threat to the main structures and this impact can be treated as major negative threat.

Mitigation

The design of the weir has considered the design flood of 1 in 10,000-year flood of 3,250 m³/s.

5.4.12 Impacts on Groundwater

The lake has already been formed, therefore, there will be no change to the groundwater.

Mitigation

No mitigation measures are required.

5.4.13 Impacts on Air Quality

Ambient air quality of microenvironment i.e. at Sarat and Salmanabad Villages would be raised, though, slightly during the construction and reconstruction activities. Fugitive dust emission from discharge of mining waste would result from tunnel excavation. This waste will have to be suitably disposed-of, or else it would add to the sediment load that will be carried by the river.

5.4.14 Impacts on Agriculture and Terrestrial Vegetation

Agriculture in the project area is practiced on a limited scale on scattered flat patches and on contour strips developed by the farmers with their own efforts and resources. The main source of irrigation in the area is the snow melt water diverted from streams towards crops and orchards and no irrigation is practiced from river water in any part of the project, and no major impact on agriculture is expected in the project area with the implementation of the project.

5.4.15 Impacts on Flora and Fauna

There would be no significant impacts on Flora and Fauna of the microenvironment of the area during operation stage.

5.4.16 Aquatic Life and Fish Stocks

5.4.16.1 Habitat Destruction

During construction and operational phases of 54 MW hydropower project cutting, blasting, excavation, drilling, extraction, removing and dumping activities of materials at large scale contribute heavy sedimentation and soil erosion which may cause habitat damage, loss of vegetation, contamination and toxic accumulation of waste not only at Attabad lake but its impact can be seen downstream of the river as well. This situation can contribute up to great extent to destruct the aquatic life, ecology, breeding and spawning grounds of fishes, benthic fauna, food chain and abundance of micro and macro living organisms. This may lead rapid shortage of food like benthic population, phytoplankton, zooplankton, nekton etc which play an important role to sustain food chain with different trophic level in any eco-system.

Fisheries Department of Hunza has introduced several thousand fingerlings of exotic fish species namely Salmo Trutta Fario (Brown Trout) at Attabad Lake and downstream river during the period from 2012 to date for propagation and the said specie has made breeding grounds at Attabad Lake and downstream as well. Besides this a number of indigenous fish species also exist in the same water bodies having commercial as well as ecological importance.

5.4.16.2 Water Pollution

Heavy machinery and equipment will be used during construction and operational phases of the project with huge quantity of explosives for blasting of rocks. Resultantly heaps of leftovers of explosives, grease, chemicals, lubricants, and other harmful materials will be produced on daily basis. These pollutants through run off rain water enter into the lake and river course increase toxicity of water causing rapid destruction of fish population and riverine ecology.

5.4.16.3 Fish Migration

Fish usually migrate from one place to another for search of food, shelter and spawning/breeding. Due to construction of the project fish migration might be affect up to some extent.

Mitigation

- Rapid mechanism of dispose-off of such kinds of hazardous materials will be required on urgency basis by dumping the extracted hazardous materials selecting safe landfill areas away from the main river course and its watershed, so that contaminated water in form of runoff could not enter directly into the main course.
- Land sliding and soil erosion are also the main factor to contribute silt load on river bed manifold causing damage to resting and nesting grounds of fishes. Construction of protective walls and gabions at certain points to make sure the stoppage of sliding debris. Plantation and vegetation cover can also be helpful for slope stabilization. Plants, herbs and sharbs reduce the level of pollution and toxicity at a great extent as bio-filter and carbon suckers.
- Fish ladder shall be insured for freely movement of fishes.
- Fish screening system should be developed so that fish may not be trap at intake, penstock pipe or channel.
- Sewage water treatment discharged from all labour camps and toilet facilities must be treated before disposal into the river.
- Tanks of fuel, oil and other liquids to be placed quite distant from any water body.
- Washing of vehicles or other machinery in the river or nallahs to be strictly prohibited.
- Oil changes for engines and other machinery to be only allowed in workshops.
- All vehicle and machinery to be maintained properly in order to avoid any leakages.

5.4.17 Impacts on Power

The most significant impact of the project will be the power generation as the region is presently facing acute shortage of power. The power generating capacity of the project is estimated as 54 MW, which is enough to remove the power shortage from the area. The power generated will help to establish new industries, to boost commercial activities and to enhance job opportunities

in the valley. Electricity generation impacts are considered to be most significant positive impact of the project.

5.4.18 Impacts on Employment Opportunities

During operation stage, a large number of both skilled and semi- skilled manpower will be required, who will be recruited from the local area. Employment generation during the operation phase is considered to be of a major positive nature.

5.4.19 Impacts on Social Services

Access roads and basic infrastructure will be built as part of the project and will facilitate the access for people to goods and services. After completion of the project, these facilities and infrastructure will be available to the general public of nearby villages. The impact of better communication and other social services is considered to be a moderate positive impact of the project.

5.4.20 Impacts on Tourism, Landscaping and Visual Amenity

The Northern Areas of Pakistan cover 72,496 km² and possess one of the most rugged landscapes on earth and about 101 peaks above El 7,000 m. Every year hundreds of tourists (local and foreign) visit the area particularly during the summer.

Hunza is known for their outstanding natural beauty, high peaks and landscape and it is a popular destination among tourists from both Pakistan and abroad. The area offers tourists opportunities for outdoor activities such as hiking, fishing and trophy hunting. Impact relating to recreation activities is considered to be moderately positive.

5.4.21 Impact on Women

Contrary to the construction phase, there will be much less movement of vehicles as well as people in the area during the operation phase. Thus during this phase no negative impacts on women are expected.

6 ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

6.1 OBJECTIVES OF ENVIRONMENTAL MANAGEMENT AND MONITORING

This section of the ESIA report provides an overall approach for managing and monitoring the environmental and social issues raised by the construction and operation of the Attabad Lake Hydropower Project. The objective is to provide an overall framework for implementing the mitigation measures that adequately address the identified adverse impacts and also the enhancements for predicted positive impacts. In addition, the items that require monitoring of the environment are also identified. All of these measures are to be put into a coherent Environmental Management and Monitoring Plan (EMMP), complete with the institutional arrangements and resources required to successfully implement the required actions.

The main objectives of an EMMP are as under:

- Provide the details of the project impacts, along with the proposed mitigation and enhancement measures.
- Define the roles and responsibilities of the project stakeholders, including the project proponent, contractor, supervisory consultants and other key players.
- Identify the training requirements needed for the key role players in order for them to effectively implement the EMMP.
- Provide a mechanism in the form of an environmental monitoring program, that outlines which key parameters (both for the natural and social environment) will need to be monitored and the frequency that each of these has to be carried out.
- The objective is to ensure that mitigation measures are being effective in keeping environmental conditions within prescribed limits and if they are not, then making sure that there is an effective response mechanism that allows corrective action to be implemented.

6.2 MITIGATION MANAGEMENT MATRIX

The Mitigation Management Matrix (MMM), a preliminary outline is considered to be one of the main elements of the EMMP. The MMM shall be prepared during detailed design keeping in view the required functions and responsibilities and is to be used as the management tool for the implementation of mitigation measures. The mitigation management matrix should include:

- The required mitigation measures recommended in the ESIA report.
- Identification of the person or institution/organization directly responsible for adhering to or executing the required mitigation measures.
- The person or institution/organization responsible for ensuring and monitoring adherence to the mitigation measures.

- The parameters that will be monitored to ensure compliance with environmental standards and also with the requirements and objectives of the mitigation measures.
- The timing at which the mitigation or monitoring has to be carried out.

6.3 MANAGEMENT OF DIRECT CONSTRUCTION IMPACTS

Construction programs and management of construction impacts shall be included by drafting appropriate environmental management clauses into the construction contracts. Once a master checklist of direct construction impact issues has been finalized then a monitoring checklist can be created for use by the supervising engineers during the construction period. It is crucial to clearly define the responsibilities of each of the parties in the construction works (contractors, supervisors and the project proponent).

6.4 SITE RESTORATION PLAN

The main areas that will require site restoration include the main construction site area, workers' accommodation sites, land used for vehicle and material workshops and stores along with material excavation and storage areas and temporary access roads and tracks. These areas will need to be restored to their original condition as far is possible and where there has been significant change then landscaped to fit with the surrounding area. The restoration work includes the removal of all temporary construction works and materials, followed by the landscaping and planting of the areas, including provision of adequate surface drainage to ensure that there will be no erosion and particularly sedimentation into the reservoir. The following procedures will be adopted for the restoration of the site:

- All temporary constructions built for the site development will be removed.
- Areas used for construction camps will be restored to their previous condition as far as is possible and where this is not then appropriately landscaped and planted to an agreed plan.
- All toxic and hazardous chemicals and materials will be totally removed from the site followed by treatment and environmentally appropriate disposal.
- During the construction program efforts will be made to minimize the risk of oil and chemical spills and an effective clean-up program should be in place to remove these as soon as they happen.
- All debris from construction activities should be removed from the site and appropriately separated, reused, recycled and composted with the residual material appropriately incinerated.
- All redundant fencing and gates will be removed and excavated pits will be appropriately backfilled.

6.5 RESERVOIR MANAGEMENT PLAN

Reservoir area will need to be managed during both the construction and operation of the project. The risk of debris entering the intakes also has to be considered. Once a clear idea of the construction program has been agreed then an appropriate reservoir management plan can

be drawn up. This should also include the fisheries development plan for the reservoir, along with a recreation and tourism management program for the area.

The reservoir management plan will also have to consider the need for upstream catchment management measures in the watercourses that directly discharge into the reservoir, based upon the results of water quality monitoring that will be carried out. The quality of the reservoir water will also need to be monitored to ensure that there is not a buildup of nutrients that could cause problems with algal growth. If this should start to occur, then adequate measures will need to be taken to prevent nutrient loaded water from flowing into the reservoir.

6.6 IMPACT MONITORING PROGRAM

6.6.1 Objectives of the Impact Monitoring Plan

The objective of the environmental monitoring activities to be carried out during the construction and operation stages of the project will be as follows:

- To monitor the actual project environmental impact on the physical, biological and socioeconomic indicators that will be selected to be appropriate for such work in order to compare appropriate indicators with the situation before the start of the project.
- To provide information that will allow recommend mitigation measures to be drawn up for any unforeseen impact or where the adverse impact level exceeds that anticipated.
- Ensure compliance with legal regulatory requirements and also community obligations, including health and safety at both the construction and operational stages of the project.
- Ensure the safe and environmentally sound disposal of excess construction materials, solid waste and effluents, along with the adequate management of noise and dust emissions.

The main objectives of environmental monitoring during the operation phase will be to:

- Appraise the adequacy of the ESIA with respect to the predicted long-term impacts of the project on the physical, biological and socio-economic environment of the area.
- Evaluate the effectiveness of the mitigation measures proposed in the EMMP and recommend any improvements in the EMMP if they are found to be required.
- Compile periodic incident and accident data to support analyses that will help to minimize future risks.
- Monitor the survival rate of the proposed vegetation planting program and make appropriate proposals to ensure that balanced mixed age and species stands develop in the area that provide sustainable supplies of fruit, fuel-wood and fodder for the local population.

6.6.2 Monitoring Strategy

All the compliance monitoring will be executed by the Contractor during the construction stage of the project to ensure that they operate according to the regulatory framework. Supervision of the

compliance environmental monitoring work during the construction stage will be carried out by the Supervisory/Management Consultants (SC).

6.6.3 Monitoring Parameters and Frequency

i) Natural Environment

For the physical environment the following parameters will need to be regularly monitored both before and during construction:

- Ambient air quality (mainly NOx, Sox and CO)
- Batching and crushing plant emissions (smoke, dust, etc.) during operation
- Ambient noise levels
- Water quality (drinking, surface and groundwater), for both chemical composition and also sediment

ii) Socio-economic Environment

The impacts on the socio-economic environment will be monitored by the SC using changes in household economic livelihoods as a major indicator in the longer term. Other key aspects that will need to be monitored include environmental and community health, safety issues, employment availability and generation, along with physical mobility and access, especially for women.

At the construction stage of the project the Supervisory Consultant will maintain a Social Complaints Register. This is an open public document that allows anybody to register a complaint which must then be thoroughly investigated and a judgment made as to its justification and the action need to address the issue.

6.7 CONSTITUTION OF PROJECT ENVIRONMENT MANAGEMENT COMMITTEE

Sr. No.	Agency	Representative	Status
1	WAPDA	Project Director	Chairman
2	Government of GB	DC/ AC (Concerned)	Member
3	Consultant	Resident Engineer	Member
4	Main Contractor	Designated Engineer	Member
5	Environment Department	Director, EPA GB Representative	Member
6	Local Government	Chairman District Council	Member
7	NGO	Representatives of two functional NGOs of the region	Member

6.8 LAND REQUIREMENTS FOR THE PROJECT

Resettlement, land requirements and acquisition for any mega project is a sensitive task, however, for this project these issues are not as critical as in other projects. Attabad Lake was formed in 2010 as a result of a natural disaster and it still recovers about 4.5 km^2 of land which includes lands of Ainabad, Shishkat, Gulmit and Gulkin. Shishkat, Gulmit and Gulkin are were partly damaged but Ainabad was completely submerged.

Land will be acquired for mostly powerhouse site which includes land powerhouse, switchyard, project colony and project offices. Land at weir site is mostly riverine land and will be acquired from the government. Land required for the Attabad Lake HPP is mentioned in the Table 6-1. Land Requirement for the Project is depicted at **Drawing-II**

Table 6-1: Land Requirements for Attabad Lake HPP

Sr. No.	Description	Town / Village	Land in Acres	Land in Kanals	Land Cost per Kanal (DC Rates)	Remarks
1	Powerhouse Side	Sarat	4	32	750,000	Community Land of Ganish Village
2	Weir and Associated Structures	Attabad	15	120	500,000	Mostly it is riverine land. Left Side of Hunza River is Community Land of Ganish Village and Right Side is Community Land of Attabad Village.
3	Access Roads to Sites	-	-	-	-	Old KKH will be repaired where available and new will be constructed where not available
4	Permanent Project Colony	Sarat	2.5	20	1,500,000	Community Land of Ganish Village
5	Transmission Line	Throughout the T.L route	As per site	As per site	Varies	Land for T.L will be acquired along the route
	Total		**21.5**	**172**		

6.9 ENVIRONMENTAL MITIGATION AND LAND ACQUISITION COST

Land Acquisition and Environmental Mitigation cost have been kept for the cost of permanent land acquisition for project components, temporary land acquisition, building compensation, spoil disposal area rehabilitation, rehabilitation of villages, livelihood allowance for affectees,

monitoring & evaluation and land conservation etc. The total cost of land acquisition and environmental mitigation is estimated as Rs. 208.450 Million as shown in Table 6-2

Table 6-2: Cost Estimate for Land Acquisition and Environmental Mitigation

Price Index – March, 2021
US$ Exchange Rate = Rs. 157

Sr. No.	Description	Unit	Qty	Rate	Cost	
				(PKR)	(PKR)	(US$)
1	Permanent Land Acquisition*					
-	Powerhouse Site	kanal	32	750,000	24,000,000	152,866
-	Weir & Associated Structures	kanal	120	750,000	90,000,000	573,248
-	Project Colony	kanal	20	750,000	15,000,000	57,325
-	Miscellaneous	LS	1	16,000,000	16,000,000	101,911
2	Temporary Land Acquisition	LS	1	1,000,000	1,000,000	6,369
3	Building Compensation	LS	1	15,000,000	15,000,000	95,541
4	Spoil Disposal Area Rehabilitation	LS	1	4,000,000	4,000,000	25,478
5	Rehabilitation of Villages	LS	1	2,000,000	2,000,000	12,739
6	Livelihood Allowance for Affectees	LS	1	2,000,000	2,000,000	12,739
7	Monitoring and Evaluation	LS	1	16,500,000	16,500,000	105,096
8	Capacity Building/training	LS	1	2,000,000	2,000,000	12,739
9	Land Conservation	LS	1	2,000,000	2,000,000	12,739
				Sub-Total	**189,500,000**	**1,207,006**
10	Contingencies 10%				18,950,000	120,701
				Total	**208,450,000**	**1,327,707**

PHOTOGRAPHS

Photograph 1: Attabad Lake

Photograph 2: Attabad Land Slide Information

Photograph 3: Shamshal Nullah

Photograph 4: Fine Sediment Deposits near Passu

Photograph 5: Powerhouse Site

Photograph 6: Hunza River D/S of PH Site

Photograph 7: Hunza and Nagar Rivers Confluence Point near Ganish

Photograph 8: Civil Dispensary Gulmit

Photograph 9: Meeting with Director EPA Gilgit

Photograph 10: Meeting with Director KIU Hunza Campus

Photograph 11: Meeting with Assistant Commissionaire Gojal Hunza

Photograph 12: Meeting with Representative of Water & Power Dept. of GB

Photograph 13: Meeting with President Local Ismaili Council Gulmit

Photograph 14: Meeting with Director Forrest and Wildlife Department Hunza

Photograph 15: Meeting District Health Officer Hunza

Photograph 16: Meeting with Director Agricultural Department

Photograph 17: Meeting with District Education Office Hunza

Photograph 18: Meeting with Principal Al-Amin Model School Gulmit

Photograph 19: Visit of Bulbulik Music School Gojal

Photograph 20: Socio-Economic Survey of Local Cummunity Gulmit

Photograph 21: Bulbulik Music School Gojal

Photograph 22: Socio-Economic Survey of Locals near Attabad Lake Site

Photograph 23: Socio-Economic Survey of Local Community Shishkat

Photograph 24: Socio-Economic Survey of Locals Gulkhin

Photograph 25: Socio-Economic Survey of Locals Sarat

Photograph 26: Socio-Economic Survey of Locals Salman Abad

Photograph 27: Socio-Economic Survey of Locals Gulmit

Photograph 28: Socio-Economic Survey of Locals Gulmit

Photograph 29: Socio-Economic Survey of Locals near Attabad Lake Site Shishkat

Photograph 30: Environmental & Socio-Economic Survey Team

Photograph 31: Collection of Water Sample from Attabad Lake

Photograph 32: Collection of Water Sample from Gulmit Glacier Melt

Photograph 33: Agriculture Seed Farm/Nursery Shishkat Gojal

Photograph 34: Government Middle School Shishkat Gojal Hunza

Photograph 35: Testing of Lake Water with Portable TDS Meter

Photograph 36: Testing of Lake Water with Portable PH Meter

APPENDICES

List of Respondents of Socio-Economic Survey

S. No	Name	Village/ tehsil/UC	Profession	Land owned (Kanal)	Comments and concerns about Attabad Lake	In case of Resettlement
1.	Sabir Shah	Gulmit/ Gojal-1	Abroad Job	3	It will produce electricity but it will increase upstream level.	No where
2.	Zaheer	Gulmit/Gojal-1	Farmer	2	Electricity generation	Islamabad
3.	Didar Karim	Gulmit/Gojal	Forester	40	Electricity generation	Nearest village
4.	Didar Ali	Gulmit/Gojal	Manager	----	Hydropower Project	Islamabad
5.	Ghulam Muhammad	Gulmit/Gojal	NGO Job	5	Power generation	Hunza
6.	Aaqib Jaffar	Gulmit/Gojal	Business Man	15	Life of lake is short/ Electricity generation	No where
7.	M.Khan	Gulmit/ Gojal	Tehsil officer	25	Electricity generation	City
8.	Bashir Khan	Gulmit/Gojal-1	Business student	1	Electricity generation	No where
9.	Karim Ullah	Gulmit/Gojal-1	Farmer	3	Electricity generation	No where
10.	Arman Ali Shah	Gulmit/Gojal-1	Farmer	5	Electricity generation	No where
11.	Aman Gul	Gulmit/Gojal-1	Farmer	2		No where
12.	Akbar Khan	Gulmit/Gojal-1	Farmer	2	Electricity generation	No where
13.	Sherdil Khan	Gulmit/Gojal	Shop Keeper	4	Power House	No where
14.	Razia	Gulmit/Gojal	Farmer	----	----------	Karachi

S. No	Name	Village/ tehsil/UC	Profession	Land owned (Kanal)	Comments and concerns about Attabad Lake	In case of Resettlement
15.	Nazir Ahmad bulbul	Gulmit/Gojal	Head Master	10	It will produce electricity but it will increase upstream level.	No where
16.	Malika	Gulmit/Gojal	Business	-----	Electricity generation	Gulmit
17.	Ayyaz Uddin	Gulmit/Gojal	Master trainer	3	Electricity generation	Islamabad
18.	Karim Jan	Gulmit/Gojal	Dtiver	1	Electricity generation	Karachi
19.	Noor Jahan	Gulmit/Gojal	Govt Officer (retd)	2	Electricity generation	Islamabad
20.	Hajat begum	Gulmit central	Farmer	------	---------	No where
21.	Abdul-a-Jan	Shishkat/Gojal	Shop keeper	20	Electricity generation	----------
22.	Shor Khan	Shishkat/Gojal	Health worker	15	It will increase water level	Hunza
23.	Habib-ur-Rehman	Shishkat/Gojal	Electrician	4	Electricity generation	----------
24.	Ghulam Sarwar	Shishkat/Gojal	Teacher (retd.)	2	Electric power project	No where
25.	Walayat Khan	Shishkat/Gojal	Farmer	20	Electric power project	Hunza
26.	Ameer Ali	Shishkat/Gojal	Army (retd.)	18	Power Project	Hunza
27.	Rahat Shah	Shishkat/Gojal	Shop Keeper	7	No idea about project	Hunza
28.	Liaquat Ali Khan	Shishkat/Gojal	Driver	10	Power Grid	No where

S. No	Name	Village/ tehsil/UC	Profession	Land owned (Kanal)	Comments and concerns about Attabad Lake	In case of Resettlement
29.	Hussan Bano	Shishkat/Gojal	House Wife	20	Electricity generation	City
30.	Ghulam Qadir	Shiskat/Gojal	Teacher (retd.)	20	Electricity generation	No where
31.	Asghar Khan	Shiskat/Gojal	Teacher	3	Electricity generation	----------
32.	Hafeez Ullah	Shiskat/Gojal	Tanslator (Chinese)	10	Dam and Electricity	City
33.	Karim Baig	Passu/Gojal-1	Army Retd.	5	----------	No where
34.	Muhammad Jan	Passu/Gojal-1	Farmer	70	----------	City
35.	Jalal-Uddin	Passu/Gojal-1	Farmer	80	----------	No where
36.	Baber Majeed	Passu/Gojal	Manager US-Aid	200	Electricity generation	Karachi
37.	Tariq Aziz	Passu/Gojal	Business Man	25	----------	No where
38.	Tahira Parveen	Passu/Gojal	Business Man	40	----------	Not decided
39.	Malika	Passu/Gojal	Banker (Retd.)	30	----------	No where
40.	Ghulam Rahim	Passu/Gojal	Shop Keeper	100	Elecricity generation	----------
41.	Nazara Baig Tajil	Passu/Gojal	Shop Keeper	10	Termination of Load shedding	Not decided
42.	Liaquat Ali Khan	----------	Business Man	40	Electricity generation	Zarabad
43.	Didar Ali	Passu/Gojal	Shop Keeper	60	Electricity generation	Sultanabad
44.	Rehana Parveen	Hussaini/Gojal	Business woman	1	Electricity generation	Gilgit

S. No	Name	Village/ tehsil/UC	Profession	Land owned (Kanal)	Comments and concerns about Attabad Lake	In case of Resettlement
45.	Javed Iqbal	Hussaini/Gojal	Business	15	----------	Gulkin
46.	Bibi Hijrat	Hussaini/Gojal	Farmer	1	Electricity generation	Gilgit
47.	Akbar Hussain	Hussaini/Gojal	Business Man	40	Power Plant	Karachi
48.	Nasir Khan	Ghullkin/Gojal	Army (retd.)	100	----------	Abroad
49.	Qadir Parwana	Ghullkin/Gojal	Hotel Manager	14	Dam & Power Supply	No where
50.	Sift Ullah	Ghullkin/Gojal	Army (retd).	24	Power House	Gilgit
51.	Mehar Numa	Sarat/Ali Abad	----------	60	Electricity generation	Ali Abad
52.	Isa Khan Numberdar	Sarat/Ali abad	Numberdar/farmer	10	Power Grid	Nearest Town
53.	Alam zewar	Sarat/Ali Abad	House wife	5	----------	Ali abad
54.	Irfan Karim	Sarat/Ali Abad	Chinese Translator	50	Electricity generation	Nearest Town
55.	Ghulam Jafar	Attabad/Aliabad	Farmer	4	Electricity generation	Altit
56.	Sadam Hussain	Attabad/Aliabad	Farmer	25	Power Grid	Nearest Town

Appendix-B-I

Questionnaire for Socio-Environmental Survey (EIA)

(Interview Schedule for Village/Town Profile)

Interviewer_____ Date_____

INTERVIEW LOCATION

Village/Town_____ Union Council_____

Tehsil_____ District_____

---

1. POPULATION

i. Total Population_____
ii. No. of Males_____
iii. No. of Females_____
iv. No. of Children_____

2. ETHIC GROUPS

Major Castes:

i) _____ ii)_____ iii)_____

iv) _____ v)_____ vi)_____

3. HOUSING

i. Total Houses _____
ii. Pacca Houses _____
iii. Mix Houses _____
iv. Katcha Houses _____
v. Total Farm Households _____
vi. Total Landless Household _____

4. LANDHOLDINGS

(a) Total Agriculture Land of the Village/Town

i. Land under Cultivation (%age) _____

ii. Land Non-cultivable (%age) _____

(b) Distribution of Farmers by Farm Size

i. No. of Farmers owning Large Farm Size 100 acre

ii. No. of Farmers owning Medium Farm Size 50 acre

iii. No. of Farmers owning Small Farm Size below – 10 acre

(c) Water Supply System source

i) River ii) Irrigation iii) Tube well

iv) Rain Water

5. EDUCATIONAL FACILITIES

School	Type	Available	Available Outside the Village/Town		
		No. of Students	Place	Distance (km)	Approximate No. of student going to
Primary School					
Boys	Govt.				
	Private				
Girls	Govt.				
	Private				
Middle School					
Boys	Govt.				
	Private				
Girls	Govt.				
	Private				
High School					
Boys	Govt.				
	Private				
Girls	Govt.				
	Private				

6. CONDITION OF SCHOOLS

Description	Types of Condition		
	Good	Satisfactory	Bad
Boys School			
Building			
Staff Competency			
Student Discipline			
Student Performance			
Student Strength			
Girls School			
Building			
Staff Competency			
Staff Regularity			
Student Strength			
Student Discipline			
Student Performance			

7. HEALTH FACILITIES

Description	Available in Village/Town	Outside the Village/Town	
		Place	Distance (km)
Human Health			
Rural Health Dispensary			
Mother's Child Centre			
Private Doctor			
Lady Health Visitor (LHV)			
TBAs			
Hakim			
Others			
Livestock Health			
Veterinary Hospital/Dispensary			
Other			
Other Basic Facilities			
Post Office			
Bank			
Telephone PCO			
Pacca Link Road			
Clean Drinking Water			
Water Supply Scheme			

8. COMMON DISEASES

i.	Malaria	ii.	Cholera	iii.	Arthritis	iv.	Goiter
v.	Stomach	vi.	TB	vii.	Diabetes	vii.	Any other

9. NEAREST TOWN

Name _____

Distance (km) _____

10. MAIN CROPS AND THEIR YIELDS

Crops	Yield (Kg/Area)			Major Reason (s) for Low Yield
	Maximum	Minimum	Average	
Wheat				
Vegetable				
Fodder				
Maize				
Orchard				
Other				
Fruits				

11. People engaged in other occupations

Fishery	
Govt. Job	
Private. Job	
Other Job	
Labour	
Unemployment	

Appendix-B-2

Questionnaire for Sociological Survey

(Interview Schedule for Village/Town Profile)

Interviewer _____ Dated _____

Male/Female _____

INTERVIEW LOCATION

Village/Town_____ Union Council_____

Tehsil _____ District_____

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1. **Project Awareness**

   i) Have you heard about Attabad Lake Hydropower Project

   Yes _____ No_____(Tick the Applicable).

   ii) How did you learn about it?

   Radio/TV_____ Relatives _____

   Newspapers_____ (other specify)_____

   iii) What do you know about the Project?

   _____

2. Household Details of Respondents

Enter details of household

Sr. No.	Name	Position in family	Age/ Year	Occupation	Highest Level of Edu achieved	Vaccination Y N	Resident house	If No, Where Living	This land	Other Land	Reason work

3. Land Holdings of Respondents

List: The areas of land that you occupy

Place	Location (Name of village/Town)	Size Acre	Owned Y or N	Distance from main area	If not owned temporary basis			
					Share crop	Rent	Other specify	Rent Paid

4. House of Respondents

House details	Area (ft^2)	Constructed area (ft^2)	Room Nos.	Constructed Form	
				Kacha	Pacca

5. Food & Agriculture of Respondents

5.1 Main Area

i) Crop (given area in Area)

Crop Name Rabi/Kharif	Machinery use of animals use for harvesting the crop	Irrigated (kg)				Barrani (kg)			
		Area	Harvested	Sold	Bought	Area	Harvested	Area	Bought

ii) Fruit Trees or Tree Crops in Village/Town

Indicate harvested, sold & bought yield in kg.

Fruit Trees	Nos.	Harvested	Sold	Bought

iii) Live Stock of Respondents

Live Stocks	Current	Sold	Bought
Bull			
Cow			
Calves			
Horses			
Mules/Donkeys			
Goats			
Sheep			
Poultry			
Ducks			

5.2 **Area Number for crops in acre.**

Crops Name	Irrigated (kg)				Barrani (kg)			
Rabi/Kharif	Area	Harvested	Sold	Bought	Area	Harvested	Area	Bought

6. Living Standard Survey of Respondents

Which of the following items do you have?

Item No.		
1.	Refrigerator	
2.	Deep Freezer	
3.	Television	
4.	Washing Machines	
5.	Geyser	
6.	Electric Fan	
7.	Electric Iron	
8.	Sewing Machine	
9.	Radio/Tape Recorder	
10.	Bicycle	
11.	Motor Cycle/Scooter	
12.	Rickshaw	
13.	Dish Antenna	
14.	Telephone	
15.	Air Cooler	
16.	Power Generator	
17.	Tractor	
18.	Truck	
19.	Tractor Trolley	
20.	Electric Water Pump	

6.1 Living Expenditure Estimates of Respondents

i) Agriculture (yearly estimates)

Item	Cost Rs.
Seed	
Bagged Inorganic Fertilizer	
Crop Agrochemicals herbicides insecticides	
Live stock, agrochemicals	
Hired Labour from location	

ii) Food Expenses of Respondents

Item	Cost Rs.
Meet/Beef/Chicken	
Milk	
Eggs	
Ghee/Butter	
Flour	
Rice	
Fish (Fresh from river)	
Fertile/Pulses/Grams	
Other Specify	

iii) Household (non food) expenses (average for month) of Respondents

Item	Cost Rs.
Washing Soap (Powder)	
Bathing Soap/Slopes	
Kerosene Oil	
Forest Wood for cooking	
Electricity	
Telephone	
Other specify	

iv) Clothing Shoe expenses (for family) during the month of Respondents

Item	Cost Rs.
Winter (Last)	
Summer (Last)	

v) Education expenses average for year Rs._____

vi) No. of boys attending school No. of girls _____

vii) Health Expenses (average for year) Rs._____

viii) Transportation Cost average/month Rs._____

ix) Govt. Taxes (average for year) Rs._____

7. Borrowings Facilities

Last year did you borrow money

i) Yes _____ or No _____

If yes

a. How much did you borrow?

b. For what purpose was the money borrowed?

c. Source of Borrow?

d. How much has been paid back?

1. None 2. On quarter 3. One half paid

4. Three quarters 5. All

8. Health

What are some of the common diseases occurring in your family during the last year.

	Place where treatment sought (click for each disease)										
Gender	Disease	None	Dr./Hospital	MCH Centre	Dispensary	Hakeem	Pir/Moulvi/Sufi	Pharmacist	Medical Store	Homeopath	Other specify
Men											
Women											
Children											

9. Child Birth

9.1 How many of your children were born at hospital

9.2 How many children were born at home

9.3 Who delivered the last baby born? was it any of the following (Tick 1)

i) Traditional _____

ii) TBA _____

iii) Doctor _____

iv) Other Specify _____

10. Forest

i) Do you own trees/Forests? Yes / No

If Yes, No. of forest trees _____

ii) Did you plant any tree last year? Yes / No

If Yes, how many did you plant and name of trees _____

iii) How many trees did you cut down last year? _____

iv) Why did you cut these down? _____

v) How much money did you get from tree sales? _____Rs. (last year)

vi) How much fuel wood do you need per day for domestic purposes ____kg/day

vii) Where do you harvest this fuel wood?

Location, distance to carry _____

viii) Do you gather other forest products? If yes what are these.

ix) Did you sell any forest products last year? If so how much money did you earn _____Rs.

11. River & Water Supply Usage

i) For which of the following purpose do you use River and Water Supply? Choose multiple options for more than one answer.

1) Fish (if yes) 2) Washing/Bathing 3) Drinking

4) Other uses specify

ii) If you do not use the river water, what are your water supply sources?

1) Spring 2) Well 3) Pumped groundwater

4) Public stand Pipe 5) Hand Pump 6) Other specify

iii) How much far do you have to travel to fetch water for daily use? _____km

iv) Who fetches water mostly? Husband/Wife Daughter/Son Male/Female

12. River Flow Reduction in Hunza River

12.1 If the project reduced the river flow, Is this concern you? Yes/No

If Yes why _____

13. Fishing

i) Name the water source where your catch fish? _____

ii) How much times you catch fish in a week? (summer/winter) _____

iii) What is your purpose for catching fishing? _____

iv) How much do you normally catch per week (summer/winter) _____kg.

v) What fishing gear do you use?

Net _____ Hand line_____ Trap_____ Other specify

vi) Do you sell fish? Yes / No

If Yes, location where you sell your catch _____?

vii) How much of your caught fish do you able sell each week? _____kg.

viii) What is value of this sale of caught fish per day? _____Rs.

14. Alternative Income sources & development requirement.

14.1 Are you satisfied with your living conditions Yes / No

If yes why_____

14.2 In your opinion what kinds of development projects/improvements are needed for this area. please explain your reasons.

15. General Resettlement Concerns

15.1 If the project proceeds, some people may be relocated. If this happens what beneficial/adverse effects do you consider, the Project would have on the following:

Question	Beneficial	Adverse
On your farming		
On your livestock of grazing		
On your family		
On your village community		
Other specify		

15.2 In case you will have to move, do you have any place where you could move?

15.3 Location and distance from your present residence.

Appendix- B-3

Questionnaire for Women Survey

(Interview Schedule for Village/Town Profile)

Interviewer _____ Dated _____

Name Female _____ Age _____years

INTERVIEW LOCATION

Village/Town_____ Union Council_____

Tehsil _____ District_____

1. What is your marital status? Single / Married
2. How many children do you have? _____boys _____girls
3. At what age you were married? _____years
4. Family size
5. What is your Education?
6. What is your occupation?
   a. Job (if yes, specify_____)
   b. Housewife
   c. Student (if yes, then level _____ and education institute _____)
7. Role of women in decision making?
8. Diseases
9. Early age marriages
10. Medical facilities for women
11. In your opinion, which steps should be taken for uplifting of women social status?

12. Do you know or have an idea of project?

13. In case, compensation will give to you, where do you want to live

    (near village/or another big city)

14. If vocational training institute is opened for women's social uplifting then which of the following setup would you prefer?

a. Fruits or vegetables preserve factory
b. Livestock
c. Fish Packaging Setup

15. Do your children go to school? Yes/No

    If No then why? _____

    If yes then which level _____ School name_____

16. Does your Daughter go to School? Yes/No

    If No then why? _____

    If yes then which level _____ School name_____

Government of Gilgit-Baltistan
Gilgit-Baltistan Environmental Protection Agency
Shahrah-e-Quaid-e-Azam, Khomer, Gilgit
Phn 05811-920679, Fax 05811-922016

No. GB-EPA-WQMS-5(6)/2018/604

Gilgit, dated November 19th, 2020

To,

The Additional Chief Engineer (Planning),
WAPDA Lahore.

Addl. C.E. HP
No: 580
Date: 23-11-2020

Subject: **ATTABAD LAKE HYDROPOWER PROJECT- WATER SAMPLES LABORATORY TESTING**

I am directed to refer your office letter No.GM(H)P/D-(I/680/2407dated 9th November, 2020 on the subject and enclose herewith the invoice and results of water samples tested in Gilgit-Baltistan Environmental Protection Agency Laboratory as received.

Enclose: **As above**

Syed Jarrar Hussain

(SYED JARRAR HUSSAIN)
Assistant Director (Lab/NEQS)

DD (Civil)

Needful done.

www.gbepa.gog.pk

Government of Gilgit-Baltistan
Gilgit-Baltistan Environmental Protection Agency
Shahrah-e-Quaid-e-Azam, Khomer, Gilgit
Ph# 05811-920679, Fax 05811-922016

No. GB-EPA-WQMS-5(6)/2018

Gilgit, dated November 19th, 2020

To,

The Additional Chief Engineer (Planning),
WAPDA Lahore.

INVOICE OF WATER SAMPLES TESTED

Sr#	Test Parameters	Total Samples Tested	Rate per Sample	Total
01	**Bacteriological Test** E.coli	06	8000	48000
02	**Physical Tests** pH Temperature Turbidity Total Dissolved Solids Electrical Conductivity Colour Odour Taste			
03	**Heavy Metals Test** Copper Aluminum Iron Manganese Chromium(VI) Nickel Boron Nitrate Nitrite			
	Total: Fourty Eight Thousand Only			48,000

Note:
Payable at Treasury/Sub Treasury National Bank of Pakistan Gilgit under the head of account CO-3370.

(SYED JARRAR HUSSAIN)
Assistant Director (Lab/NEQS)

SYED JARRAR HUSSAIN
Assistant Director (Admin/L...
Gilgit-Baltistan Environmental...
Protection Agency (GB-EPA

Gilgit-Baltistan Environmental Protection Agency

Drinking Water Quality Test Report

Chemical Parameters

Doc No: LAB/WQM/001-F
Effective Date: 01/04/2010
Version No: 02
page 1 of 1

Sampling Date: 5/11/2020	Location: Hunza	District: Hunza	Union council:
Methodology / Technique: Voltammetry and Photometry (Metalyser HM 3000 and Metalmeter HM 2000)			

Test Criteria: The water samples are tested against National Standards for Drinking Water Quality of Pakistan

National Standards for Drinking Water Quality of Pakistan (mg/l)

Nitrate	Nitrite	Cu	Al	Fe	Mn	Cr6	Zn	Ni	B		
<50	≤3	2	≤0.2	----	≤0.5	≤0.05	5.0	≤0.02	0.3		

Sr #	Sampling point	Test Results (mg/l)									
		Nitrate	Nitrite	Cu	Al	Fe	Mn	Cr6	Zn	Ni	B
1	Hunza River side before confluence of Ghoizhal Nullah	ND	ND	0.1	ND	ND	ND	0.03	ND	0.01	ND
2	Ghoizhal Nullah by entering Hunza	ND	ND	0.07	ND	0.04	ND	0.02	ND	0.02	ND
3	Hunza river side near power house	ND	ND	0.2	ND	0.3	ND	ND	ND	0.01	ND
4	Attabad lake heading area	2.3	0.9	ND	ND	ND	ND	0.03	ND	0.02	ND

Conclusion: The concentrations of nitrate, copper, iron, chromium 6 and nickel in above samples are within National Standards for Drinking Water Quality of Pakistan.

Tested By	Verified By	Approved By
Name: Syed Kashif Hussain	Name: Nasir Hussain	Name: Syed Jarrar Hussain
Designation: Field Monitoring Assistant	Designation: Scientific Officer (Lab/WQM)	Designation: Assistant Director (Lab/WQM)
Signature & Date: K.Kazim	Signature & Date:	Signature & Date:

Gilgit-Baltistan Environmental Protection Agency

Drinking Water Quality Test Report

Chemical Parameters

Doc No: LAB/WQM/001-F
Effective Date: 01/04/2010
Version No: 02
page 1 of 2

Sampling Date: 5/11/2020	Location: Hunza	District: Hunza	Union council:
Methodology / Technique: Voltammetry and Photometry (Metalyser HM 3000 and Metalmeter HM 2000)			

Test Criteria: The water samples are tested against National Standards for Drinking Water Quality of Pakistan

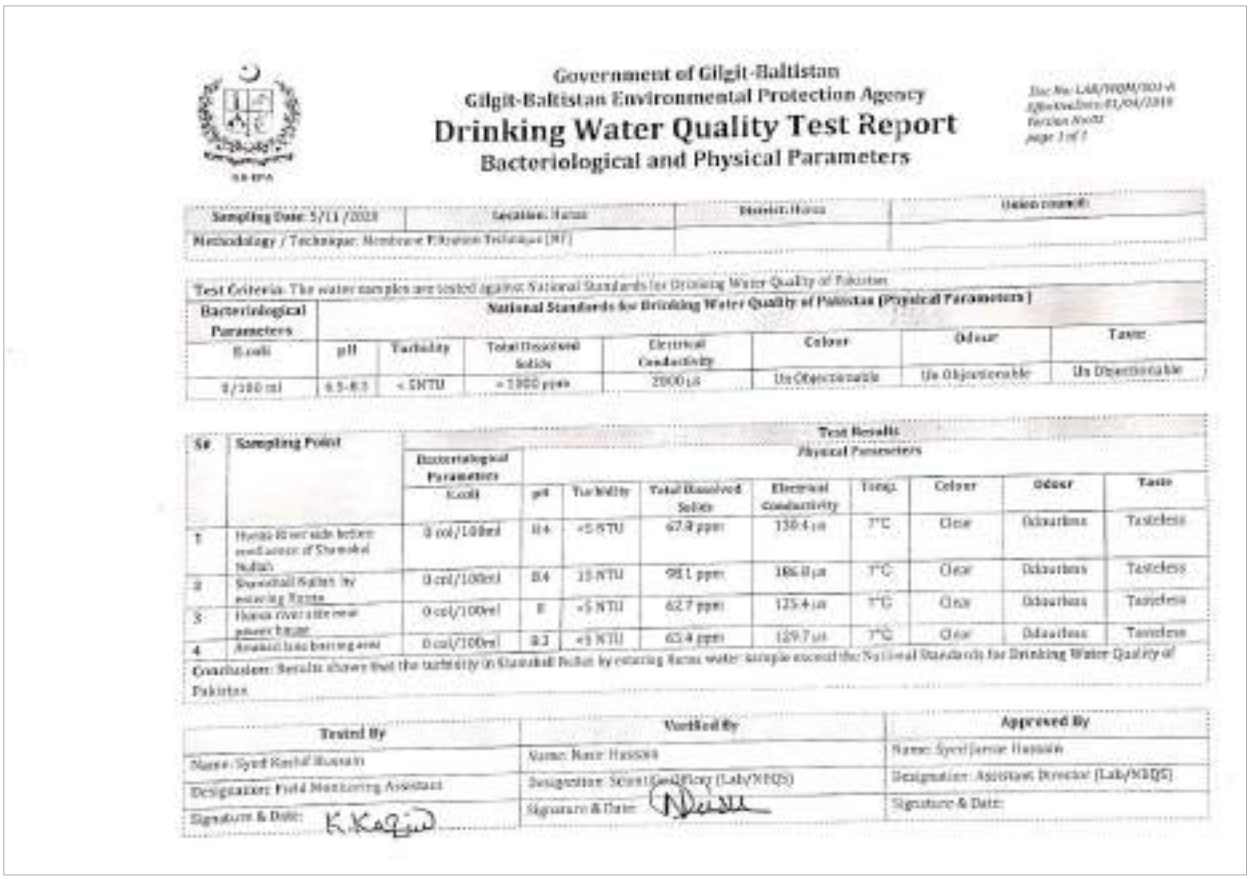
National Standards for Drinking Water Quality of Pakistan (mg/l)

Nitrate	Nitrite	Cu	Al	Fe	Mn	Cr6	Zn	Ni	B		
		2	≤0.2	----	≤0.5	≤0.05	5.0	≤0.02	0.3		

Sr #	Sampling point	Test Results (mg/l)									
		Nitrate	Nitrite	Cu	Al	Fe	Mn	Cr6	Zn	Ni	B
5	Gulmit tap water	ND	ND	0.02	ND	ND	ND	ND	ND	0.01	ND
6	Gulmit Glacier near Hunza river	ND	ND	ND	ND	ND	ND	0.14	ND	0.2	ND

Conclusion: The concentration of Cr6 and Ni exceed National Standards for Drinking Water Quality of Pakistan in Gulmit glacier near Hunza water sample.

Tested By	Verified By	Approved By
Name: Syed Kashif Hussain	Name: Nasir Hussain	Name: Syed Jarrar Hussain
Designation: Field Monitoring Assistant	Designation: Scientific Officer (Lab/WQM)	Designation: Assistant Director (Lab/WQM)
Signature & Date: K.Kazim	Signature & Date:	Signature & Date:



Government of Gilgit-Baltistan
Gilgit-Baltistan Environmental Protection Agency

Drinking Water Quality Test Report

Bacteriological and Physical Parameters

Sampling Date: 5/11/2018	Location: Hunza	District: Hunza	Union council:
Methodology / Technique: Membrane Filtration Technique [MF]			

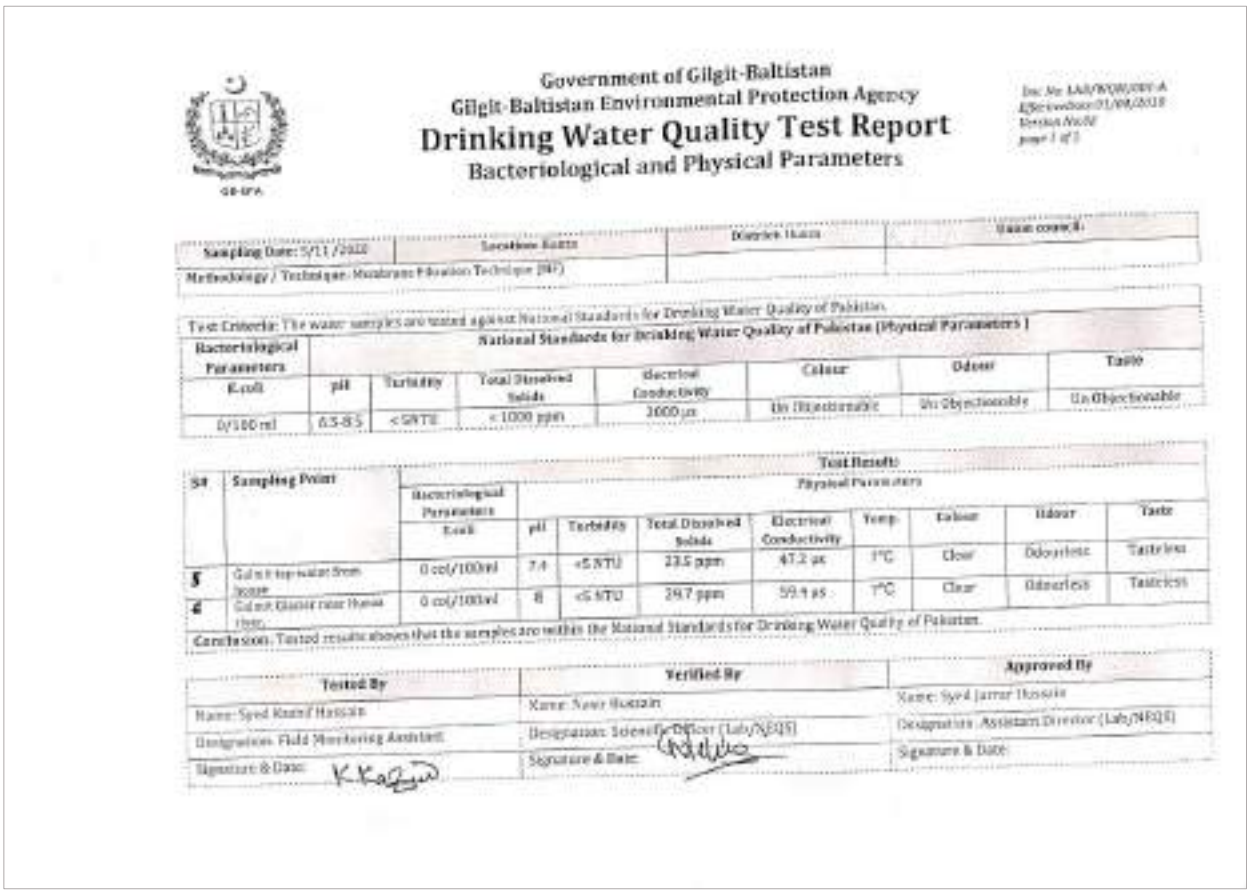
Test Criteria: The water samples are tested against National Standards for Drinking Water Quality of Pakistan

Bacteriological Parameters	National Standards for Drinking Water Quality of Pakistan (Physical Parameters)						
E.coli	pH	Turbidity	Total Dissolved Solids	Electrical Conductivity	Colour	Odour	Taste
0/100 ml	6.5-8.5	< 5NTU	< 1000 ppm	2000 µS	Un Objectionable	Un Objectionable	Un Objectionable

Sr#	Sampling Point	Test Results: Bacteriological Parameters	Physical Parameters						
		E.coli	pH	Turbidity	Total Dissolved Solids	Electrical Conductivity	Temp.	Colour	Odour	Taste
1	Hunza River side before confluence of Shimshal Nullah	0 col/100ml	8.4	<5 NTU	67.8 ppm	130.4 µs	7°C	Clear	Odourless	Tasteless
2	Shimshal Nullah by entering Hunza	0 col/100ml	8.4	15 NTU	98.1 ppm	186.0 µs	7°C	Clear	Odourless	Tasteless
3	Hunza river side near power house	0 col/100ml	8	<5 NTU	62.7 ppm	125.4 µs	7°C	Clear	Odourless	Tasteless
4	Aramkot tube bearing area	0 col/100ml	8.2	<5 NTU	65.4 ppm	129.7 µs	7°C	Clear	Odourless	Tasteless

Conclusion: Results shows that the turbidity in Shimshal Nullah by entering Hunza water sample exceed the National Standards for Drinking Water Quality of Pakistan

Tested By	Verified By	Approved By
Name: Syed Kashif Hussain	Name: Nasir Hussain	Name: Syed Jamat Hussain
Designation: Field Monitoring Assistant	Designation: Scientific Officer (Lab/WEQS)	Designation: Assistant Director (Lab/WEQS)
Signature & Date: K.Kashif	Signature & Date:	Signature & Date:



Government of Gilgit-Baltistan
Gilgit-Baltistan Environmental Protection Agency

Drinking Water Quality Test Report

Bacteriological and Physical Parameters

Sampling Date: 5/11/2018	Location: Hunza	District: Hunza	Union council:
Methodology / Technique: Membrane Filtration Technique [MF]			

Test Criteria: The water samples are tested against National Standards for Drinking Water Quality of Pakistan

Bacteriological Parameters	National Standards for Drinking Water Quality of Pakistan (Physical Parameters)						
E.coli	pH	Turbidity	Total Dissolved Solids	Electrical Conductivity	Colour	Odour	Taste
0/100 ml	6.5-8.5	< 5NTU	< 1000 ppm	2000 µs	Un Objectionable	Un Objectionable	Un Objectionable

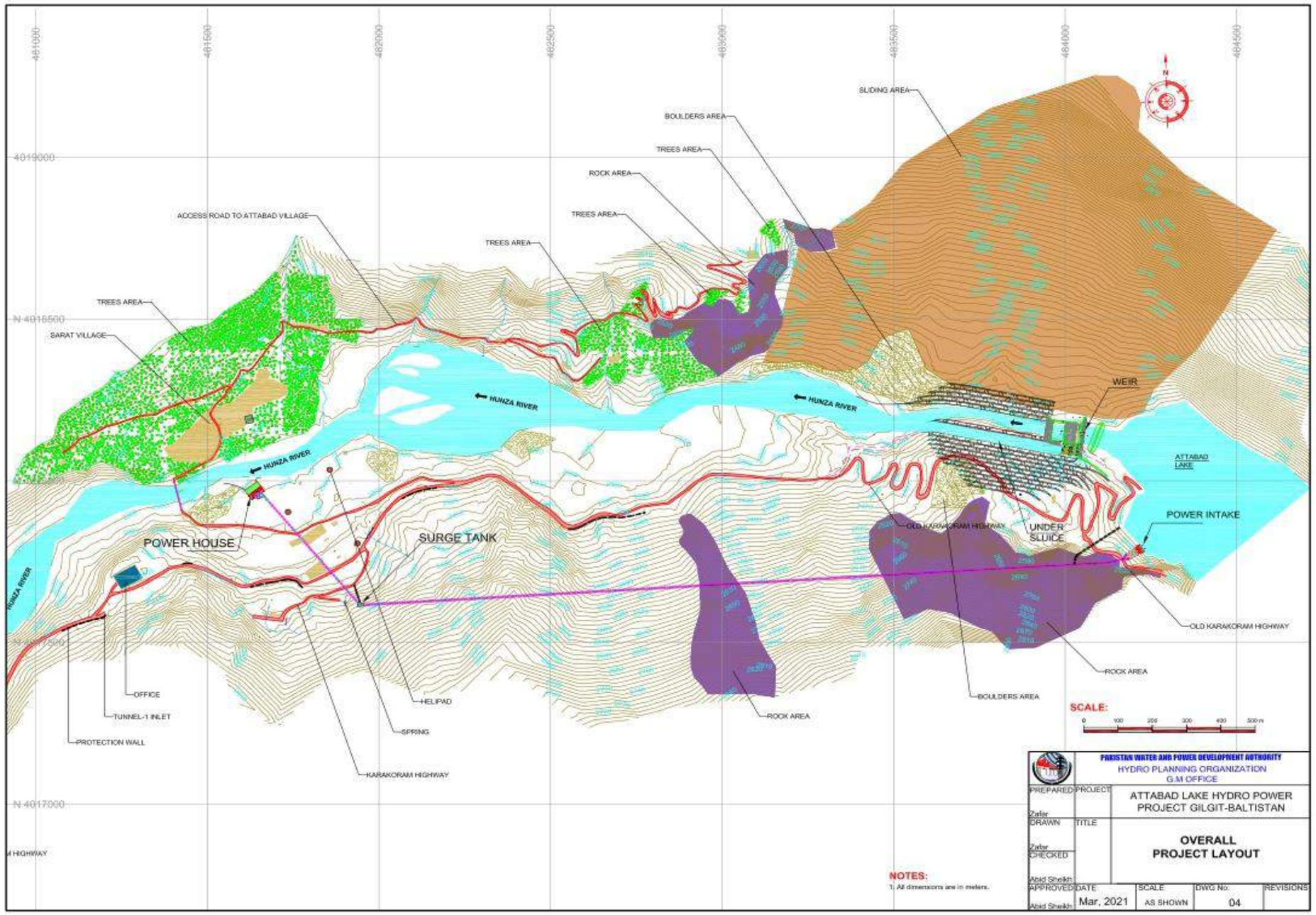
Sr#	Sampling Point	Test Results: Bacteriological Parameters	Physical Parameters						
		E.coli	pH	Turbidity	Total Dissolved Solids	Electrical Conductivity	Temp.	Colour	Odour	Taste
5	Gulmit tup water from house	0 col/100ml	7.4	<5 NTU	23.5 ppm	47.2 µs	7°C	Clear	Odourless	Tasteless
6	Gulmit Glacier near Hunza river	0 col/100ml	8	<5 NTU	29.7 ppm	59.4 µs	7°C	Clear	Odourless	Tasteless

Conclusion: Tested results shows that the samples are within the National Standards for Drinking Water Quality of Pakistan

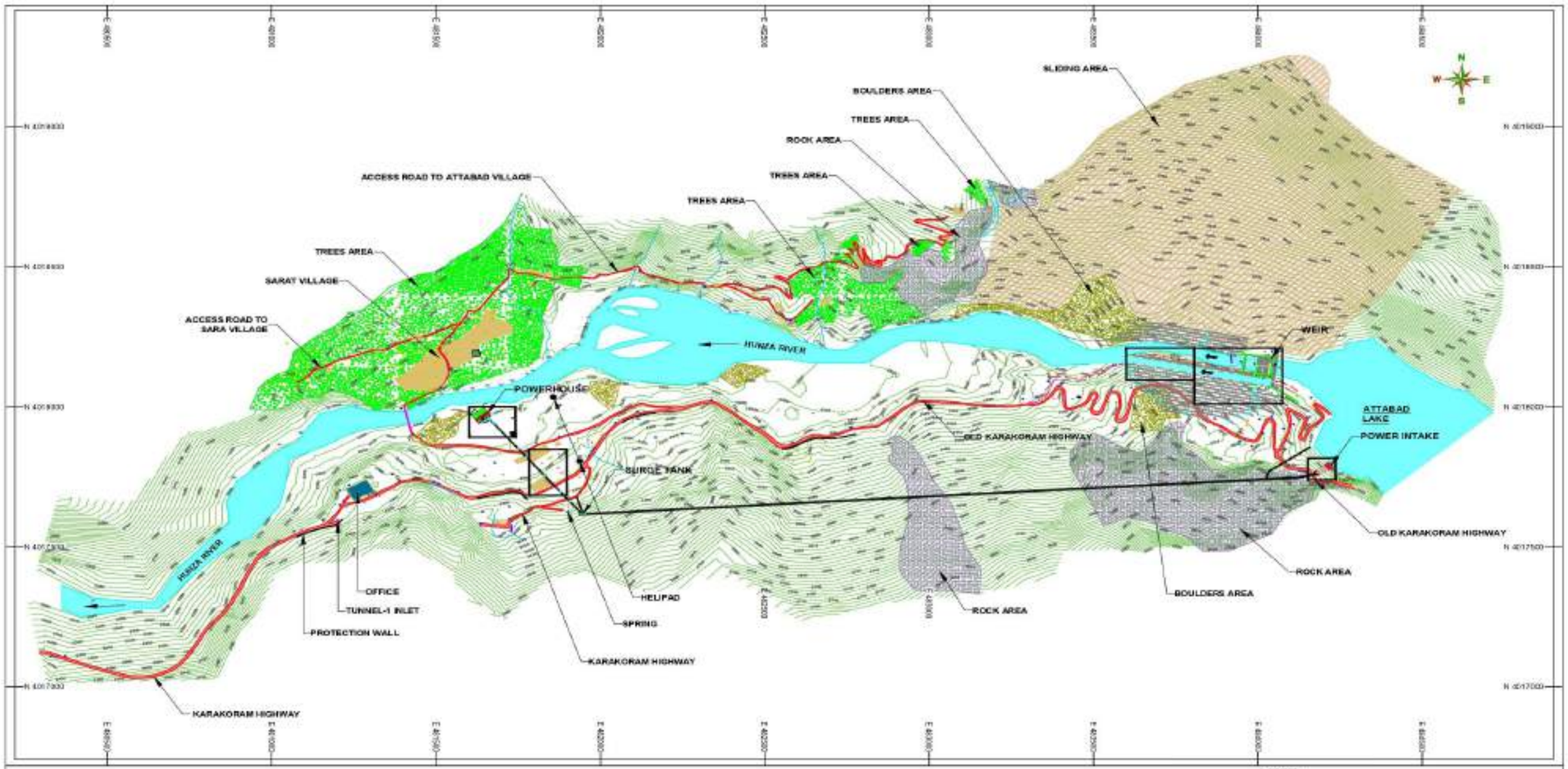
Tested By	Verified By	Approved By
Name: Syed Kashif Hussain	Name: Nasir Hussain	Name: Syed Jamat Hussain
Designation: Field Monitoring Assistant	Designation: Scientific Officer (Lab/WEQS)	Designation: Assistant Director (Lab/WEQS)
Signature & Date: K.Kashif	Signature & Date:	Signature & Date:

Drawings

Drawing I Project Layout



Drawing II Land Requirement for the Project



LEGENDS:

- RIVER/NALLA
- HOUSES/SHOPS
- ROAD
- KATCHA ROAD/TRACK
- CONTROL POINTS
- CONTOURS
- ELECTRIC POLE/T.POLE
- RETAINING WALL
- TREES AREA
- DRAIN AND NULLAH
- BRIDGE AND CULVERT
- BOULDERS
- WATER TANK
- SPRING
- JAMAT KHANA
- RFL
- HELLIPAD
- SLIDING
- ROCK
- LAND REQUIREMENT FOR THE PROJECT

100 0 100 200 300 400 500m
SCALE

NOTE:
1. ALL THE UNITS ARE IN METERS UNLESS OTHERWISE NOTED
2. SURVEY OF PAKISTAN (SOP) METRIC COORDINATE SYSTEM WAS USED FOR FIELD OBSERVATIONS

PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY
GENERAL MANAGER (HYDRO) PLANNING

PREPARED: Sabeen	PROJECT	ATTABAD LAKE HPP FEASIBILITY STUDY REPORT
DRAWN: Arshad	TITLE	PROJECT LAND REQUIRMENT
CHECKED: Nazakat		
APPROVED: Abid Sheikh	DATE: Jun: 2021	SCALE: 1 : 12,000
	DWG No: 024	REVISIONS